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10th International Conference
on
Information & Communication Technologies (ICT)
in
Urban Planning and Spatial Development
and
Impacts of ICT on Physical Space

Manfred SCHRENK (Hg./Ed.)

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GEO MULTIMEDIA 05

Proceedings of 10th symposion on
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URBAN PLANNING AND SPATIAL DEVELOPEMENT
and
IMPACTS OF ICT ON PHYSICAL SPACE

Beiträge zum 10. Symposion zur Rolle der
INFORMATIONS- und KOMMUNIKATIONSTECHNOLOGIE
in der
STADTPLANUNG UND REGIONALENTWICKLUNG
sowie zu den
WECHSELWIRKUNGEN ZWISCHEN REALEM UND VIRTUELLEM RAUM

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reviewed paper

What about time in urban planning & design in the ICT age?

Paul DREWE

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'This web of time – the strands of which approach one another, bifurcate, intersect or ignore each other through the centuries – embrace every possibility'.

(Jorge Luis Borges, The garden of forking paths)

OUTLINE

Time is connected to network thinking in urbanism. It comes into play when households or companies make actual selective use of urban technology systems for their special purposes – as revealed by space-time budgets or logistic spaces. Hence urban planning and design can be seen as a search for spatial concepts satisfying the needs of household and company networks. Therefore it is important to focus on the mutual interactions of time and space. If the spatial concepts often lack a temporal dimension then, first of all this temporal dimension needs to be highlighted; that is:

- major trends of temporal development,
- basic rhythms of time use,
- some facts about time use.

Space-time budgets and business logistics chains are ways of combining time and space, taking into account their mutual interactions. The author of this essay functions as a 'guinea-pig' in presenting his personal space-time budget, picturing a typical day. This prepares the ground for discussing space-time budgets in more general terms including the impact of ICT on them plus some final remarks about the company counterpart of space-time budgets.

The gist of all this is the search for new instruments of planning and design in line with the New Charter of Athens. It seems more promising to be guided by network thinking than by speculations about emerging, continuous cities. There are different ways of putting network thinking to a test:

- analyzing emergent network-based concepts,
- rereading the classics,

• a design studio,

• urban time policies,

• mobility in prospect.

Putting network thinking to a test means investigating the (potential) time sensitivity of the different approaches and the spatial concepts they may produce. Testing them includes checking for the role of ICT. It is important to integrate ICT because it supports the development of new temporal regimes.

By asking ourselves ‘What about time in urban planning and design?’ we are also asking ‘What about people in urban planning and design?’ This is most clearly proven by urban time policies. They are also the best way of answering Lynch’s time-honored question ‘What time is this place?’

1 TIME AND THE ‘NETWORK CITY’

The ‘Network City’ has been treated elsewhere as a paradigm challenge for urban design and planning (Drewe, 2003a). In fact, it is not a new, ready-made spatial concept, but rather a matter of network thinking in urbanism. See also < http://www.networkcity.nl

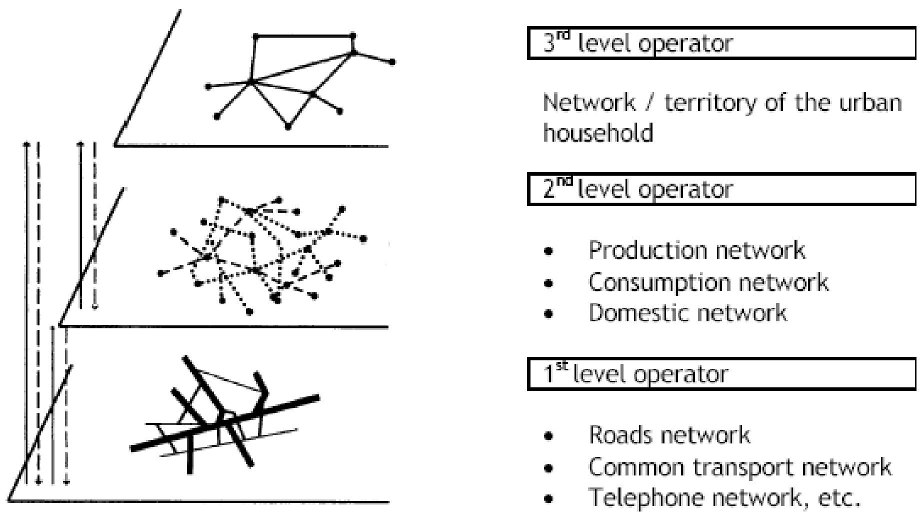


Figure 1 has become the trademark of network thinking focusing on three, interacting levels of network operators that (re)organize urban space (Dupuy, 1991: 119):

• level one involves the suppliers of technical networks such as water and sewer, energy, transport and ICT; level one covers the infrastructure, the services offered and the operators (Graham and Marvin, 2001 refer).

• on level two we find functional networks of common-interest users centering on consumption, production, distribution and social contacts; specific location factors apply to each of the networks.

• on level three both households and companies make actual, selective use of technical networks and services for their special purposes.

It is on level three that time comes into play.

Household networks can best be measured in terms of space-time budgets or action spaces (see Dijst and Vidakoviæ, 1997). Company networks, on the other hand, are closely related to logistics, logistic chains and logistic space (Hesse, 2002).

The framework shown in figure 1 has also been applied to the Internet (see Drewe, 2002, for details). Level three referred to how the data actually flows on the Internet between points of origin and points of destination. Trace routes of the data flows have revealed an important time dimension of the Internet: the number of milliseconds that it takes a ping packet from the point of origin to each hop (from the node of origin to the node of destination) and back. The response time of accessing and downloading the home pages of web sites is an important performance indicator of the Internet.

The interrelations between level one (the Internet infrastructure), level two (the Internet industry) and level three (traffic on the Internet) can be conceptualized as interrelations between respectively supply, demand and performance. Figure 2 refers.

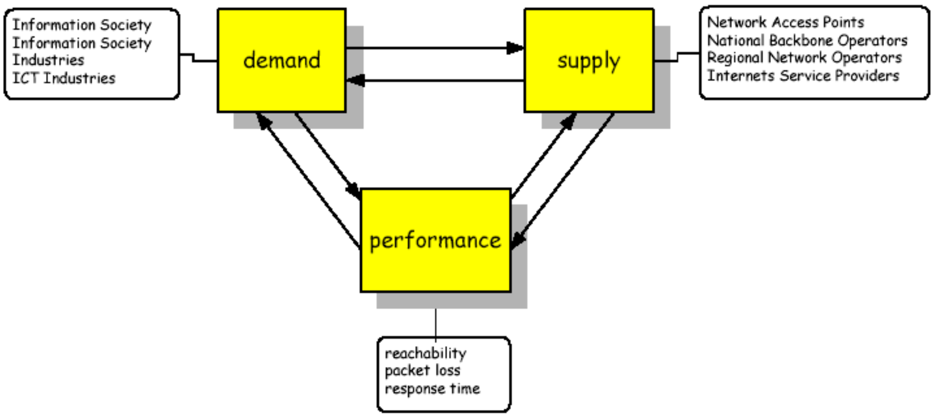


Fig. 2. The Internet – interrelations between supply, demant and performance

2 TIME AND SPACE, MUTUAL INTERACTIONS

If the spatial concepts applied in urban planning and design lack a temporal dimension (Klaasen, 2003) then, first of all, this temporal dimension needs to be highlighted. Why is time important? Or why has it become so important that it features – at least in some countries – on the political agenda? See, for example, Boulin and Mückenberger (2002).

Could it be that time has undergone significant changes that clash with cities or space lagging behind? Has not the demand of citizens expanded and diversified whereas the urban service supply, to a large extent, still functions according to traditional rhythms – as Gwiazdzinski (2002) sees it?

It does not suffice, however, to highlight only the time dimension. If the focus is on urban planning and design, one needs to introduce space as well: first, the spatial impact of significant changes of temporal patterns, changes which in turn are caused by societal changes and, then, the impact of changing spatial structures on temporal patterns.

Changes in spatial structure can result from urban design and planning interventions. This is where new spatial concepts come in, concepts that take into account the mutual interactions of time and space. Hence urban planning and design can be seen as a search for spatial concepts satisfying the needs of household and company networks. This quest is far from simple. As our argument is progressing, the complexity of the task will be revealed.

To summarize this section a simple scheme is shown in figure 3. It includes some of the dichotomous terms used to describe time and space and their mutual interactions.

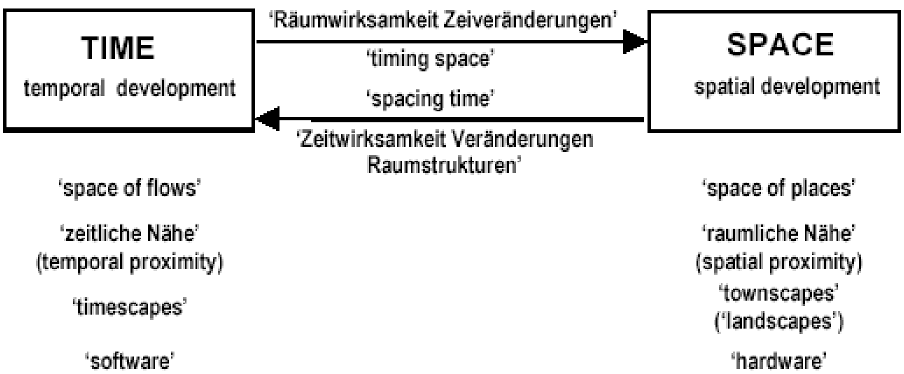


Fig. 3. Time and space, mutual interactions

3 TEMPORAL DEVELOPMENT – MAJOR TRENDS

The root causes of major trends in temporal development are economic, social and technological in nature. There are six major trends according to DATAR (2001):

- a globalizing economy pressures companies to function around the clock, 'following the sun',
- lifestyles tend to invidualize which leads to a less synchronized daily life,
- old ways to synchronize life via work hours no longer function what with flexibility,
- women's labor participation has increased significantly starting in the sixties,
- new types of multiform mobility have emerged daily, weekly and annually,
- ICT has spread massively.

The overall effects on temporal development are threefold: acceleration, expansion and flexibilization. Take for example shorter product or branch–life–cycles; faster transport systems, in particular air traffic and, similarly, ICT (acceleration). Temporal expansion affects all kind of supplies and individual options whether related to consumption or work (flexible working hours). Acceleration is pushing expansion and flexibilization as well. The latter causes instability in temporal patterns. See Henckel and Eberling (2002) for a wealth of details.

Moving on with our argument and in order to become more specific, the question of how to measure the use of time must be tackled.

4 TIME USE: BASIC RHYTHMS

Time use is usually described in terms of basic rhythms: daily, weekly, yearly and life cycles (figure 4).

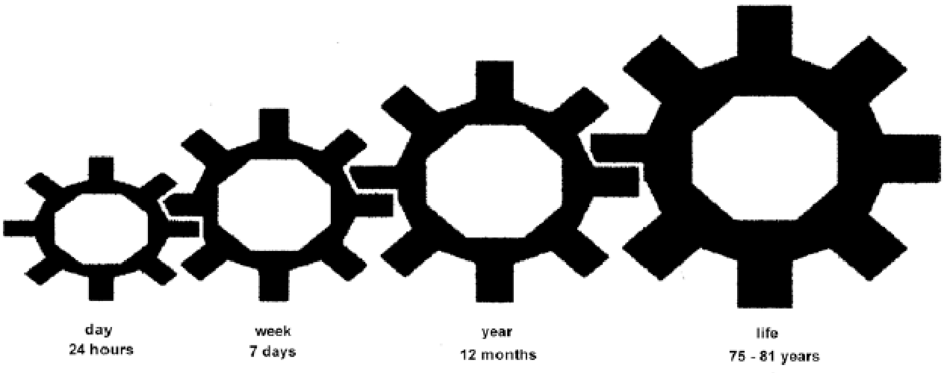


Fig. 4. Basic rhythms of time

A time budget describes **what** is done, **when** and **by whom**. One usually distinguishes activities such as work, leisure, education, shopping, public and private services, and travel. The actors can be classified in terms of sex, phase-in-the-life cycle, socio-economic position, ethnic origin and the like. Figure 4 in fact depicts the basic cycles of single-person households. In the case of multiple-person households different rhythms need to be coupled or synchronized. Without distinguishing different kinds of actors one would gloss over the distributional side of time use, that is the issue of distributional justice. With the increase in woman's labor participation, the issue is often related to the position of women (versus men). Another trend is the massive spread of ICT which, however, is far from evenly distributed among actors as revealed by the so-called digital divide (Drewe, Fernandez and Hulsbergen, 2003). Once time use or time budgets have been measured, one is able to specify what is at stake when it comes to a distributional debate:

- life expectancy,
- disposable time, free from labor (but not involuntary as in the case of unemployment or inconvenienced by night shifts),
- discretion or choice with regard to time use,
- collective time institutions such as weekends or holidays allowing for stability and predictability of time use, in especial social contacts.

See also Henckel (2002).

Once time budgets have been measured, it also becomes possible to specify the impact of the acceleration, expansion and flexibilization of temporal development. Take for example **flexible working hours** with their rather 'disturbing' effects on basic rhythms and time budgets (Henckel, 2002). Flexible working hours reduce times shared with others and make times less predictable. Commuter distances tend to shrink and so does mobility for leisure purposes. Speed accelerates and the amplitudes of rhythms change (oscillate). And finally, flexible working hours allow for a high degree of individualization.

> ***What about the time use of companies? In logistics, the usual order cycle time is 24 hours which is also a daily rhythm. Rush orders have a cycle of less than 24 hours and therefore are closely linked to express services. The stock order cycle, on the other hand may be weekly or even yearly. One might also consider product-life-cycles or branch-(company-)life-cycles.***

This is as far as the temporal analysis goes. It is time to introduce the 'where', that is the location of activities or activity spaces. Time budgets more often than not reflect spatial effects, in particular spatial constraints.

But before the construction of space-time budgets (in section 6), some empirical illustrations will be presented in order to prevent speculations about temporal developments. The degree to which acceleration, expansion and flexibilization actually occur is an empirical question. And as to future developments, it is still uncertain. Without the existence of major uncertainties, there would be no reason to build scenarios of time use. Here is a French example of scenario building. In DATAR (2001) three possible futures are sketched:

- ‘la fuite en avant’: time use dictated by market forces, continuous time (around the clock) and individual times dominate
- ‘la fuite en arrière’: growing resistance to flexibilization, back to traditional rhythms and collective times
- a scenario combining individual and collective rhythms of time use.

Stiens (2002) who has also constructed three scenarios has focused more explicitly on the spatial impact of different ‘timescapes’.

5 TIME USE: SOME FACTS

Time Use Surveys are held in most countries. European Communities (2003) (Eurostat) contains results from 13 European countries focusing on time use at different stages of life. An example is given in table 1 emphasizing differences (similarities) between women and men, and countries.

Table 1 Average time per day spent on different activities and the percentage performing an activity on the average per day for females and males.

Age group	Belgium 12 - 95 years		Denmark 16 - 74 years		France 15 - years		Finland 10 - years		Sweden 20 - 84 years		UK 8 - years		Estonia 10 - years		Hungary 15 - 84 years		Slovenia 10 - years		Norway 10 - 79 years	
	Hours and min	%	Hours and min	%	Hours and min	%	Hours and min	%	Hours and min	%	Hours and min	%	Hours and min	%	Hours and min	%	Hours and min	%	Hours and min	%
Sleep	**8:34**		**7:53**		**9:03**		**8:38**		**8:08**		**8:40**		**8:49**		**8:43**		**8:36**		**8:15**	
women	8:41	100	7:58	100	9:10	100	8:42	100	8:12	100	8:43	100	8:50	100	8:49	100	8:40	100	8:20	100
men	8:27	100	7:47	100	8:58	100	8:33	100	8:03	100	8:37	100	8:50	100	8:36	100	8:31	100	8:09	100
Meals and personal care	**2:40**		**2:48**		**3:01**		**2:03**		**2:22**		**2:10**		**2:11**		**2:24**		**2:09**		**1:54**	
women	2:42	100	2:52	100	3:01	100	2:06	100	2:30	100	2:16	100	2:09	100	2:19	100	2:07	100	2:01	100
men	2:37	100	2:42	100	3:00	100	1:59	100	2:14	99	2:04	99	2:12	100	2:30	100	2:11	100	1:48	100
Gainful work	**2:02**		**3:27**		**2:34**		**2:35**		**3:17**		**2:40**		**2:22**		**2:33**		**2:42**		**2:59**	
women	1:28	31	2:59	37	1:55	30	2:04	30	2:40	37	1:56	29	2:00	29	2:01	35	2:13	27	2:20	34
men	2:38	46	4:00	46	3:16	43	3:12	41	3:57	49	3:25	43	2:49	36	3:08	39	3:13	36	3:38	47
Study	**0:43**		**0:37**		**0:30**		**0:35**		**0:16**		**0:40**		**0:30**		**0:30**		**0:44**		**0:36**	
women	0:41	16	0:40	13	0:30	9	0:36	13	0:18	8	0:40	13	0:27	10	0:29	9	0:44	14	0:38	12
men	0:45	17	0:33	9	0:31	9	0:34	11	0:13	6	0:40	13	0:34	12	0:30	9	0:44	13	0:35	11
Household work and family care	**3:12**		**2:51**		**3:17**		**2:52**		**3:10**		**2:53**		**3:32**		**3:39**		**3:26**		**2:42**	
women	3:58	98	3:20	96	4:13	95	3:32	96	3:44	98	3:41	93	4:27	96	4:39	95	4:25	94	3:16	96
men	2:23	95	2:17	90	2:16	80	2:05	86	2:33	92	2:03	83	2:28	84	2:33	84	2:24	79	2:09	89
Volunteer work	**0:09**		**0:13**		**0:13**		**0:14**		**0:12**		**0:10**		**0:14**		**0:10**		**0:08**		**0:09**	
women	0:08	15	0:11	12	0:12	11	0:14	13	0:12	14	0:12	13	0:13	11	0:07	5	0:06	6	0:09	10
men	0:09	15	0:16	12	0:15	10	0:15	11	0:13	13	0:09	9	0:16	11	0:13	5	0:10	7	0:09	8
Socialising	**1:02**		**1:21**		**0:55**		**1:04**		**1:10**		**1:07**		**0:50**		**0:51**		**1:09**		**2:02**	
women	1:05	63	1:26	79	0:55	62	1:08	71	1:15	77	1:13	69	0:51	64	0:48	49	1:08	66	2:15	90
men	0:59	78	1:16	66	0:54	46	1:00	56	1:04	63	1:02	56	0:48	47	0:54	51	1:10	64	1:49	78
Leisure time	**1:13**		**1:00**		**0:53**		**1:23**		**1:20**		**1:06**		**1:04**		**0:56**		**1:26**		**1:18**	
women	1:08	67	0:51	59	0:41	42	1:12	72	1:13	71	0:57	59	0:54	56	0:47	41	1:12	66	1:13	66
men	1:18	66	1:11	59	1:06	49	1:36	72	1:27	70	1:15	59	1:17	60	1:06	49	1:40	71	1:23	64
TV video	**2:18**		**1:58**		**2:07**		**2:16**		**1:53**		**2:26**		**2:27**		**2:44**		**2:01**		**1:57**	
women	2:12	93	1:51	81	2:02	77	2:08	86	1:45	82	2:16	87	2:15	86	2:39	88	1:50	83	1:45	83
men	2:24	94	2:06	83	2:12	80	2:26	86	2:02	84	2:37	88	2:40	87	2:49	87	2:12	87	2:10	86
Radio, music, reading	**0:39**		**0:34**		**0:29**		**0:58**		**0:43**		**0:33**		**0:49**		**0:29**		**0:31**		**0:44**	
women	0:34	68	0:34	57	0:28	39	1:00	76	0:45	67	0:33	50	0:49	59	0:25	33	0:31	44	0:47	70
men	0:44	71	0:33	60	0:30	39	0:56	68	0:41	57	0:33	46	0:51	56	0:34	43	0:32	43	0:41	61
Travel	**1:23**		**1:15**		**0:55**		**1:08**		**1:23**		**1:24**		**1:07**		**0:56**		**1:06**		**1:15**	
women	1:16	92	1:14	86	0:51	67	1:06	78	1:20	87	1:21	87	1:00	76	0:51	76	1:01	78	1:10	87
men	1:31	95	1:15	84	1:00	73	1:11	80	1:27	91	1:27	89	1:11	81	1:02	81	1:11	83	1:20	89
Unspecified activities	**0:05**		**0:03**		**0:03**		**0:14**		**0:06**		**0:11**		**0:05**		**0:05**		**0:02**		**0:09**	
women	0:07		0:04		0:02		0:12		0:06		0:12		0:05		0:06		0:03		0:06	
men	0:05		0:04		0:02		0:13		0:06		0:08		0:04		0:05		0:02		0:09	
Total	**24 h**		**24 h**		**24 h**		**24 h**		**24 h**		**24 h**		**24 h**		**24 h**		**24 h**		**24 h**	

Hours and minutes gives average time per day over the whole year, % gives percentage of persons per day who has performed the activity. Survey period: A full year during 1998-2001. Sources: National Time use studies, see Methodological Notes.

The table depicts the daily cycle, but hours and minutes and averages over the whole year. Here are some of the highlights:

- there (still) is a large difference in the gender division of gainful work and domestic work,
- watching TV takes about 40% of free time in most countries both for women and men,
- employed persons sleep less and have less free time,
- the differences in time use between women and men are larger in households with children.

European Communities (2003) provides a cross section of time use. But what about changes over time? A Dutch Time Use Survey can serve as an illustration as it covers the years 1975 - 2000 (Breedveld and Van den Broek, 2001).

Three tables have been selected for summarizing 'time use in an increasingly busy society'. Tables 2a through 2c describe weekly cycles with regard to time budgets, the structuring of time, and free time.

Table 2a Time budget in outline, population aged 12 and over, 1975-2000 (in hours per week)[a], in percent and index 2000, 1995 = 100)

	1975	1980	1985	1990	1995	2000	index
committed time	40.7	40.8	40.7	42.0	42.6	43.9	103
work	14.8	14.0	14.1	16.6	17.3	19.4	112
care	19.1	19.5	19.4	18.5	18.9	19.0	100
education	6.7	7.3	7.2	6.9	6.4	5.5	86
personal time	76.3	76.8	75.3	75.5	75.0	76.6	102
free time	47.9	47.0	49.0	47.2	47.3	44.8	95
% combining tasks (20-64 years)	20	24	28	33	38	47	125

a The three categories do not add up to exactly 168 hours, because some activities cannot be attributed precisely to one of the main categories.

Table 2b Timing of paid and domestic work, population aged 20-64 years, 1975-2000 (in hours per week, in percent and index 2000, 1995 = 100)

	1975	1980	1985	1990	1995	2000	index
paid work	17.7	17.2	17.3	19.0	20.4	22.4	110
daytime on weekdays	15.3	14.8	14.7	16.0	17.3	19.2	111
evening, night and weekend	2.4	2.4	2.6	3.0	3.1	3.2	103
% paid work evening/night/weekend	*14*	*14*	*15*	*16*	*15*	*14*	*93*
domestic work	25.0	24.5	25.1	23.4	23.5	22.9	97
daytime on weekdays	15.4	14.9	15.0	13.7	13.2	12.4	94
evening, night and weekend	9.6	9.6	10.1	9.7	10.3	10.5	102
% domestic work evening/night/weekend	*38*	*39*	*40*	*41*	*44*	*46*	*104*

Table 2c Use of free time, population aged 12 years and older, 1975-2000 (in hours per week and index 2000, 1995 = 100)

	1975	1980	1985	1990	1995	2000	index
total free time	47.9	47.0	49.0	47.2	47.3	44.8	95
printed media	6.1	5.7	5.3	5.1	4.6	3.9	86
electronic media	12.4	12.1	13.6	13.7	14.2	14.8	104
social contacts	12.7	12.5	11.5	11.4	10.9	10.1	93
social participation	2.0	2.0	2.2	2.1	2.2	1.8	81
going out	2.4	2.2	2.4	2.6	2.6	2.5	97
sport and exercise	1.5	1.6	2.1	1.8	2.1	1.8	85
other hobbies	8.2	8.7	9.0	7.7	7.5	6.8	91
free time mobility	2.6	2.3	2.9	2.9	3.2	3.0	94
% free time spent out of home	36	35	37	37	39	36	93

In reading these tables one has to take into account a number of contextual variables: October 2000 represented the peak of the economic cycle as well as a period of bad weather. Moreover, since 1996 two laws came into force allowing for greater variation in working hours and opening hours for shops (in the evening and on Sundays). Interpreting the tables shown here, background information from the survey will be used, too. Time pressure due to increased labor participation (especially of women) has increased over the 25-year period. Hence more people needed to combine and work tasks (but women still performed two thirds of the domestic and care tasks). The structuring of time can be measured in terms of collective peak times for activities such as work or in terms of individual routines. Despite of more opportunities for variation in working hours and opening hours for shops, time structures showed little change. And, finally, total free time has declined and this decline has accelerated with one major exception: time spent on electronic media. While the use of computers has grown, the 'digital divide', measured in terms of PC use, has widened.

A final word about mobility: 'After increasing for several years in succession, the time spent on mobility stabilized in 2000 at the level of 1995. Car use increased within the mobility budget at the expense of other means of transport' (Breedveld and Van der Broek, 2001: 132).

The examples given in this section point to the importance of time use surveys and hence of monitoring actual temporal developments. Time use surveys may contradict 'grand trends'. But radical changes may still lie ahead, i.e. long-term changes and as such subject to uncertainty.

6 TOWARDS SPACE-TIME BUDGETS

Surveys measuring time use tend to hide the spatial dimension. Ever since Hägerstrand (1970), however, the use of time and of space are combined. See for example the space-time budget of a four-person household on a weekday in the town of Lund (figure 5).

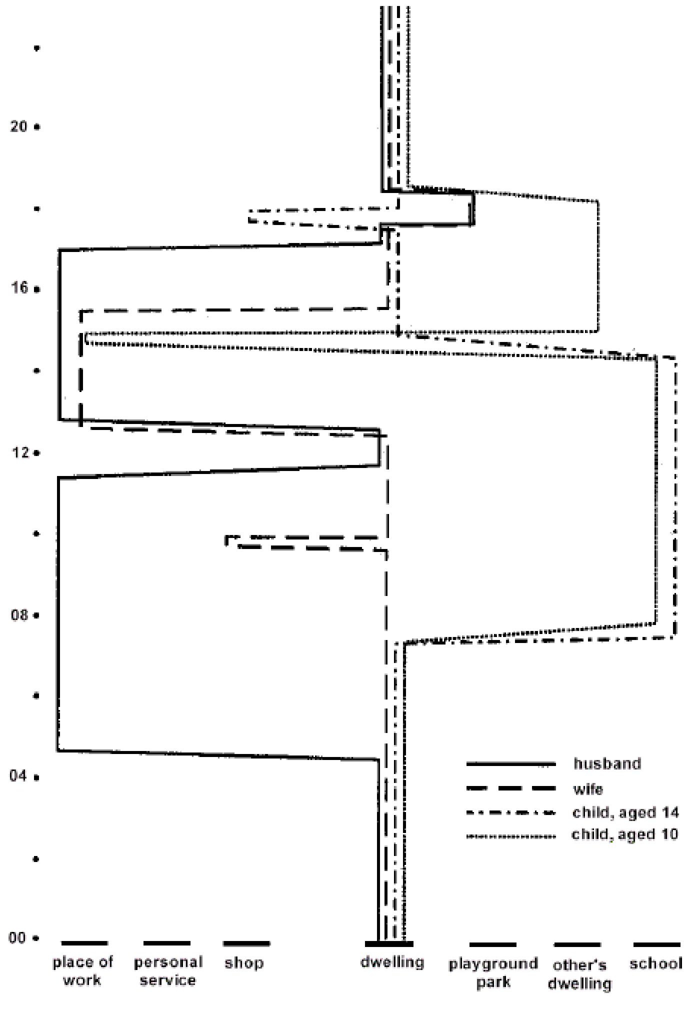


Fig. 5. Time-space budget of a four-person household in Lund, Sweden

This figure combines the daily cycle with various locations or activity places over town. In fact, there are four cycles (of husband, wife and two children respectively) which are obviously coupled or synchronized. In order to switch locations one has to travel. In principle, the space-time budget allows for the calculation of travel times and should also indicate the mode of transport.

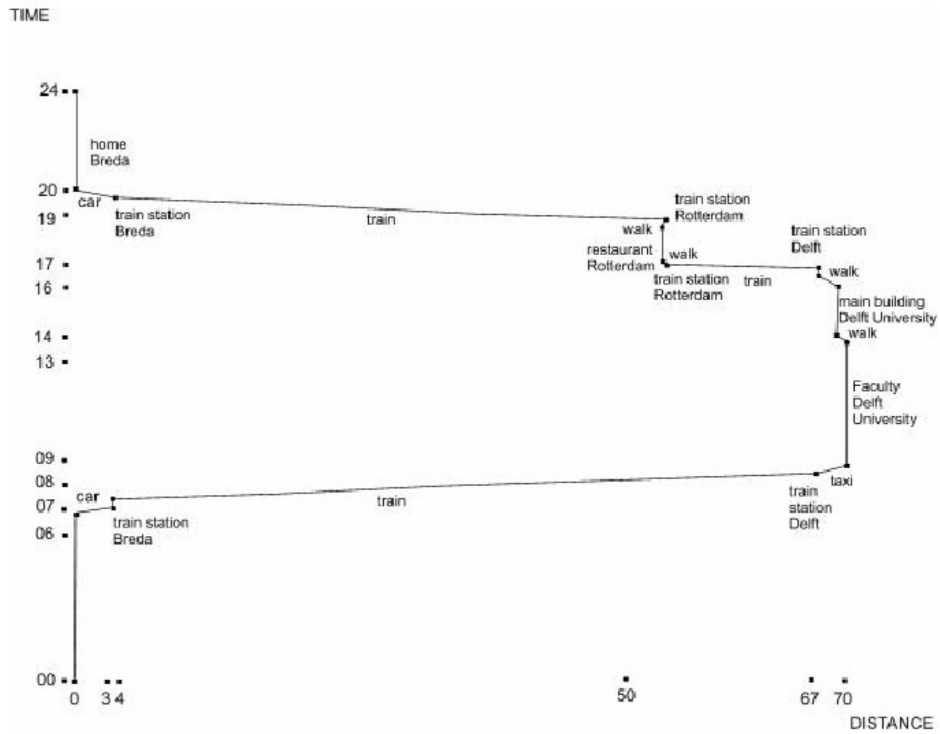


Fig. 6. A typical day of Paul Drewe

Figure 6 pictures a typical day of the author of this essay hereafter referred to as the actor. He works at some 70 kilometers from home as a professor at a university. On his way back home he stops twice. First, he chairs a committee meeting at the university's main building. Then, he stops at a restaurant in a nearby city for dinner and 'networking'. The chain of mobility is rather complicated as it comprises private car, train, taxi, walk, train, walk, train and private car again. As the actor's wife takes him to the station and picks him up there ('kiss and ride'), their respective time uses need to be synchronized at this point. The evening meal is prepared for one person only and the actor is unable to do any shopping except for shops located at the stations or in their vicinity (or during the walk to the station for that matter). If the train is late, the mobile telephone is used as a 'synchronization technology'.

By the way, the train rides of more than two hours are usually combined with work and leisure activities such as reading.

Figure 5 and 6 are not exactly sophisticated drawings though they depict the essential features of space-time budgets. Ever since Hägerstrand has introduced the spatio-temporal model, mapping, visualization and modeling have advanced in sophistication using ICT as a tool. Here are a few examples:

- *the space-time cube revisited from a geovisualization perspective (Kraak, 2003),*
- *a GIS approach to invidual accessibility in space-time (Kwan, 2003), see also:*
- < *http://www.csiss.org/events/workshops/2003,AST2003/materials.html* >
- *the city as a process in time and space (Ferschin et al, 2002),*
- *the visualization of territories and cities (Debarbieux and London, 2003) including chronotopic mapping, among others (Laousse, 2003); see also the work of Stabilini on chronographic maps and GIS tools,*
- *graphs and networks, and multilevel modeling (Mathis, 2003).*

Figure 6 shows an individual action space. Attempts have been made to model this space (Dijst and Vidakoviæ, 1997). This includes a typology of actual action spaces and a simulation model. Within a time internal of 13.5 hours, the actor visits three activity places and stays there for some 9 hours altogether. To be able to do so the actor must travel approximately 3 hours covering about 137 kilometers. It is important to calculate travel time apart from time spent on activities at destinations unlike Eurostat has done for the journey-to-work classifying it 'as part of work' as distinguished from 'travel excluding travel as part of work'. This separation is important because a household's time (and money) budget restricts its mobility behavior. Usually, a constant fraction of daily time is spent on travel, typically between 1.1 and 1.5 hours (Schafer and Victor, 1977; also Zahavi, 1979). With 3 hours devoted to the journey-to-work, the actor's mobility behavior is not really typical (neither is the fact that he takes the train). But obviously a total travel of time 3 hours is affordable. Moreover, it allows for combining interesting work with pleasant living outside the country's metropolitan area. However, the frequent malfunctioning of the railway system puts a serious strain on the actor's space-time budget. But so would a journey-to-work by private car because of frequent traffic jams.

Generally speaking, an individual action space is restricted in three ways, by:

• money and time budgets that limit mobility, the availability of means of transport and the ability to use them,

• coupling constraints with regard to places and the time plans of institutions and other individuals,

• institutional restrictions such as limited access to institutions caused by property, opening hours, entrance fees or prices.

How about the impact of ICT on space-time budgets, especially on constraints? The actor's space-time budget shown in figure 6 is not repeated five times a week. Depending on the amount and

urgency of research activities some days are spent at home undisturbed, teleworking. Teleworking saves 3 hours. A laptop, connected to the university, allows for substituting face-to-face contacts at the university, online networking with colleagues elsewhere and online consulting of sources of information. Similarly during working hours a colleague's PC is sometimes used for networking and search purposes although face-to-face contacts are prevailing. Networking, starting either from the university or from home, is an essential part of a research program, i.e. The Network City Design Studio: < http://www.networkcity.nl >. This studio is linked to researchers in Latin America, Europe and the United States. Networking includes an occasional videoconference with Mexico.

Similarly, ICT provides access to banks, shopping, entertainment and other non-working activities. With ICT the individual action space becomes much less constrained, provided of course one has access to ICT. A shift to e-activities is a shift to a higher speed. And a higher speed means a higher reach. A little time goes a long way in 'travel on the electronic highway' (a longer way even than in air travel and travel by high-speed trains). If one embeds time and ICT in accessibility analysis, a picture of space-time budgets evolves like the one shown in figure 7 (Janelle, 2002).

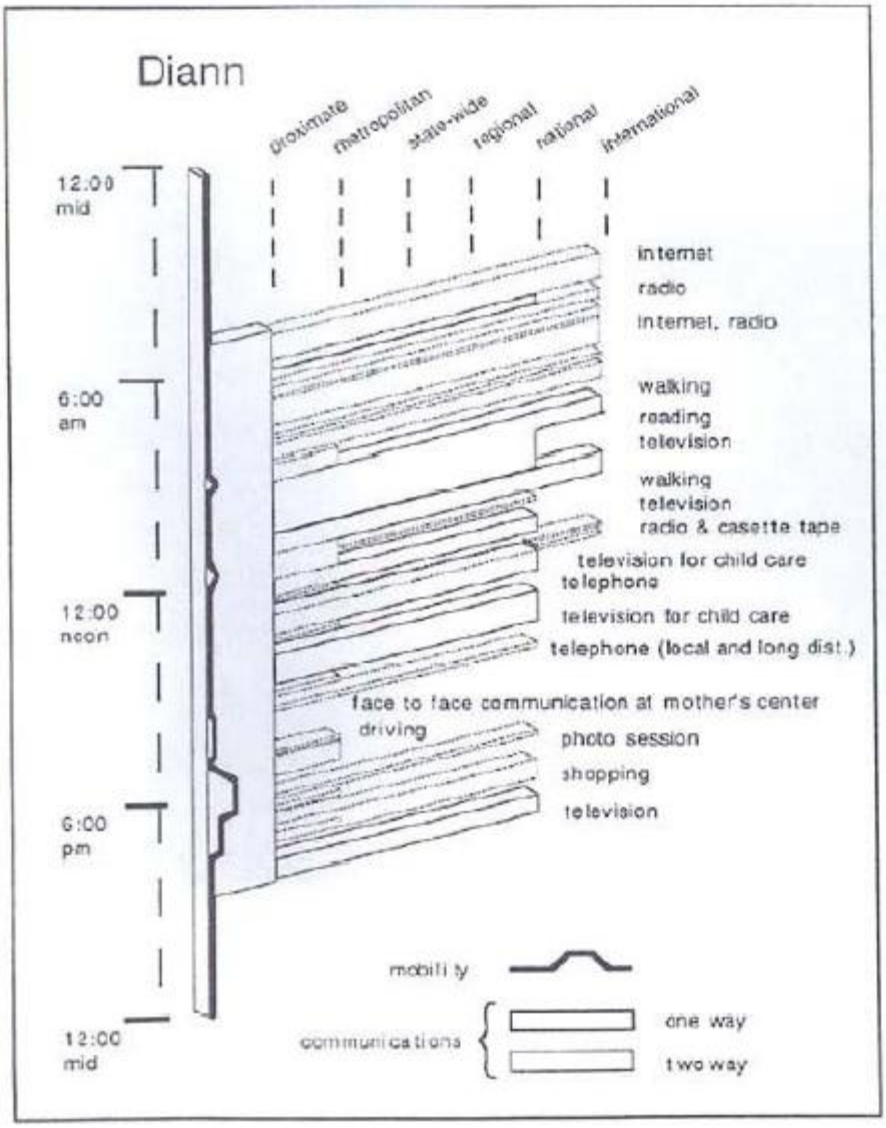
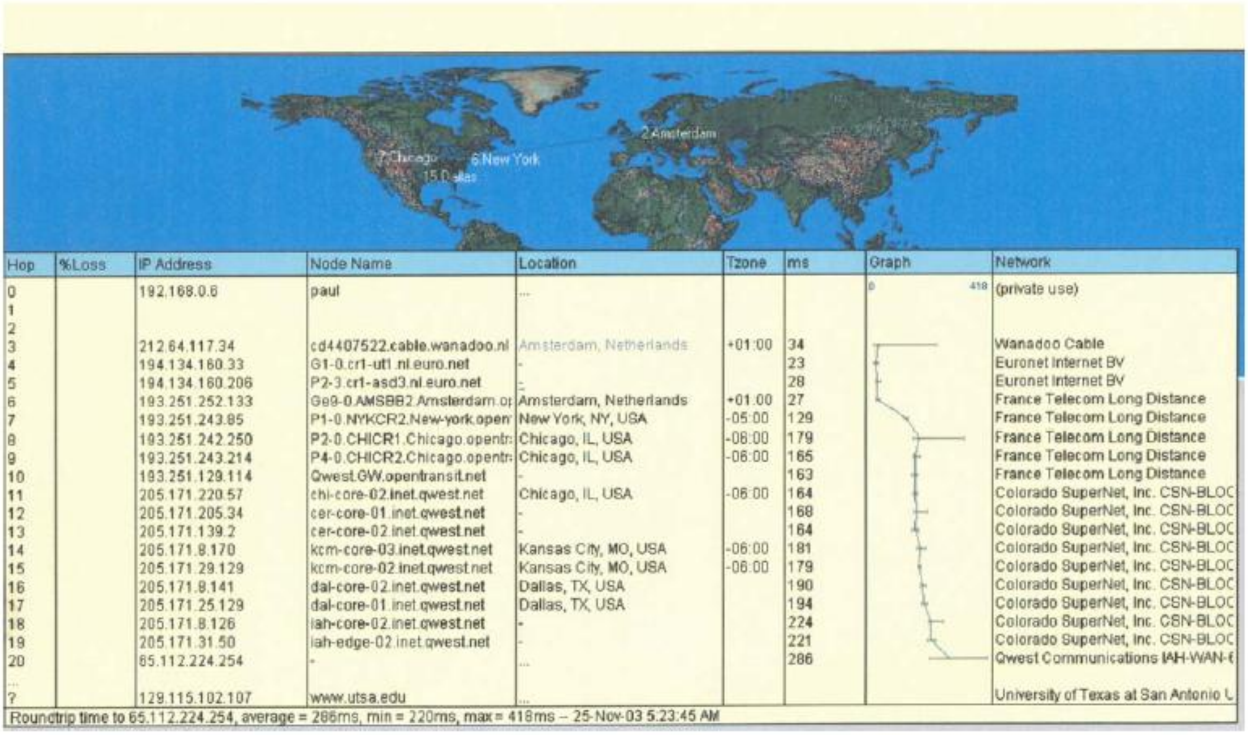


Fig. 7. Diann's extensibility for a typical Thursday, autumn 1997 Paul Adams (2000)

But does the digital reach really have a spatial dimension? Or are the innumerable websites and email addresses located in the 'blue nowhere' (Google, by the way provides access to some two and half billion sites). It is indeed possible to trace physical destinations of data flows by applying so-called traceroutes. Visiting the home base of a colleague at the University of Texas at San Antonio took less then 300 milliseconds of roundtrip time (table 3). Another examples revealed a little more than 200 milliseconds, visiting Amazon in Seattle to order a book (table 4). The traceroute reports can be compared to weather reports. The Internet may function smoothly in 'good weather' with physical distance between cities turning into milliseconds. But one may encounter 'bad weather', too, such as delays. Information packets may get lost or even blocked, not reaching their destination (see Drewe, 2002 for earlier traceroute applications). These problems are the equivalents of private or public transport disturbances.

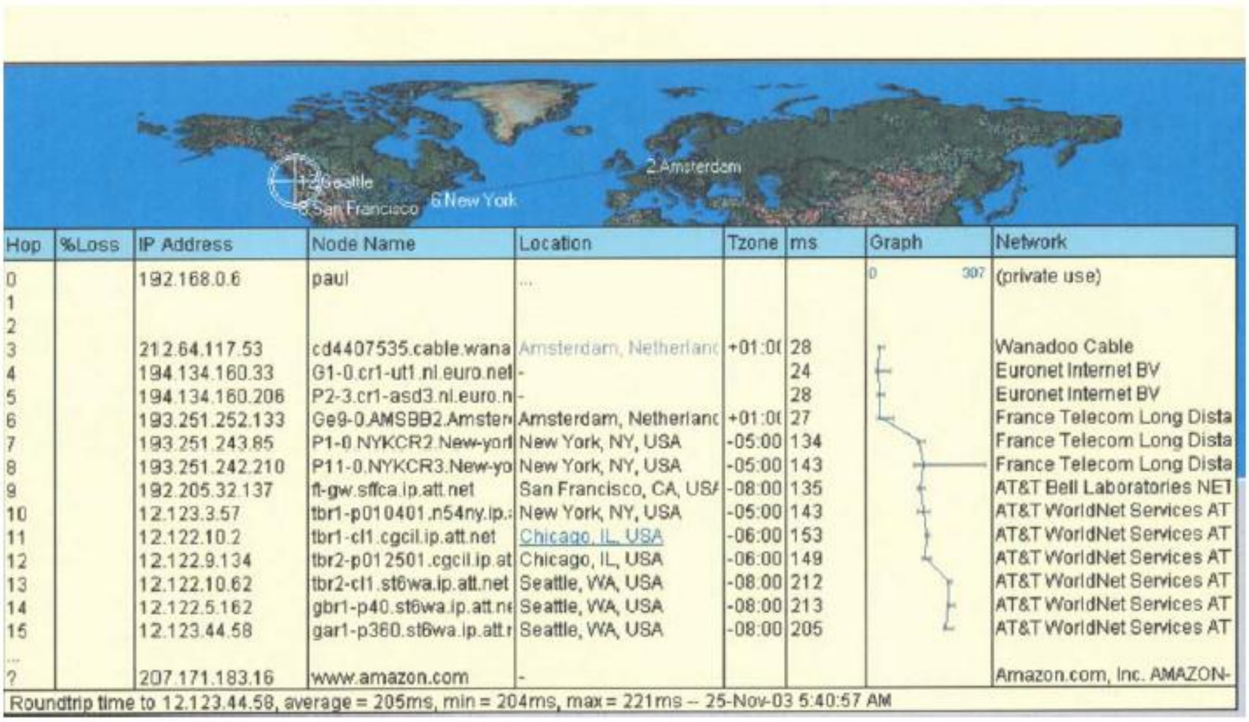
Report for www.utsa.edu [129.115.102.107]



Hop	%Loss	IP Address	Node Name	Location	Tzone	ms	Graph	Network
0		192.168.0.6	paul	...			0 418	(private use)
1								
2								
3		212.64.117.34	cd4407522.cable.wanadoo.nl	Amsterdam, Netherlands	+01:00	34		Wanadoo Cable
4		194.134.160.33	G1-0.cr1-ut1.nl.euro.net	-		23		Euronet Internet BV
5		194.134.160.206	P2-3.cr1-asd3.nl.euro.net	-		28		Euronet Internet BV
6		193.251.252.133	Ge9-0.AMSBB2.Amsterdam.op	Amsterdam, Netherlands	+01:00	27		France Telecom Long Distance
7		193.251.243.85	P1-0.NYKCR2.New-york.open	New York, NY, USA	-05:00	129		France Telecom Long Distance
8		193.251.242.250	P2-0.CHICR1.Chicago.opentr	Chicago, IL, USA	-06:00	179		France Telecom Long Distance
9		193.251.243.214	P4-0.CHICR2.Chicago.opentr	Chicago, IL, USA	-06:00	165		France Telecom Long Distance
10		193.251.129.114	Qwest.GW.opentransit.net	-		163		France Telecom Long Distance
11		205.171.220.57	chi-core-02.inet.qwest.net	Chicago, IL, USA	-06:00	164		Colorado SuperNet, Inc. CSN-BLOC
12		205.171.205.34	cer-core-01.inet.qwest.net	-		168		Colorado SuperNet, Inc. CSN-BLOC
13		205.171.139.2	cer-core-02.inet.qwest.net	-		164		Colorado SuperNet, Inc. CSN-BLOC
14		205.171.8.170	kcm-core-03.inet.qwest.net	Kansas City, MO, USA	-06:00	181		Colorado SuperNet, Inc. CSN-BLOC
15		205.171.29.129	kcm-core-02.inet.qwest.net	Kansas City, MO, USA	-06:00	179		Colorado SuperNet, Inc. CSN-BLOC
16		205.171.8.141	dal-core-02.inet.qwest.net	Dallas, TX, USA		190		Colorado SuperNet, Inc. CSN-BLOC
17		205.171.25.129	dal-core-01.inet.qwest.net	Dallas, TX, USA		194		Colorado SuperNet, Inc. CSN-BLOC
18		205.171.8.126	iah-core-02.inet.qwest.net	-		224		Colorado SuperNet, Inc. CSN-BLOC
19		205.171.31.50	iah-edge-02.inet.qwest.net	-		221		Colorado SuperNet, Inc. CSN-BLOC
20		65.112.224.254	-	...		286		Qwest Communications IAH-WAN-(
...								
?		129.115.102.107	www.utsa.edu	...				University of Texas at San Antonio L

Roundtrip time to 65.112.224.254, average = 286ms, min = 220ms, max = 418ms -- 25-Nov-03 5:23:45 AM

Table 3. Traceroute report: home – University of Texas at San Antonio



Hop	%Loss	IP Address	Node Name	Location	Tzone	ms	Graph	Network
0		192.168.0.6	paul	...			0 307	(private use)
1								
2								
3		212.64.117.53	cd4407535.cable.wana	Amsterdam, Netherlanc	+01:0(	28		Wanadoo Cable
4		194.134.160.33	G1-0.cr1-ut1.nl.euro.net	-		24		Euronet Internet BV
5		194.134.160.206	P2-3.cr1-asd3.nl.euro.n	-		28		Euronet Internet BV
6		193.251.252.133	Ge9-0.AMSBB2.Amsten	Amsterdam, Netherlanc	+01:0(	27		France Telecom Long Dista
7		193.251.243.85	P1-0.NYKCR2.New-yorl	New York, NY, USA	-05:00	134		France Telecom Long Dista
8		193.251.242.210	P11-0.NYKCR3.New-yo	New York, NY, USA	-05:00	143		France Telecom Long Dista
9		192.205.32.137	ft-gw.sffca.ip.att.net	San Francisco, CA, US/	-08:00	135		AT&T Bell Laboratories NET
10		12.123.3.57	tbr1-p010401.n54ny.ip.:	New York, NY, USA	-05:00	143		AT&T WorldNet Services AT
11		12.122.10.2	tbr1-cl1.cgcil.ip.att.net	Chicago, IL, USA	-06:00	153		AT&T WorldNet Services AT
12		12.122.9.134	tbr2-p012501.cgcil.ip.at	Chicago, IL, USA	-06:00	149		AT&T WorldNet Services AT
13		12.122.10.62	tbr2-cl1.st6wa.ip.att.net	Seattle, WA, USA	-08:00	212		AT&T WorldNet Services AT
14		12.122.5.162	gbr1-p40.st6wa.ip.att.ne	Seattle, WA, USA	-08:00	213		AT&T WorldNet Services AT
15		12.123.44.58	gar1-p360.st6wa.ip.att.r	Seattle, WA, USA	-08:00	205		AT&T WorldNet Services AT
...								
?		207.171.183.16	www.amazon.com	-				Amazon.com, Inc. AMAZON-

Roundtrip time to 12.123.44.58, average = 205ms, min = 204ms, max = 221ms -- 25-Nov-03 5:40:57 AM

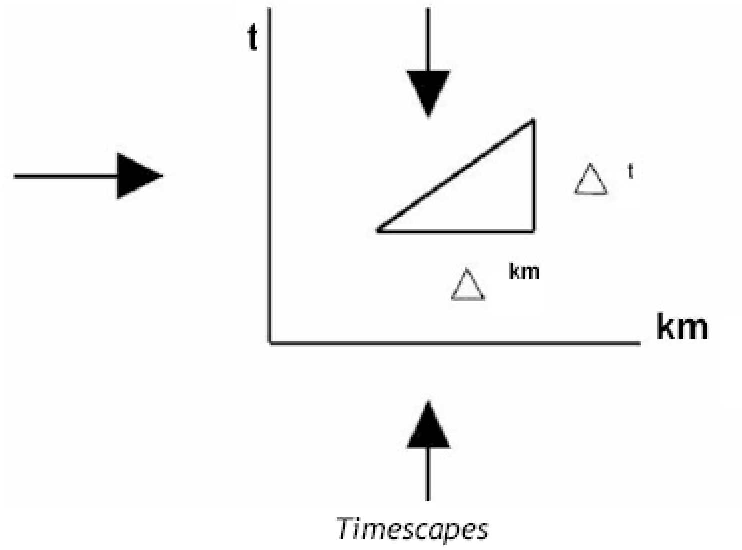
Table 4. Traceroute report: home – Amazon, Seattle

So far the space-time budgets of households or individuals.

As far as companies are concerned, it is the business logistics chain that provides the framework for 'inserting' locations in order cycles (24 hours, rush or stock orders). There are activity places of material management as well as physical distribution management. The former includes raw materials and semi-final products suppliers, and production planning. Physical distribution management comprises final products storage, wholesalers, retailers and consumers. First, companies respond to their clients' needs. Second, these companies (in particular large, multinational companies) employ logistic service providers to set up logistic chains which allow to deliver goods to points of sale in time according to the cycle required. Third, in order to compose logistic chains, choice is made of modes of transport, European or regional distribution centers and transit platforms. This includes the choice of ports as entry points into the European market. Logistic chains from factories to points of sale necessarily tend to be tailor-made (see also Drewe and Janssen, 2002). The resulting space-time budgets can be analyzed in terms of 'logistics zones' and (non-spatial)' logistic regimes' (Hesse, 2002). See also Läpple (1995). To handle the information flows and synchronize the different activities involved, ICT is indispensable (in particular EDI). One notes a trend towards infogistique as the French call it (Irepp, 2000). E-commerce is generally considered as one of the new driving forces behind logistic chains, i.e. business-to-business (B2B) e-commerce and business-to-consumer (B2C) e-commerce. As space or physical distribution still matters, one needs to construct space-time budgets for companies, too.

7 IN SEARCH OF NEW INSTRUMENTS OF PLANNING AND DESIGN

Dealing with time and space, one has to take into account their mutual interactions. This is a matter of timing space as well as spacing time, of townscapes as well as timescapes. It is the space-time budget of both households and companies which provides the appropriate frame of reference:



Changes occur with regard to the temporal and spatial dimension or the mobility pattern (including digital mobility). Searching for new instruments of urban planning and design the focus is, of course, on the spatial dimension. But to be able to deal with time, the practitioners need to be aware of time use, basic rhythms and major trends, and students need to be trained in this. For practitioners in Italy, 'Territorial Time Plans' are even required by law for municipalities with more than 30000 inhabitants (Mareggi, 2001). In fact, some countries are more advanced, i.e. more sensitive to urban time policy issues than others. More about this later.

Taking into account mobility patterns in urban planning and design is closely linked to network thinking in urbanism (see section 1). Although time sensitivity, too, leads to network thinking. The 'Network City' as a new paradigm translates into an integrated planning of land use and urban technology networks, including ICT (Drewe, 2003b).

Should we look for new city concepts from which new instruments can be derived? In 2003 the New Charter of Athens has been published, seventy years after its predecessor which has provided the

dogma of mainstream urbanism until today (European Council of Town Planners, 2003).

> ***The Athens Charter of 1933 is based on two false premises: '(a) it is desirable to concentrate functions into giant packages; (b) the geometry within each package is homogenous. Nevertheless, a city contains so many complex functions that it is impossible to isolate them, let alone concentrate them, so that imposing a simplistic geometry on urban form inhibits the human activities that generate living cities' (Salingaros, 2000: 15).***

Over the years important changes have occurred in every conceivable domain, changes that are challenging future cities. ICT or urban time policies are just two more recent issues. The New Charter may contain all the right 'sound bites' – such as sustainability, connectivity and the like – but still must be translated into new instruments of planning and design to become effective and to reassert the grounding powers of urbanism. Time, by the way, is not a topic in the New Charter.

Why not start from time-oriented city concepts right away. Gwiazdzinski (2002) lists a number of emerging continuous cities, that is cities functioning around the clock:

• the **global city** (Sassen, 1991) such as New York, London or Tokyo where the consumer can find (almost) everything each hour of the day and all year around;

• the **linear city** of international transport connections (motorways, railways….) and their oases of continuous time (stations, motorway stops, seaports, airports, taxi stops);

• the **archipelago city** with their emerging 'bastions of continuous time'-services and production still largely organized in a 24 hours sequence: industrial plants, restaurants, hospitals, hotels, police stations, fire brigade stations;

• the **festive city**, specialized like Ibiza or Las Vegas: living in the utopia of leisure and permanent fun;

• the **virtual city** of networks, the WWW and its electronic appendices (computers, telephones, television…) which have colonized our homes and urban space.

These city concepts may inspire same designers, but to reassert the grounding powers of urbanism they, too, need to be translated into instruments. Moreover, the assumption of an emerging continuous city needs to be checked against known facts of time use and uncertainties concerning future developments.

Why not choose the 'Network City' as starting point for our search of new instruments? In session 1 its relationship with time has been explored. Throughout this essay the 'Network City' is conceived of as a new way of thinking cities, not as a new ready-made spatial concept. Hence it is not to be confused with 'réseaux de villes' (France), 'Städtenetze' (Germany) or 'stedelijke netwerken' (The Netherlands). In an earlier paper (Drewe, 2003) network thinking has been put to a test by:

• analyzing emergent network-based concepts,

• rereading the classics,

• a design studio.

In the part that follows these are the steps will be followed. But this time the emphasis will be on time sensitivity. To this will be added urban time policies and prospective mobility. The least one can hope to achieve is to prepare the stage for research into the matter.

7.1 Emergent network-based concepts

Two examples from the US are selected: the 'Millennium City' (Page et al, 2003) and the 'Hudson County Cyberdistrict' (WRT, 2003). See also the related case of Jersey City (Page and Phillips, 2003). These are examples from planning and design practice, examples of integrating urban technology systems in land-use design. As these systems include ICT, the cases also illustrate how to design with ICT.

The winning entry for the Millennium City competition for Orange County tries to achieve smart sprawl through a network-oriented development. This is a process in seven steps:

• development of a county-scale organization to stimulate the growth of e-commerce, e-business, e-government, distance education and telemedicine;

• creation of a county-wide high capacity Metropolitan Area Network (MAN) with commercial, non-profit and government components;

• establishment of a system of Network Stations of different sizes at dozens of strategic locations throughout the county to provide access to the MAN (including high speed access to the Internet);

• transformation of single-function buildings into mixed-function buildings with Network Stations adding functions;

• creation of plans for adding a mix of functions to single-function districts such that housing, jobs and services will be integrated at distances no greater than 2 miles (also using infill bricks and mortar projects as well as Network Stations for this purpose);

• creating of Neighborhood Transportation Zones around the Network Stations (mixed vehicle streets catering to low-impact vehicles);

• begin of reclaim of some of the land devoted to the high-performance automobile (such as housing construction on surface-parking lots in retail centers or office parks or reclaim of streets).

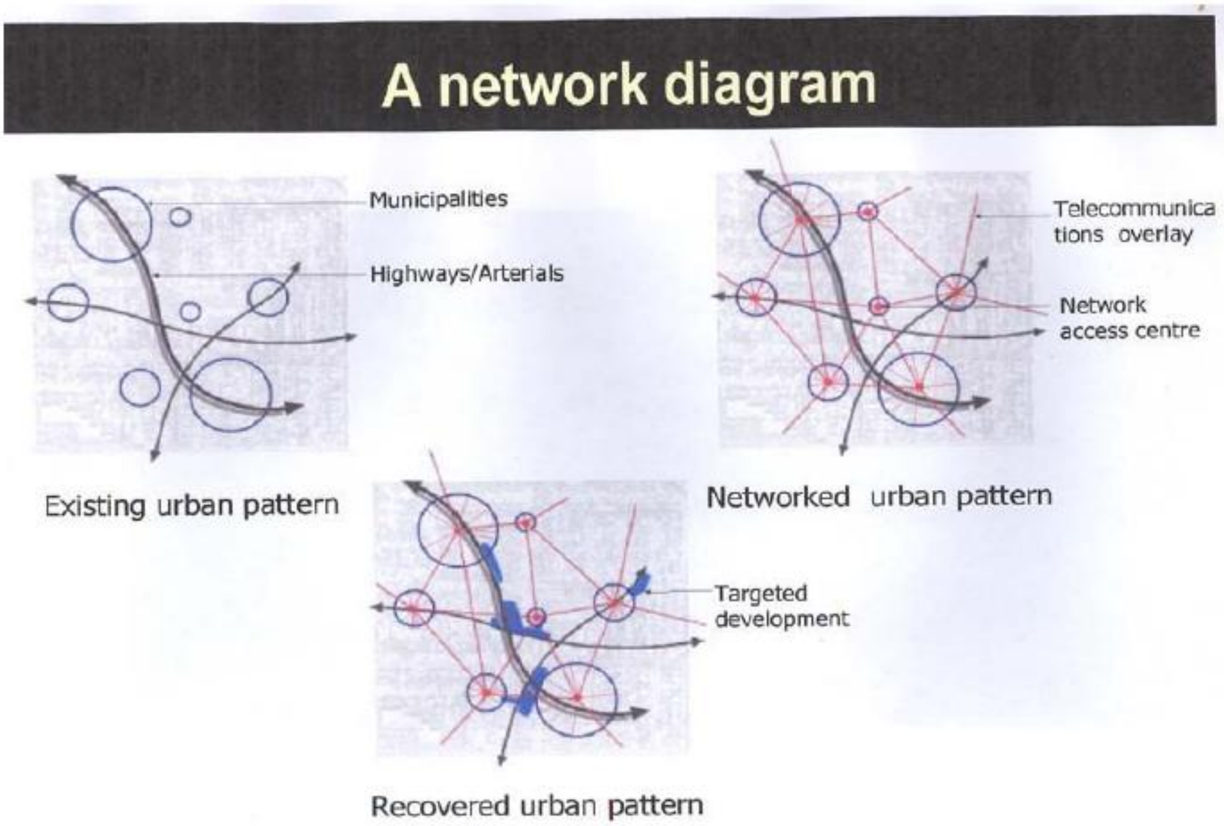


Fig. 8. A network diagram

Figure 8 illustrates how the existing urban pattern is recovered by means of a networked urban pattern. As a follow-up to the Millennium City, the Hudson County Cyber Strategy requires three initiatives, the:

• Network Neighborhood Initiative,

• Network Enterprise Initiative,

• Cyber Strategy Coordination Initiative.

The first and the second initiative comprise design elements. According to the Network Neighborhood Initiative, ICT is used to increase the pull of existing activity centers to the immediately adjacent residents and business reducing demand for trips of over a mile or two. This initiative is also meant to reinforce a local sense of pride-of-place in neighborhoods. The initiative includes the following projects.

• Network Neighborhood Centers Plan (Centers Plan) comprising shared network access facilities or Network Stations (as in Orange County) to start with Centers Pilot Projects (three centers);

• Mixed use public facilities such as schools, libraries, public transportation stations, parks and city halls (to be combined with the Centers Plan) plus a Mixed Use Public Facilities Pilot Project focusing on rail platforms and stations;

• Centers Plan Revision and Developer Recruitment (after the implementation of the two pilot projects);

• Neighborhood Transportation Zones, Vehicles and Services Pilot Project (similar to the Millennium City) in the service areas for each designated center.

The Network or Electronic Initiative is not an initiative in itself but rather a complement to the Network Neighborhood Initiative The general idea is to facilitate the transition of delivery activities of each enterprise (production and services): from 'bricks and mortar' to digital networks and to create demand for mixed function facilities. Several projects are envisaged:

• e-government targeting government services to citizens;

• countywide micro business incubator, using the new infrastructure of Network Stations;

• regional telework focusing on the administrative component of material handling and information companies;

• micro business web assistance, for example 'bricks and clicks" of retail stores;

• electronic meetings to cope with parking and congestion problems.

The proposed projects do not only affect the space-time budgets of households but also those of companies with a pivotal role of ICT. No attempt has been made yet to map potential 'chronotopes', say, of Network Neighborhood Centers or to do so as part of a pilot project. Chronotopes are '…physical places of spatial and temporal architecture animated by the rhythms of presence and co-presence of its citizens and temporary inhabitants' (Bonfiglioli, 1999: 125). Chronotopes are a tool used in urban time policies that will be dealt with in section 7.5.

7.2 Rereading the classics

In this section a few examples will be presented of how classic can be reread. Today's investigations of time and space, in particular the space-time budget analysis own a lot to a classic; that is to Hägerstrand's space-time model developed in the 1970s (see Corbett, 2003).

'Over thirty years after it was first introduced, Hägerstrand's space-time model continues to provide new ways of understanding human activity in space, and promises novel solutions for solving difficult issues of transportation and access in modern society' (Corbett, 2003: 3).

Hägerstrand is a geographer. But what about the classics in urban planning and design? Ancient concepts, however, cannot simply be cut and pasted to provide a panacea for current and future urban problems. They must allow for the inclusion of ICT and space-time analysis. The 'Network City', as a new paradigm, in fact is not really new but rather the result of rereading classical network thinkers namely by Dupuy (1991). It proved possible to apply the framework shown earlier in figure 1 (section 1) to the Internet with traceroutes enabling us to grasp and measure the 'death of distance' in milliseconds. The network in its modern meaning is characterized by three principal criteria:

- '**Topological Criterion**. The research of direct relations without intermediary and the desire for ubiquity, produces a very specific interest in the topology of a network.
- **Kinetic Criterion**. Instantaneousness, homogeneity of speeds, the interest for rapid transfers without losses of time or interruptions make the network apt to movement and defines the kinetic criterion.
- **Adaptive Criterion**. As presently conceived, networks are based on a choice of connections in space and time. The connections can necessitate a permanent support, a fixed infrastructure. On the other hand, the network has to ideally, be able to constantly adapt to the need of new connections, when they are requested and chosen by its users' (Dupuy, 2000: 5).

Both the kinetic and the adaptive criterion relate to the time dimension. Take for example the actor's daily space-time budget described in section 6. The actor's action space, in especial the reach of a working place at some 70 kilometers from home depends on the kinetic quality of a railway network. The latter is about to adapt to a higher speed which implies that with high-speed train links working places at longer distances will become within reach of the actor.

	TOPOLOGY	KINETICS	ADAPTATION	HISTORIC MARKS
Haussmann	⊗	❍	❍	
Paxton	⊗	⊗	❍	Railroad
Cerda	●	●	❍	
Henard	⊗	⊗	❍	
Soria Y Mata	●	●	●	
Wagner	●	●	●	Electricity
Insull	●	●	●	
Chambless	❍	●	●	
Hart	⊗	❍	❍	
Pinchot	●	❍	❍	
Ford	●	⊗	⊗	Automobile
Wright	●	●	●	
Rouge	●	⊗	⊗	Telephone (in France)
Riboud	●	●	❍	
De la Rochefoucauld	●	⊗	⊗	Telematics
Virilio	❍	●	❍	

● Very large emphasis ❍ Large emphasis ⊗ Middle or weak emphasis

Fig. 9. Emphasis on topological, kinetic and adaptive dimensions of networks

As shown in figure 9, the classical network thinkers in urbanism have put different emphasis on the three criteria (Dupuy, 1991: 105). Wright is one of the few who has dealt fully with all dimensions. Wright has also inspired Fishman (1988) who has laid the foundation of the very framework of today's network urbanism. Are there still lessons to be learned from Wright's 'Broadacre City' (Wright 1940, 1943; Grabow, 1977). And what about the other classics such as Cerdà? Are Cerdà's urbanistic propositions for Barcelona a source of inspiration for new instruments of planning and design (Magrinyà, 1996)?

A modern network thinker is Salingaros as his 'theory of the urban web' clearly shows. He could equally be ranked among those who have produced emergent network-based concepts though his 'connecting the fractal city'-unlike e.g. the Hudson County Cyberdistrict- is primarily a conceptual contribution. Its importance lies in the fact that he raises a number of fundamental questions: '(i) what these fractal properties are; (ii) the intricate complexity of the living urban fabric; (iii) methods of repairing urban space; (iv) an effective way to overlay pedestrian, automotive, and public transports; and (v) how to integrate physical connections with electronic connections

Theory of the Urban Web

'The processes that generate the urban web can be summarized in terms of three principles. Though not exhaustive, they are entirely general, and this paper will describe how they translate into practical design rules for specific situations. Everything has to do with connections, and the topology of those connections. The three principles may be stated as follows:

1. ***Nodes:*** *The urban web is anchored at nodes of human activity whose interconnections make up the web. There exist distinct types of nodes: home, work, park, store, restaurant, church etc. Natural and architectural elements serve to reinforce human activity nodes and their connective paths. The web determines the spacing and plan of buildings, not vice versa. Nodes that are too far apart cannot be connected by a pedestrian path.*
2. ***Connections****: Pairwise connections form between complementary nodes, not like nodes. Pedestrian paths consist of short straight pieces between nodes; no section should exceed a certain maximum length. To accommodate multiple connections between two points, some paths must necessarily be curbed or irregular. Too many connections that coincide overload the channel's capacity. Successful paths are defined by the edge between contrasting planar regions, and form along boundaries.*
3. ***Hierarchy:*** *When allowed to do so, the urban web self-organizes by creating an ordered hierarchy of connections on several different levels of scale. It becomes multiply connected but not chaotic. The organization process follows a strict order: starting from the smallest scales (footpaths), and progressing up to the higher scales (road of increasing capacity). If any connective level is missing, the web is pathological. A hierarchy can rarely be established all at once'.*

(Salingaros, 1998)

(As far as practical action is concerned, the work of Salingaros is close to that of the Prince's Foundation in Britain: < http://www.princes-foundation.org >).

The reason for referring to Salingaros, a modern network thinker, in the present section is his rereading of Alexander, in particular the pattern language. (Alexander et al, 1977). The patterns of Alexander do not have an explicit time dimension, nor do the so-called functional properties connected by 'functional notes' to the original patterns (See Alexander, 2002).

Moreover, neither the patterns nor the properties take into account ICT. Salingaros has posed the question of how to integrate physical connections with electronic connections. Looking for patterns, both the Orange County and the Hudson County provide examples:

- Network Stations plus mixed-function buildings plus Neighborhood Transportation Zones,
- Mixed use public facilities plus Network Neighborhood Centers (or Network Stations),
- Network Neighborhood plus various Electronic Initiative projects.

See also Firmino and Graham (2001) for the interplay between physical and virtual urban spaces. What about time in the pattern language? Both Alexander and Salingaros are committed to the living city or living urban fabric. Combining their concepts with those of urban time policies would only strengthen their case. Because introducing time in urban planning and design means introducing people and their needs as external criteria of the quality of design which is not common practice for example in contemporary architecture which '…has become self-referential; i.e. validated only by how well it conforms to some currently accepted style; and not by any objective external or scientific criteria '(Stringer 1975, quoted by Salingaros, 2000b, 2 & 3-4). The contributors of Salingaros to rereading the classics or to emergent network-based concepts for that matter are not the contributions of a planner of designer, but of a mathematician (and former nuclear physicist). Similarly Barabási (2002), a physicist doing research on complex networks, has demonstrated the multidisciplinary character of the 'new science of networks': awaiting to be applied to the complex network of the city. These 'outside' contributions are important stepping-stones to knowledge-based design, developing urban design into a science (Klaasen, 2003).

Another classic worth rereading is Jacobs. Apart from her plea for organized complexity more than forty years ago, her concept of city diversity is still valuable to day. ICT only strengthens the case for organized complexity. One of the conditions for city diversity in particular ties in to the objective of urban time policies, to wit the 'need for mixed primary uses':

'The district, and indeed as many of its internal parts as possible, must serve more than one primary function; preferably more than two. These must ensure the presence of people who go outdoors on different schedules and are in the place for different purposes, but who are able to use many facilities in common' (Jacobs, 1992).

Note also the emphasis on mixed function districts, buildings and public facilities in the Millennium City as well as in the Hudson County Cyberdistrict.

Our last example is Lynch, perhaps best known for 'the image of the city' (Lynch, 1960). This work has inspired Roberts et al (1999) in developing the 'integrated metropolis', another emergent network-based concept. The image of the city 'has also inspired Scott and Phillips (2003) in their urban design for Jersey City: however, in relation to electronic space or electronic networks.

'To argue today, as Lynch did 40 years ago, that Jersey City is a disorienting, obscure urban form that is no more than its sum of fragmentary enclaves and divisive infrastructure boundaries would be criticism leveled from a traditional urbanism perspective. More accurately, the city should be recognized as being rife with opportunity to explore new forms of urban expression that acknowledges the diverse and flexible interest of the information age' (Scott and Phillips, 2003: 93). See the 'exploded axonometric analysis' for design details in figure 10 (Scott and Phillips, 2003: 91).

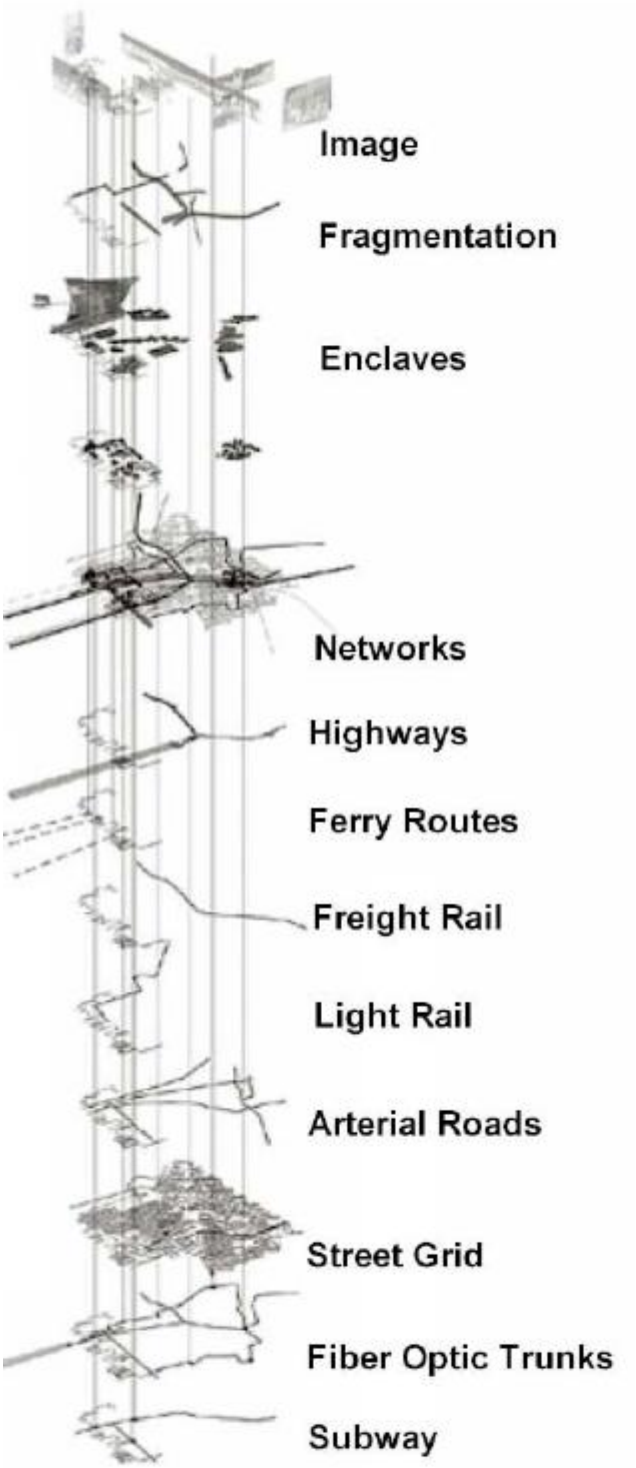


Fig. 10. Jersey City: exploded axonometric analysis

It has already been mentioned that practitioners usually do not work with spatio-temporal concepts so that they find it difficult to deal with time. Lynch has already been an exception to this in 1972 when he published 'What time is this place?' He may be even considered as a forerunner to urban time policies. Lynch therefore deserves to be(re)read, for example, his attempt to clarify the issue:

'One can think of several dimensions along which time structure can vary:

a) its grain, or the size and precision of the chunks, into which it is divided;

b) its period, or the length of time within which events recur;

c) its amplitude, or the degree of change within a cycle;

d) its rate, or the speed with which changes occur;

e) its synchronization, or the degree to which the cycles and changes are in phase, or begin and end together;

f) its regularity, or the degree to which the preceding characteristics themselves remain stable and unchanging, and

g) (in the human case and more subjectively) its orientation, or the degree to which attention is focused on past, present or future' (Lynch, 1972, 76-77).

Lynch also -as a true practitioner-describes some policies for changing things such as: the organization and celebration of time, change intelligence, prototypes, conservation, preservation, time enclaves and change management. What about instruments or methods of design?

According to Lynch a number of general methods is available to us: 'One is the visible accretion of the signs of past events which makes apparent the depth of historical time [-temporal collage-]. Another is the display of recurrent, opposed states which makes us aware of rhythmic time by contrasting the present state with remembered and expected states [-episodic contrast-]. Still another is the direct display of environmental change, when by transforming the scene – or shifting the viewpoint of the observer – the change can be made sufficiently palpable to be perceived in the experiential present [-the direct display of change & design for motion-]. Finally, there may be ways of symbolically speeding or slowing otherwise imperceptible changes – changes too glacial or too feverish to be seen – so as to bring them within our perceptual grasp [-patterning of long-range change-]. All these modes have their own characters. None of them is practiced today [-in 1972-] in any systematic way' (Lynch, 1972, 168).

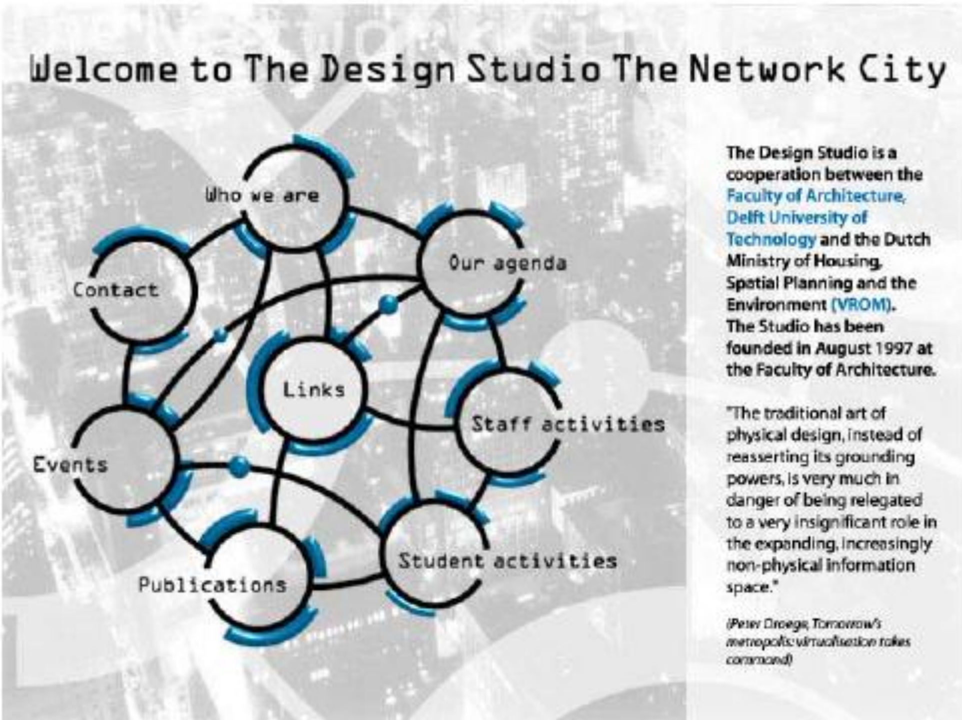
In addition to these four methods Lynch speculates about extending 'our perceptual reach by artificial means, in order or sense environmental changes' ('mutoscopes'). With ICT as a visualization tool this is within reach today.

'All of these ideas open rich possibilities for experiment, for training and for public participation. While adding directly to our enjoyment of the world, they could also serve to vivify and make coherent our image of time' (Lynch, 1972, 189).

With the rise of ICT, the question 'What time is this place?' is indeed an intriguing one. Planners and designers are essentially dealing with the future, in particular with the long run. But how can they succeed without mastering time?

'Being alive is being awake in the present, secure in our ability to continue but alert to the new things that come streaming by. We feel our own rhythm, and also feel that it is part of the rhythm of the world. It is when local time, local place and our own selves are secure that we are ready to face challenge, complexity, vast space, and the enormous future' (Lynch, 1972, 89).

7.3 A design studio



After having dealt with promising new ideas in section 7.1 and some time-honored old ideas in the previous section, the present section will be about a specific approach to the search for new spatial concepts. The Network City design studio started as a cooperation between the Dutch Ministry of Housing, Spatial Planning and the Environment, and the Faculty of Architecture at Delft

University of Technology back in 1997. The studio can be visited at: < http://www.networkcity.nl >. It involves staff, PhD students, contract researchers and undergraduate students in their final year. There are also (international) links to experts working in the same field. A new spatial concept similar to a new product of service, results from a complex interaction between three pillars: a societal or social, an economic-legal and a technological one. Figure 12 refers (Van Mieghem, 1995: 5).

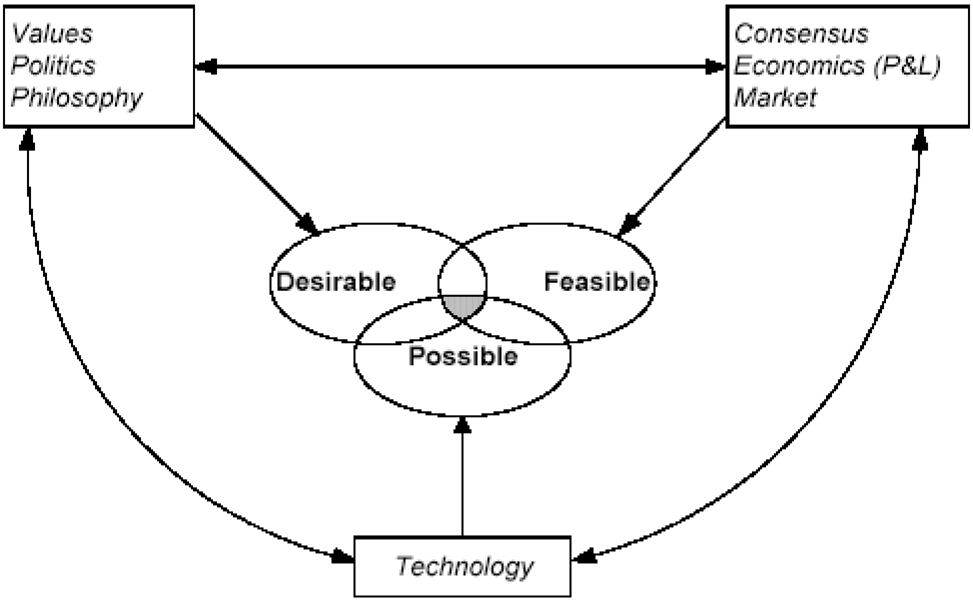


Fig. 12. The three pillars of innovation

The studio approach is one of design-oriented research aiming at possible futures – as design can demonstrate and visualize **what could be**. Possible futures tend to relate to the long term. In order to bridge the gap between a distant future and today's practice a number of location-specific test-beds has been chosen:

• the future urban agglomeration,

• the 'rest' of the Netherlands, beyond the 'periphery',

• the 'mainport' as node of a logistic network,

• the 'euroregion plus', beyond the Dutch border.

Right from the start (Drewe, 1996) the studio has focused on the opportunities offered by ICT. It is the rise of ICT in the 1990s that has triggered network thinking in urbanism. In order to understand the new technology and its implications for urban form, there are lessons to be learned from other urban technology systems such as water, energy and transport (their infrastructures, services and uses).

Time and the 'Network City' have been sketched at the outset in section 1. But so far in the studio, time has been dealt with mainly in relation to mobility and logistics. One of the projects has been about mobility and space-time behavior of the elderly (outdoor mobility of older people). This has been a European project with partners in Germany, Finland, Italy and Hungary (Mollenkopf et al, 2003, 2004). Another project deals with so-called seamless multimodal passenger mobility, i.e. chain mobility and activity-travel behavior. Logistics have been studied as part of the positioning of seaports and airports (Drewe and Janssen, 2002). Logistics are related to the time use of companies, basic rhythms and space-time budgets as mentioned before.

Hence there is still a large area of research to be covered. An important source of inspiration is the work of LABSAT at the Politecnico di Milano. LABSAT stands for Laboratory of Research and Design of Temporal Architecture Systems. This brings us to urban time policies, our next topic.

7.4 Urban time policies

'Tempi della Città' or times of the city is the expression coined for urban time policies in Italy in the 1980s, imitated by other European countries later on. The aims of these policies in Italy are fourfold:

> • 'improvement of the quality of life for citizens through a better organization and allocation of living and working hours;
>
> • modernization of public administration by simplifying its procedures, the opening of services oriented towards the temporal profile of demand, the decentralization and integration of services and office counters;
>
> • up-grading of public spaces to favour networks of socialization and to accommodate temporary dwellers and residents on mobility conditions;
>
> • reconciliation of the competition between residents and temporal dwellers, between workers and service users'.

(Mareggi, 2001, 4-5)

How has one tried to reach these aims? Mareggi (2001) lists seven thematic areas or domains of intervention each of which refers to real-world experiences or cases (today, between 140 and 170 cities have adopted an urban time policy):

- accessibility of services to the public (focusing on different age groups such as children and the elderly),
- integrated design of public spaces,
- time banks, that is the exchange of periods of time among people with different needs,
- mobility agreements to desynchronize the start/end of activities in an attempt to improve traffic conditions and to promote the use of public transport and sustainable mobility,
- opening hours of shops,
- school hours, desynchronizing them in order to decongest rush hours, create safe routes for pupils and add public transport lines,
- cultural and touristic promotion of cities, e.g. changing opening hours of museums daily, on Sunday and annually.

Similar examples can be found in Germany, Finland, the Netherlands and France. See Boulin and Mückenberger (2002) for details, in especial the second part.

Although the design of public space is the primary domain of intervention of conventional urban design and planning (though the design may not necessarily be integrated), there is much more to urban time policies. They start from a temporal description of spatial phenomena and a multidisciplinary scientific reflection which leads to an innovative problem formulation. The underlying concept of the post-industrial city echoes the New Charter of Athens evoking sustainability, flexibility, dispersal and mobility. As mentioned before, urban time policies are also dictated by law. These policies are closely related to a political process at the local level in which trade unions but, above all, women have played an important part ('Women change Times'). A specific procedure as been set up ensuring a concerted action of politicians and a variety of actors (directors and technicians from public administrations, experts, trade unions and employees, business firms and users). This is referred to as multipartner tables of co-design. Finally, a set of techniques has been developed at the Politecnico die Milano helping to identify, simulate and monitor the transformation processes of an area's spatio-temporal architecture, the key concept being the 'chronotope'.

Searching for new instruments of urban planning and design, the so-called chronotopic maps are of primary importance (chronotopic maps may be synthetic, cinematographic or chronomatic systems for local mobility.)

What exactly is a chronotope? According to Guez (2002) a chronotope refers to:

- an urbanized space, transformed over a long period of time, occupied by residential and temporal populations with cycles of uses that constitute typical temporal architectures,
- where the presence of populations alternates or clusters during daily, weekly and annual (seasonal) cycles,
- spaces attracting populations because of their residences and the accessible activities located there,
- within these urbanized spaces people and goods move in daily, weekly and annual cycles.

Within a chronotope, the distribution of populations in closed and open spaces, public and private spaces depends on rhythms marked by the coupling of activities, means of communication and transport.

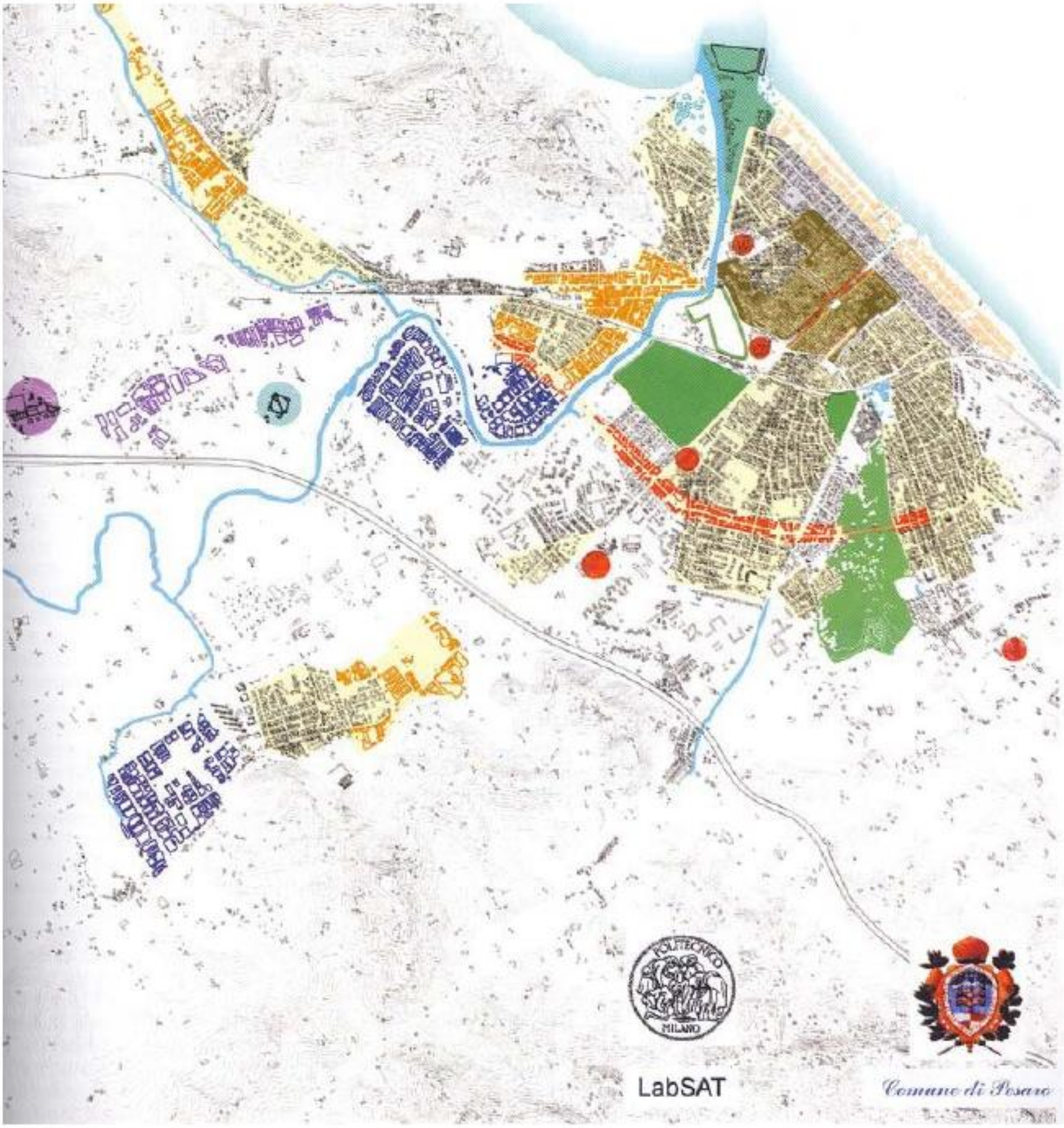
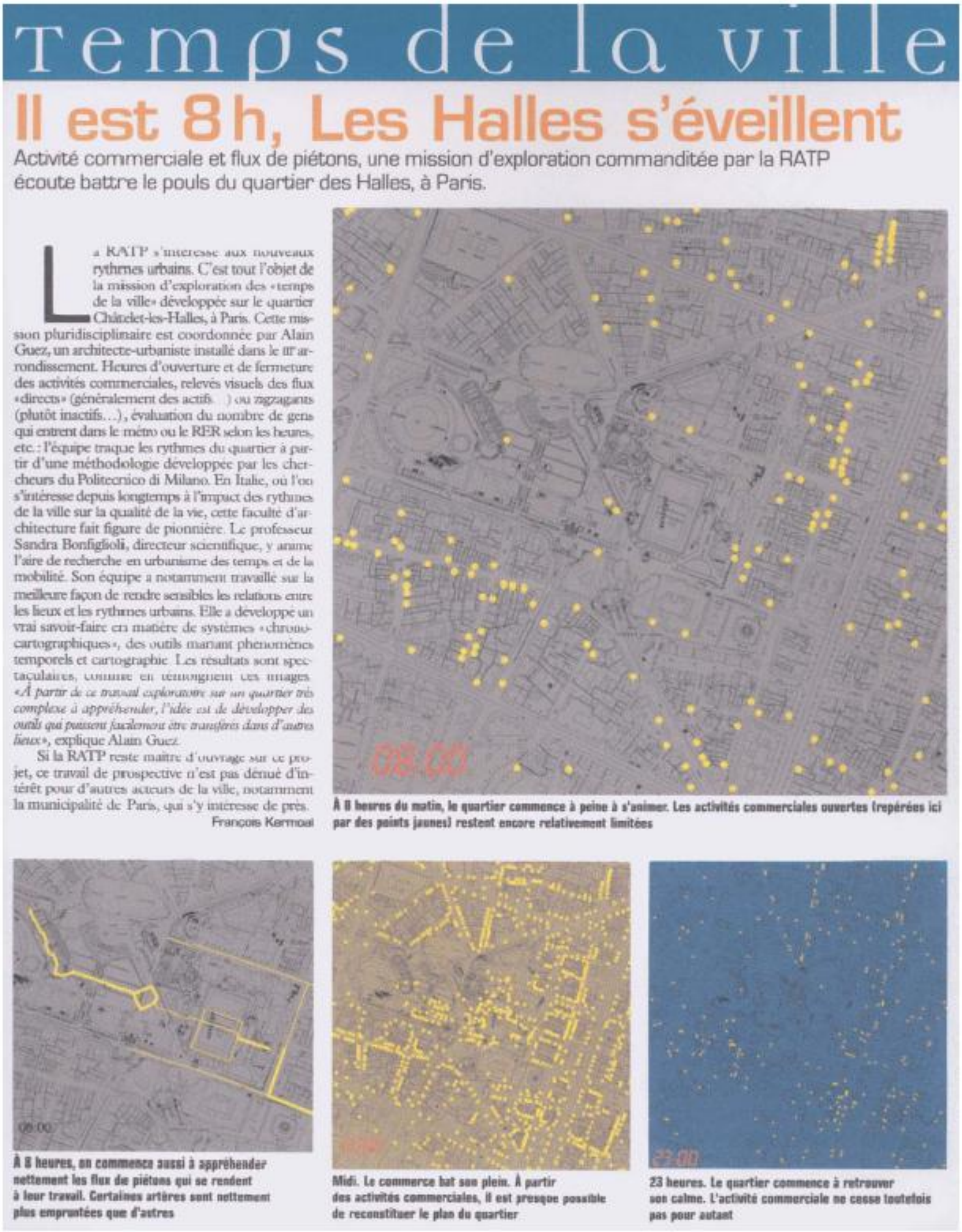


Fig. 12. A chronotopic map of Pesaro (Commune di Pesaro, 1999: 34 & 35)

REGIMI DI ORARIO	Popolazioni	Attività	Tipo di mobilità	Luogo
Durata continua di usi				
	Residenti	Residenza servizi di prossimità	Origine/destinazione zigzagante di prossimità	Il "borgo"
Calendario cidico con periodo				
Stagione	Turisti city-users residenti	Pubblici esercizi commercio alberghi intrattenimento balneare sulla spiaggia	Sosta passeggio origine/destinazione	Fascia a mare zona turistica balneare abitata stagionalmente
Giorno stagione	Residenti giovani	Passeggio	Lenta origine/destinazione	Spazio pubblico aperto
Stagione estate	City-users residenti	Balneare sulla spiaggia	Origine/destinazione	Spiaggia
Giorno settimana	Residenti	Sportiva ricreativa	Origine/destinazione	Centro sportivo
34 Feriale diurno giorno settimana anno	Pendolari residenti	Industriale artigianale	Origine/destinazione	Area industriale
Giorno settimana anno	Pendolari city-users businessmen	Terziario industriale magazzini commerciali	Origine/destinazione	Area terziario/industriale
Stagione	Residenti in loco	Agricola	Origine/destinazione	Area verde agricolo
Mese	Militari	Militare	Origine/destinazione	Caserma
Giorno settimana anno	Pendolari businessmen city-users	Ospedaliera commerciale centro direzionale campus scolastico	Origine/destinazione	Polo servizi
Tempo zero				
				Parco storico Miraflore
Durata continua di usi e calendario ciclico con periodo				
Durata continua di usi residenziali Calendario ciclico feriale diurno e serotino	Residenti city-users	Residenza commercio servizi	Zigzagante	Strada "dei quartieri"
Durata continua di usi residenziali Calendario ciclico feriale	Residenti pendolari city-users	Residenza industria artigianato commercio	Origine/destinazione	Area ad insediamento misto residenziale artigianale - industriale - commerciale
Durata continua di usi residenziali Durata continua di attività portuali Calendari ciclici feriali stagionali	Residenti pendolari city-users	Ristorazione cantieri porto	Sosta passeggio origine/destinazione	Porto
Durata continua di usi residenziali Calendario ciclico feriale stagionale	Residenti city-users	Residenza	Origine/destinazione flusso di attraversamento	Ex Città Giardino
Calendario ciclico con periodo e accadimento				
Calendari ciclici con periodo: stagione e anno Accadimenti occasionali Grandi eventi	City-users residenti	Sport spettacolo	Origine/destinazione	Grande impianto sportivo
Calendario ciclico con periodo: anno Salone del Mobile	Businessmen	Fieristica congressista	Origine/destinazione	Impianti per esposizione e sale riunioni
Calendario ciclico diurno serotino, notturno stagionalmente con periodo: giorno, stagione Accadimenti evenemenziali e occasionali	Residenti city-users businessmen militari	Passeggio sosta incontro ricreazione	Origine/destinazione lenta	Cardo - Decumano Spazio publico aperto
Durata continua - calendario ciclico con periodo - accadimento				
Durata continua di usi residenziali Calendario ciclico feriale diurno e serotino con periodo: giorno, settimana, anno Calendario ciclico festivo con periodo: anno Accadimenti evenemenziali e occasionali	Residenti in loco pendolari turisti city-users businessmen	Residenza commercio artigianato servizi amministrativi servizi alla persona culturali spettacoli musei religione ricreazione passeggio associazionismo	Origine/destinazione lenta e zigzagante di prossimità	Centro storico

Figure 12 is the prototype of a chronotopic map (Commune di Pesaro, 1999: 34 & 35).

A similar analysis has been produced for a quarter in Paris, Châtelet-les-Halles. The presence of a metro-RER station is the reason why the RATP has been interested in the daily cycle of commercial activities and flows of pedestrians (as will be shown in the next section, the RATP is interested in organizing transport according to the 'new urban rhythms') See also Laousse (2003). Figures 13 shows Châtelet-les-Halles at different hours of the day.



Temps de la ville

Il est 8 h, Les Halles s'éveillent

Activité commerciale et flux de piétons, une mission d'exploration commanditée par la RATP écoute battre le pouls du quartier des Halles, à Paris.

La RATP s'intéresse aux nouveaux rythmes urbains. C'est tout l'objet de la mission d'exploration des «temps de la ville» développée sur le quartier Châtelet-les-Halles, à Paris. Cette mission pluridisciplinaire est coordonnée par Alain Guez, un architecte-urbaniste installé dans le III[e] arrondissement. Heures d'ouverture et de fermeture des activités commerciales, relevés visuels des flux «directs» (généralement des actifs…) ou zigzagants (plutôt inactifs…), évaluation du nombre de gens qui entrent dans le métro ou le RER selon les heures, etc.: l'équipe traque les rythmes du quartier à partir d'une méthodologie développée par les chercheurs du Politecnico di Milano. En Italie, où l'on s'intéresse depuis longtemps à l'impact des rythmes de la ville sur la qualité de la vie, cette faculté d'architecture fait figure de pionnière. Le professeur Sandra Bonfiglioli, directeur scientifique, y anime l'aire de recherche en urbanisme des temps et de la mobilité. Son équipe a notamment travaillé sur la meilleure façon de rendre sensibles les relations entre les lieux et les rythmes urbains. Elle a développé un vrai savoir-faire en matière de systèmes «chrono-cartographiques», des outils mariant phénomènes temporels et cartographie. Les résultats sont spectaculaires, comme en témoignent ces images. *«À partir de ce travail exploratoire sur un quartier très complexe à appréhender, l'idée est de développer des outils qui puissent facilement être transférés dans d'autres lieux»*, explique Alain Guez.

Si la RATP reste maître d'ouvrage sur ce projet, ce travail de prospective n'est pas dénué d'intérêt pour d'autres acteurs de la ville, notamment la municipalité de Paris, qui s'y intéresse de près.

François Kermoal

À 8 heures du matin, le quartier commence à peine à s'animer. Les activités commerciales ouvertes (repérées ici par des points jaunes) restent encore relativement limitées

À 8 heures, on commence aussi à appréhender nettement les flux de piétons qui se rendent à leur travail. Certaines artères sont nettement plus empruntées que d'autres

Midi. Le commerce bat son plein. À partir des activités commerciales, il est presque possible de reconstituer le plan du quartier

23 heures. Le quartier commence à retrouver son calme. L'activité commerciale ne cesse toutefois pas pour autant

Fig. 13. Châtelet-les-Halles at different hours of the day

How does the chronotopic analysis relate tot the preceding areas of search for new instruments of planning and design? This kind of analysis would enhance emergent network-based concepts as well as 'reread' classics. Chronotopic analysis in itself, too, would constitute an important avenue research for a design studio 'Network City'. But the preceding areas of search may also provide directions for further developing the chronotopic analysis. This also holds for 'mobility in prospect' to be dealt with in the section that follows.

Urban time policies started before the rise of ICT. The chronotopic analysis does not seem to incorporate ICT properly yet. To do so, should not be too complicated if one takes for example the design proposals for the Hudson County Cyberdistrict as a starting point. It is important to integrate ICT because it supports the development of new temporal regimes.

Urban time policies, if they have a spatial dimension, are essentially geared to site planning. Urban planning and design, however, also deals with the urban whole or claims to do so. This requires links with urban technological networks. See levels one and two of the 'Network City' (figure 1) or examples from emergent network-based concepts (figures 8 and 10). Mobility, too, is a clear case at hand. Chronotopes include people and goods moving in daily, weekly and annual cycles. These moves may have origins and destinations elsewhere in the city. When the RATP has commissioned a chronotopic study of Châtelet-les-Halles it has concluded that, despite the new insights gained from this kind of analysis, further developments are needed leading to a so-called multilevel spatio-temporal navigation as shown in figure 14 (Laousse, 2003: 154). This includes levels above and below the level of the chronotopic analysis. See also Bailly (2002). Urban time policies, on the other hand, already extend to 'mobility agreements' as demonstrated by the case of Bolzano (Commune die Bolzano, 2000). This brings us to our final topic.

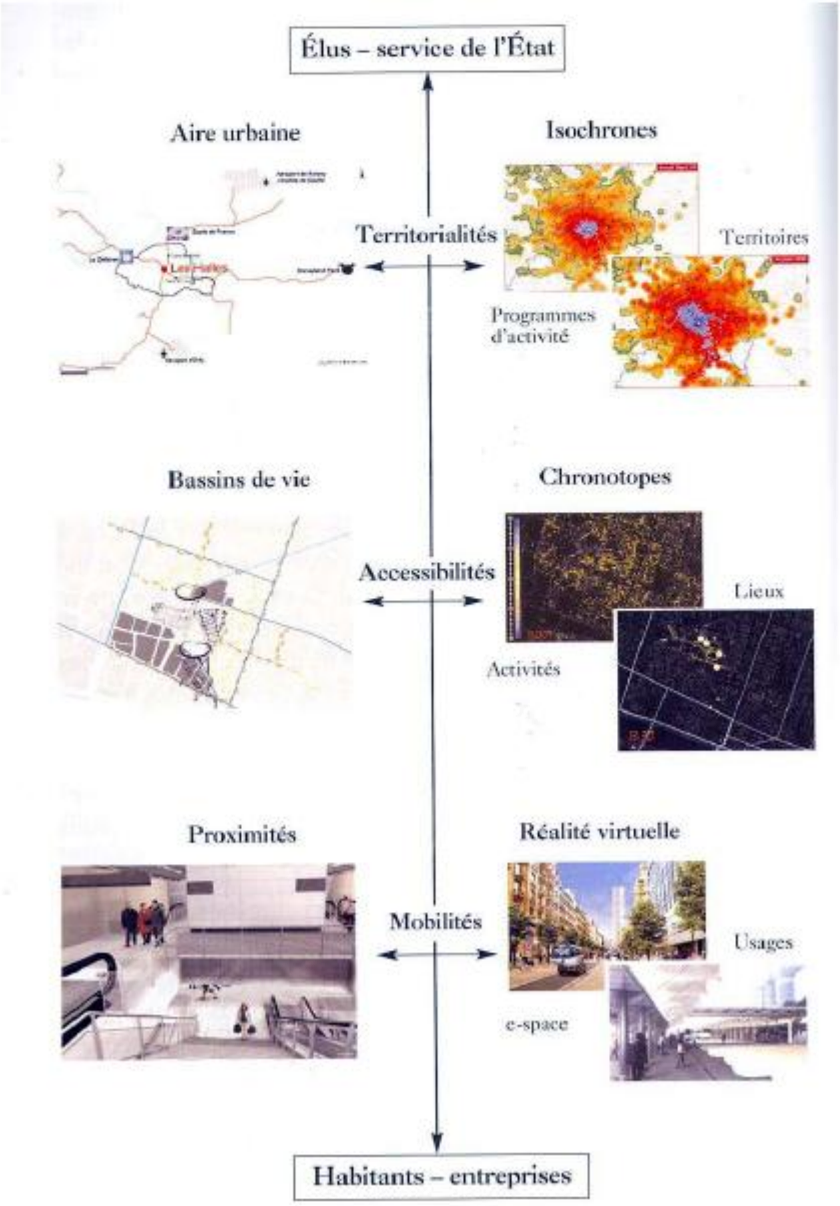


Fig. 14. A modular system of spatiotemporal navigation (Laousse, 2003: 154)

7.5 Mobility in prospect

Throughout this essay, mobility has been an integral part of dealing with time in urban planning and design. In fact, the 'Network City' as a new paradigm translates into an integrated planning of land use and urban technology systems, including those catering for mobility. The latter, however, is not going to stay the same. Mobility, in prospect, has to cope with new urban rhythms. Bailly and Heurgon (2001) from RATP provide directions for future mobility. This includes ICT, not as a substitute for transport, but as an element of choice and convergence (Drewe, 2003). The scene is set by the evolution of urban rhythms before tackling mobility as the target of urban time policies, following French and European, and in particular Italian experiences.

The evolution of urban rhythms has some important consequences for the mobility of passengers:

- mobility increases and becomes more complex,
- trip motives change,
- leisure time and tourism multiply the number of occasional trips,

• big events impact the rhythm of urban life,

• activities become more complex and less regular,

• urban populations are segmented into minorities of hypermobile (nomade) and sedentary populations and a majority of those who display an average level of mobility,

• in a mobile society, immobility is a primary cause of exclusion,

• a mobility education is needed,

• accessibility for all is at stake.

The implications for the organization are that peak hours will stay, but quiet hours will decrease and a continuous function of transport is called for with more tailor-made services. It will not be easy for existing public transport to adapt. Nevertheless the report informs about various initiatives to adapt services to the evolution of urban rhythms. The use of ICT is part of these initiatives.

(By the way, Bailly and Heurgon (2001) also deal with the mobility of goods and entrepreneurs are considered as important actors with regard to mobility. This is in line with the dual notion of space-time analysis adopted in this essay).

By way of conclusion, future mobility -in line with the evolution of urban rhythms- requires:

• new approaches to mobility research (models, mapping such as chronotopes and monitoring),

• innovations in mobility services which ask for concerted actions of different players,

• new regulations.

Let us single out the rethinking of concepts and evaluation criteria applied in today's urbanism and transport policy.

Density, for example, can no longer be used as an indicator of potential exchange unless it is combined with accessibility (taking into account different speeds, from pedestrians tot electrons, and different kinds of transport, i.e. passengers, goods and information). The **continuity** of the built environment, used to delimit politico-administrative boundaries, needs to be revisited as passengers travel beyond 30 km/h. **Physical proximity** or **distance** become less important. As the growth of distance covered by trips correlates with the growth of speed, access time becomes

preferable to distance. A nearby place can be less accessible than a place far away. A final example is geographic **centrality** which within an agglomeration no longer guarantees accessibility. It can even be a handicap for private-car users. New centralities emerge at nodes of interconnection and multimodal platforms polarizing various urban functions. As a consequence, the notion of inner city or city center changes. Notions more operational in future are polarization, functional specialization and thematic concentration. Hence (future) mobility clearly tends to clash with conventional urban planning and design once time is taken seriously in the ICT age. The paradigm challenge becomes even more urgent.

8 EPILOGUE

In 1969 Hägerstrand, the founder of the space-time model, presented a paper to the European Congress of the Regional Science Association in Copenhagen entitled 'What about people in regional science?'

'Historically, social scientists studying the effects of space on human behavior tended to treat time as an external factor, something that is relevant to understanding a given phenomenon, but not essential. Activity choices were seen being made in the context of distance alone such as with the gravity model, and often these decisions were seen in an aggregate sense, with individual decisions viewed as minor variations of those of larger zonal-based groups' (Corbett, 2003: 1).

Does not the question 'What about people?' also hold for conventional urban planning and design? Does not asking 'What about time?' bring back people in urban planning and design? This is most clearly proven by urban time policies. The chronotopic analysis reveals echoes of the past, present rhythms and the simulated presence of the future (Laousse, 2003). What better way of answering Lynch's time-honored question 'What time is this place?'

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Managing change: lessons learned in case studies on revitalising old industrial sites in European cities

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ABSTRACT

Due to global economic change, European cities have to deal with a transition from 'centres of production' to 'centres of services'. Managing this transition poses an immense challenge to cities and in particular to old industrial cities. This translates to a reconfiguration of the social and physical landscape, because traditional industries disappear leaving unemployment and derelict sites in the midst of cities.

In the course of the EU-project MASURIN (Management of Sustainable Revitalisation of Urban Industrial Sites), our research team conducted six in-depth case studies on former industrial sites in Gothenburg (S), Liverpool (UK), Lisbon (P), Berlin (D), Steyr (A) and Barcelona (ES), collected environmental, social and economic data and analysed the management process in each case. This paper critically analyses the impacts of change and the management of change in two cases studies, namely 'Am Borsigturm' in Berlin/Germany and 'Speke Garston' in Liverpool/United Kingdom. The two case studies exemplify that revitalisation processes differ from case to case and significantly depend on the political and administrative framework, funding mechanisms and the ability of stakeholders to co-operate effectively. However, even though each city chose a slightly different redevelopment approach, certain key factors and approaches need to be in place that allow cities to react to changes and to redevelop old industrial sites in a successful and sustainable manner.

The second part of the paper deals with lessons learned in all six case studies. The cases illustrate that in complex systems such as cities local circumstances, stakeholders' views and the types of organisations involved play a major role. Thus, open communication, learning throughout the process, trust, and close coordination among private and public stakeholders are essential factors in a successful revitalisation process. Several stakeholders emphasised the importance of remaining flexible in an ever changing market and adapting to the circumstances as they arise. Following a vision and a concept helps to give the process continuity and orientation, whereas rigid masterplans and over-regulation compromise flexibility and an adaptive response to changes. In the long run, the creation of resilient neighbourhoods and a sustainable urban form are necessary. Remaining flexible and adaptive throughout the redevelopment process and creating mixed use sites that are successful for the long term within a functioning public-private partnership framework are some of the major lessons learned in revitalisation processes and are basic requirements for cities in managing change.

1 INTRODUCTION

Cities are constantly affected by change and need to find effective mechanisms to deal with social, economic and environmental change. More specifically, many old industrial cities in Europe are left with former industrial and now abandoned, derelict and often contaminated urban sites in their midst. Stakeholders in urban areas need to tackle all issues critical on such a site simultaneously in order to improve environmental conditions, attract companies and create jobs. Our research team conducted six in-depth case studies on former industrial inner-city sites in European cities and scrutinized the mechanisms which lead to a successful revitalisation.

The urban system has been profoundly affected by the changes about which all geographers write: the increasing globalization of the world; and the informationalization of the economy, the progressive shift of advanced economies from goods production to information handling, whereby the great majority of the workforce no longer deal with material outputs (Hall 2003). For many European cities with old industrial sites, the transition from 'centres of production' to 'centres of services' had and in many cases still has a tremendous impact on a city's image, labour force and the spatial and socio-economic framework. Traditional industries have become obsolete or moved to suburban regions or countries with less expensive labour costs. As is demonstrated by our case studies, cities have to cope with the consequences of those changes such as social decay, joblessness and environmental contamination. Old industrial sites often lie on prime real estate in the core of a city and cities could derive multiple benefits from reusing those sites such as recycling and decontaminating land, reducing greenfield development and offering attractive jobs in city centres (Collaton and Bartsch 1996, Koll-Schretzenmayr 1999, Tomerius 2000). However, revitalising derelict inner city sites represents a major challenge for a city and is afflicted with many uncertainties and unknowns. Thus, a number of important questions arise: how should we deal with uncertainties in planning? Which management approaches and instruments should be chosen and how can sustainable and long-lasting change be achieved in highly complex and long-term redevelopment projects?

In this paper, we critically analyse and describe two case studies of Berlin 'Am Borsigturm', Germany and Liverpool 'Speke Garston', United Kingdom highlighting the impacts of a changing economy on labour markets and its socio-economic, political and environmental consequences. We then analyse how the cities dealt with uncertainties and change emphasising successful management approaches, the role of partnerships in a multi-stakeholder setting and the need to involve the public and the private sector. Lessons learned in the section that follows draw attention to key similarities and success factors found in all six case studies such as flexibility, adaptability and the capacity to co-operate which enables cities to create long-lasting and positive change.

2 METHODOLOGY

The research team chose the case study analysis, because it enabled the team to conduct an in-depth comparative analysis of six different revitalisation examples. The case study method applied provided a scientific approach for integrating quantitative and qualitative knowledge (Scholz and Tietje 2002).Case study research does not primarily aim to discover a universal, generalisable truth, but to explore, understand and describe complex, contemporary phenomena such as revitalisation processes on inner-city sites. The initiation and the process of a revitalisation project strongly depend on setting and context. A case study allows an investigation

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of a phenomenon within its real-life context, especially when the boundaries between phenomenon and context are not clearly evident (Yin 2002). Even though universal rules cannot be derived from case studies, contextual analyses, extensive data collecting and interviews allow a systematic way of looking at each case and enable researchers to learn about mechanisms which may be valid under similar circumstances. In order to achieve valuable and reliable results, certain principles have to be regarded.

At the beginning of the analysis, the most important steps were to determine research questions and to select suitable and representative cases. A list of criteria was generated, which allowed the research team to separate relevant cases from those that were not suitable. In this initial screening phase, most cases could not be accepted for further analysis, because one criterion required some industrial reuse of the site. However, typical production-oriented industrial uses are rare and usually make up only a small fraction of all uses on a given site. Once the cases were selected, appropriate contact persons who also had time and resources to share information with the research team had to be found. The research team then developed a standardised 'data needs' sheet, which is particularly essential in analyses of multiple case studies. The data needs sheet fulfilled a two-fold function: first, it served as a guiding document for the interview process and was sent to interview partners prior to the interviews. Secondly, it presented a necessary framework to organise the evaluation, analysis and description of the cases.

In order to improve validity and reliability of case studies, Yin (1994) proposes to use multiple sources of evidence, to establish a chain of evidence, and to have a draft case study report reviewed by key informants (cited in: Tellis 1997). The research team conducted literature searches, collected data from various sources and conducted on site-visits and interviews with different key individuals (from the private and public sector). The most valuable source of information were the interviews with 3-7 individuals per case study, which made a total of 30 interviewed persons. Interviewees included project managers at developer firms, a director and planners and engineers at city administrations, managers of regional and local agencies and organisations, a public relations manager and researchers. Each interview was recorded on tape and conducted by two researchers. This allowed researchers to jointly review interview results and thus enhanced reliability and robustness of the conclusions drawn from the case studies.

Multiple cases strengthen results and increase confidence in the robustness of the theory (Tellis 1997).Conducting six different case studies helped researchers derive certain similarities and patterns as to how cities deal with change exemplified through revitalisation projects. Studying and comparing different cases provided the research team with in-depth knowledge about revitalisation processes, best practices and lessons learned. At the end of the case study analysis all interviewees were asked to review and comment on the draft version of the research results. This feedback helped improve the quality and reliability of the study.

3 TWO CASE STUDIES

3.1 Case study 'Am Borsigturm' in Berlin/Germany

3.1.1 Impact of change

The 15 ha site 'Am Borsigturm' lies in the North-western part of Berlin/Germany in the district Reinickendorf (see figure 1). Since the 1830s, this site has been used for industrial production such as locomotives produced by the famous entrepreneur family Borsig. 100 years ago, the Borsig company was a symbol for economic growth in Berlin. More than 14,000 locomotives were produced in the factories on the site and exported to the whole world (Birk and Engel 2000). In the early 1920s the first high-rise building of Berlin was erected and named the "Borsigturm". To this day, it remained the landmark of the site.

For economic reasons, production of locomotives in Tegel stopped in 1930, but other industrial activities on the site continued. Due to economic change, production on the site declined little by little. Only a few new companies moved there and by that time large parts of the site had already deteriorated. After the fall of the Berlin Wall, rapid structural changes took place. Berlin had been an enclave in the middle of the GDR (German Democratic Republic). This meant protection and support for companies which where willing to stay in West-Berlin, but it also restricted the potential for further development. After reunification, companies and investors were expecting a booming market in Berlin. Although the site 'Am Borsigturm' was a contaminated industrial brownfield at the beginning of the 1990s (see figure 2), it also was a site with high development potential: it was a famous, well-known site embedded into the urban fabric with an excellent location next to highways, railways and underground transportation.

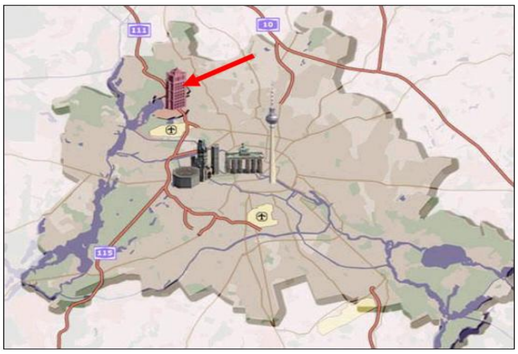

Figure 1: Location of the site 'Am Borsigturm', http://www.am-borsigturm.de

Figure 2: Site 'Am Borsigturm' in 1992, Birk and Engel, 2000

The impact of change was dramatic. In the span of a few years, industry had to adapt to completely new market conditions. Due to speculation, land prices rose rapidly which forced industries and residents to leave the city and move to the suburban region. Derelict sites remained, and large investors and companies failed to appear.

Physical/Environmental impact

> The site 'Am Borsigturm' is situated in an excellent location: near the Tegeler Lake and with direct access to highway, railway and metro. As a derelict site, it had negative effects on neighbouring areas. The site was not accessible for residents and was an eyesore for the whole district. Due to its former industrial use, the site was partly contaminated and represented a long-term environmental risk.

Impact on image

> The loss of companies and population also means a loss of image for the city. After the city's borders were opened, industries and residents moved from the city to the suburban region of Berlin. Between 1993 and 2000 Berlin lost 93,000 of its residents. Now the population stabilised. Image is an important factor in the severe competition on a global market. International investors can choose between several cities, which have the image to be "global cities" (Sassen 1996). If sites deteriorate and companies and residents move away, cities become unattractive for global players on the market. For Berlin as the new capital of a reunited Germany, the image of the city was crucial for attracting investors and new companies.

3.1.2 How did the city deal with change?

In 1992, Herlitz AG succeeded in the competition for the site 'Am Borsigturm' and bought the site expecting a high profit. It founded Herlitz Falkenhöh AG (later RSE Projektmanagement AG) as a subsidiary to develop the site. Due to rising prices on the land market, the Berlin Senate decided to develop a concept, which was supposed to help stabilise land prices for industrial land and thus maintain industry within city borders. In November 1992, the site became part of this initiative called ISK (Industrieflächen-sicherungskonzept), which meant a restriction to industrial use only. Further barriers for the developer RSE were: preservation of historic buildings, uncertainty in the degree of contamination afflicting the site, environmental requirements, zoning, integration into neighbouring uses and the general economic situation in Berlin. RSE embarked on a strategy to develop the site in intensive co-operation with the City of Berlin, which was essential for successfully implementing the revitalisation concept. The transformation of the derelict site into a modern attractive location was only possible with the approval and support of the public administration. Additionally, neighbouring areas which had to be considered in a holistic concept for transformation belonged to the city of Berlin. Thus, an intensive public-private-partnership between RSE and the city of Berlin was a crucial precondition for a successful revitalisation.

Besides the need for co-ordination with the public administration, RSE was highly dependent on the market and the demands of potential investors. To fulfil the needs of the market and of the city, a mixed use concept was chosen. In the meantime, the ISK-concept was revised and the restriction to exclusive industrial use was lifted: uses were broadened to include production-oriented services. The concept at one time had been successful in stabilising land prices for industrial land, but it also became evident, that it did not take into account actual market needs and thus was no longer appropriate to satisfy current needs. The city of Berlin realised that it made no sense to conserve the prior conditions and adapted its strategies and plans to the changes. The changed economic situation was also an important issue in the discussions and negotiations between RSE and the city. The central question for the city was: How does manufacturing change in the city and how should the city react to economic changes (Birk and Engel 2000)? The revitalisation concept was adapted to modern requirements of light industry and production-oriented services.

To realise the vision of a mixed use site, the area had to be opened to the population. The site was to be reintegrated into the urban fabric, but without neglecting its industrial history. Refurbished historic buildings became the brand of the site (see figure 3). The revitalisation of the site was a process, where the direction was clear but the approach as to how to realise the vision was uncertain. Many sceptics also doubted whether the process would be successful. Shop-owners of neighbouring streets were afraid of the competition with large shopping facilities on the revitalised site. Thus, surveys, demand analyses and architectural competitions were conducted before deciding on the ultimate mix of uses on the site. In the end, the following uses were realised: residential (206 flats), shopping ("Hallen am Borsigturm"), a health care centre, recreational and leisure facilities, restaurants etc. The high quality architecture substantially improved the image of the site and was honoured with special awards for excellent refurbishment.

Figure 3: Aerial view of the site 'Am Borsigturm' during revitalisation process, Birk and Engel, 2000

In 2003, the revitalisation process was approximately 80% complete. The site was cleaned-up, the quality of open space has improved, and historic buildings were preserved and adapted to new needs. 'Am Borsigturm' became a truly mixed use site and a new economic centre of north-western Berlin.

3.2 Case study of 'Speke Garston', Liverpool, United Kingdom

3.2.1 Impact of change

The city of Liverpool had several run-down and derelict neighbourhoods with high unemployment rates and a lack of job opportunities. Speke Garston, the case study site, was one of the hardest hit areas situated in the south of Liverpool with poverty, unemployment around 23% and few opportunities for locals to obtain jobs (http://www.sgp.org.uk/sgp.htm 2004). The site has a population of 23,400 and encompasses industrial, residential and commercial areas as well as green space, sports and leisure facilities. Accessibility to the site is excellent; several bus lines, rail lines, and national motorways connect the site with the rest of the city and surrounding areas (see figure 4). The Port of Garston is nearby and the Liverpool Airport is also located adjacent to the site.

Figure 4: Speke Garston the Liverpool Region, Speke Garston Development Company, 2002a

Brief historical background

Conditions in Speke Garston are the result of major ups and downs in the economy over a span of decades despite a long succession of attempts to regenerate derelict neighbourhoods in Liverpool (Meegan 2004, Ireland, oral comm., 2003). The city has a long history of having to deal with substantial economic and social change. At the turn of the 20th century, the city was known as a regional and national port and trading city and was at the peak of its economic power. As global trade closed down during the inter-war years, the city's economic stronghold began to crumble because global trade came to a halt (Misselwitz 2004). A recession with high unemployment followed that was counteracted by land purchase programmes to enable industrial development on the outskirts of the city. Housing relocation programmes to new towns such as Speke Garston at the periphery were supposed to clear slum housing and improve housing conditions after the Second World War (Misselwitz 2004). Neither of these measures succeeded in helping Liverpool achieve its former economic glory. In the 1960s, a national relocation programme for national and multi-national corporations moved a lot of companies to Liverpool, created jobs and helped alleviate poverty (Misselwitz 2004). However, this second wind only lasted a decade when the social and housing problems created through relocation to the outskirts and a major die-out of local businesses in the city centre combined with a general economic downturn in Britain initiated the next major wave of decline. The city of Liverpool lost half of its population since the 1930s. Between 1978 and 1991, 37% of jobs disappeared in Liverpool despite numerous urban policy initiatives to reverse the decline (Meegan 2004).

Socio-economic impacts

The general economic downturn in Liverpool also affected Speke Garston, because many companies abandoned the site and moved operations overseas or elsewhere in the region. New firms could not be attracted because of the area's poor image and lack of job skills in the local population. Without a major upgrade of the Liverpool airport, companies exhibited no interest in locating in Speke Garston (Green, oral comm., 2003). Extremely high unemployment rates and high crime coupled with a work force that to a large extent either had no skills at all or needed to be retrained represented an insurmountable hurdle to agencies responsible (Spencer, oral comm., 2003).

Physical and environmental impacts

High unemployment rates in the local population over decades also affected the area physically. Neither the city nor owners of houses or apartments were capable of investing in upgrading the housing stock or keeping the area from deteriorating further. The city was unable to invest in infrastructure improvements, maintaining green space or offering good public transport to the local population. Clean-up of contaminated sites from industry (e.g. tanning operations) that had left the site was equally impossible due to lack of funds.

3.2.2 How did the city deal with change?

The above brief chronology of how change affected Liverpool exemplifies what the city and its population has had to endure in the last century. It also illustrates that numerous attempts made up until the early 1990s to respond to change such that neighbourhoods and the city as a whole can regain their former economic power proved fruitless in the long run (Meegan 2004). In 1993 Liverpool received Objective 1 status as one the poorest areas in the European Union with only 75% of average EU GDP. At that point, the City of Liverpool together with a national agency called English Partnership, responsible for promoting regeneration projects across England submitted a successful bid for UK and EU Objective 1 funding to support the establishment of a regeneration agency called Speke Garston Development Company (SGDC) in 1993 (Ireland, oral comm., 2003).

Holistic management approach

This influx of money enabled the subsequent establishment of a joint venture developer firm, limited by shares that would be responsible for upgrading the physical environment including infrastructure, road corridors and other common areas. That in turn would allow the company to engage in its second major task which was to promote Speke Garston's strategic sites to attract large-scale investments to Liverpool (Speke Garston Development Company 2002a). The new regeneration developer company and its partner agencies knew that simply attempting to redevelop the site without simultaneously tackling high unemployment rates and poor housing conditions in the area would prove as insufficient as all other one-dimensional approaches in the past. This time, they wanted to design a holistic approach capable of creating long-term positive change for the area that would attract companies to Speke Garston, reduce unemployment through training and empowerment initiatives and improve the housing stock (Speke Garston Development Company 2002a).

Therefore, a consortium of project promoters including the City of Liverpool helped establish two additional organisations, the Speke Garston Partnership (1995) and South Liverpool Housing (1999) funded through EU Objective 1 money and EU and national funds respectively. The Speke Garston Partnership (SGP) is in charge of establishing training and education programmes. They also address issues such as community safety, childcare and health thereby empowering the local population (http://www.sgp.org.uk/sgp.htm, 2004). South Liverpool Housing (SLH) is responsible for managing and upgrading 3,700 homes and for creating a safe and people-friendly environment (http://www.slhgroup.co.uk/).

Revitalisation Status

All three organisations in charge emphasised that this holistic and integrative management approach proved to be the right combination to create real and long-lasting change for the better. SGDC attracted large pharmaceutical and automotive companies such as a Jaguar production plant, numerous SMEs including suppliers and retail firms to the New Mersey Shopping Park (see figure 5) (Speke Garston Development Company 2002b). They also restored several historic buildings and created e.g. a business village out of the former Bryant & May match factory. The airport of Liverpool was privatised and Objective 1 funding helped convert and rebuild it. Liverpool is moving up the league table of U.K. airports and today is one of the fastest growing in Europe (http://www.liverpooljohnlennonairport.com/about_us/index.html?history). In total, the company improved 192 hectares of land (Speke Garston Development Company 2002a) and planned to create 278,000 m^2 of new industrial and commercial accommodation and 9,300 full-time jobs. The Speke Garston Partnership created two very successful education and training programmes to enhance employability of locals and reduce unemployment figures. The two programmes called JET (Jobs, Education, Training) and Partnership for Learning helped 4,000 people find jobs and trained 16,000 individuals through a diverse range of courses (http://www.sgp.org.uk/sgp.htm 2004). SLH has become a very successful and respected housing association that fulfilled all its major objectives such as refurbishing homes and establishing several youth and community initiatives in the first 5 years of the programme.

Figure 5: Speke Garston regeneration area, Speke Garston Development Company, 2002a

In 2003, the revitalisation process is still on-going and will continue for many years to come, although Objective 1 funding will likely end in 2007. According to company officials, they created change through this partnership approach. Unlike project promoters in the past, it was crucial that new partners recognised that successful regeneration takes years to develop and understood that provisions need to be put in place that ensure a successful continuation of a regeneration process so that programmes initiated are finalised or supported until they are self-sustaining or no longer necessary. Speke Garston is thus well on its way of once again becoming an attractive business location and living environment.

4 MANAGING CHANGE – LESSONS LEARNED

As the description of the two selected case studies demonstrates, a universal recipe for a successful revitalisation process does not exist. History, site conditions, funding mechanisms and regulatory framework fundamentally influence options for redevelopment. However, similarities and principles can be derived from six European case studies.

Although the cases researched turned out to be good practice examples, they revealed risks, pitfalls and challenges that often occur in the course of a revitalisation process:

Financial aspects:

- high costs for clean-up, refurbishment, preservation of historic buildings etc.
- liability issues regarding contamination
- high dependence on funding: on very derelict sites initial funding is essential for starting revitalisation processes.

Concepts and instruments:

- misbelief that "one concept fits all": instead a concept has to fit to the conditions and framework given in each specific case.
- insufficient integration into the existing urban fabric
- short-sighted and inflexible planning and instruments

Conflicts between public and private interests:

- excessive and rigid zoning and environmental requirements
- bureaucracy
- private profit maximisation neglecting long term sustainable development

Partly, our case studies were also afflicted with some of the risks, pitfalls and challenges mentioned above. But in the course of the revitalisation process that lasted decades the cities and developers managed to overcome those obstacles. Interviewees from different case studies emphasized similar principles, which have to be in place for a successful revitalisation. The following section reports major lessons learned in our study of revitalisation processes in six European cities.

4.1 Vision and leadership

In many cases, revitalisation is a long term process with many ups and downs. For implementation, a vision and a visionary are needed.

First, having a clear vision of the desired goal, which is also communicated to and in the ideal case shared by all stakeholders, is a necessary ingredient to move change in a particular direction (Senge 1990, Wiesbord 1992, Wiesbord and Janoff 1995 in: Costanza 2000). Following a vision does not mean that the process will not be adapted to new circumstances and market conditions, but it helps giving it continuity and orientation. Holding on to a vision makes it easier to communicate a concept and a strategy to different stakeholders and to make them believe in the project. Strong values and a vision are essential components in the sense-making process for management of complex systems (Olsson et al. 2003).

Secondly, visionaries or key leaders are needed who believe in a project's future success and are willing to move through the cycles of the process (Swiss Federal Office for Spatial Planning 1999). In most of our case studies, developer companies assumed the role of leaders.

In the case of Berlin, the vision of a mixed use site steered the whole revitalisation process. The details of the concept were adapted throughout the process, but the vision remained and was implemented successfully. The developer RSE can be seen as visionary in this case and was supported by other stakeholders such as the city of Berlin. RSE took the risk and believed in a prosperous future of the site 'Am Borsigturm'. RSE was the key leader of the whole revitalisation process and was fully responsible for the outcome.

4.2 Co-operation and trust

A revitalisation process is also a social process, where stakeholders from the public and private sector with very different interests are involved. Inevitably, conflicts and misunderstandings arise throughout the process when different stakeholders are not satisfied with any part of the revitalisation. The best way to harmonise conflicts between public and private interests and finding a common solution is frequent and open communication and co-operation among all stakeholders. Successful co-operation can also result in public-private partnerships through e.g. clustering of companies and educational institutions on the same site to encourage and foster collaboration.

Balancing varying interests through intensive coordination and collaboration is essential for reaching an accepted and robust outcome and let “win-win-situations” become more likely (Barton 2000). Therefore, trust among the stakeholders involved is a necessary precondition. Trust can develop in situations where all stakeholders openly communicate issues, can rely on each other, share a common vision, and most importantly participate in decision-making. Lack of trust between people on the other hand has proven to be a barrier to the emergence of collaborative arrangements (Baland and Platteau 1998 in: Olsson et al. 2003).

All our case studies illustrate that communication, co-operation and trust between public and private stakeholders are essential for an efficient revitalisation process and a sustainable outcome. In Berlin, all interviewees emphasised that good communication between city authorities and developers was instrumental in implementing the revitalisation successfully. Due to the rapid changes that occurred in Berlin in 1989, a close co-operation between the private and public sector was particularly important and helped all involved adapt to new circumstances more quickly.

4.3 Developer companies

In many cases, developer firms or agencies are in charge of revitalising derelict old industrial sites. Even though the initiative to begin with the revitalisation process often comes from the public sector, executing the actual mandate to revitalise is often placed in the hands of developer firms. Public administrations derive multiple benefits from putting developers in charge of redeveloping sites. In many cases researched the public sector is represented on the board of the developer company. In this role, authorities can exercise control over how the site is to be developed. Developers have to assume full fiscal responsibility for their actions which forces them to be profitable. Some are financed through a mix of public and private funding, others have to finance themselves primarily through the private market. Developers thus find themselves in a challenging role also because they have to strike a balance between public and private interests. Therefore, private developers have to respond to market conditions and work a lot more efficiently and with less bureaucracy than would be the case if e.g. city administrations were in charge of revitalising sites. Because of their position between the private market and public requirements, developers are forced to closely co-operate and collaborate with the public sector as well as many other stakeholders such as companies or investors. Thus, developers often represent the functional link between organisational levels and stimulate the interplay between different stakeholders.

The Speke Garston Development Company in Liverpool represented the centrepiece of the management approach followed in Liverpool. The holistic partnership approach between the developer company (SGDC), an organisation responsible for creating job training initiatives (SGP) and a housing association (SLH) proved to be crucial in the ultimate success of the project (see figure 6). Even though each partner had a clear and well-defined role and needed to implement its separate objectives and report to its respective board of directors, they closely co-operated, exchanged information and relied on each other throughout the process. The developer also cooperated with numerous other important stakeholders such as public agencies at the local, regional and national level in support of the revitalisation process.

Figure 6: Coming Together Sculpture, Speke Garston, Liverpool, http://www.leighspaints.co.uk/news/MerseysideSculpture.asp

4.4 Flexibility in complex processes

Revitalising old industrial sites in the middle of urban areas is a highly complex issue and confronts those responsible with major challenges (Tomerius 2000, Koll-Schretzenmay 1999, Stahl et al. 2001). Additionally, revitalisation is afflicted with many uncertainties, because it is impossible to accurately predict market developments such as the success of particular industries, or housing needs for the long term. The case study of Berlin illustrated the high level of uncertainty the city faced regarding its social and economic future.

Traditional instruments, such as blueprints and command-and-control approaches, have proved to be inappropriate for managing change, because they do not address the complexity and inherent uncertainties of the process (Folke et al. 2002, Adger 2003). Traditional instruments such as masterplans without provisions for modifications attempt to control change and are based on beliefs in linear processes and complete knowledge. *In contrast to a command-and-control approach, management that accepts uncertainty and seeks to build resilience can sustain social-ecological systems, especially during periods of transformation following disturbance* (Folke et al. 2002). As our case studies demonstrate, changes like the shift from production-oriented industries to services have a dramatic impact on cities and cause major disturbances in the previously fairly stable social, economic and spatial patterns. Such periods of change are perceived as crises, but they can also be seen as starting points for renewal. The best way to deal with or even benefit from sudden changes and uncertainties is to remain flexible and adaptive (Carpenter et al. 2001). Thus, policies and tools which try to steer such processes must also be flexible and adaptable. Continuous, feedback-driven reassessment of measures and actions and a comparison of current developments to the vision aimed at are essential.

The Liverpool case study illustrates how a regeneration process can be initiated and implemented successfully despite high uncertainties as to how the market would respond or whether training programmes for locals really would yield skilled workers. The Speke Garston Development Company wrote a very short masterplan that included e.g. clear guidelines of how to handle infrastructure upgrades that would occur at the very beginning of the process. However, it only very roughly specified planned developments for different areas of Speke Garston and left a lot of room for later modifications and detailed planning. They thus acknowledged that years later in the planning process, changes in plans would almost certainly be required in order to achieve the objectives set out at the start of the revitalisation process.

Adaptive management is a very promising approach for managing uncertainties. The instrument was conceived and first applied in the areas of environmental assessment and resource management to develop more effective and more resilient policies (Holling 1978). Gunderson (2000) states that *most policies are really questions masquerading as answers. Since policies are questions, then management actions become treatments in the experimental sense*. This view encapsulates part of the essence of adaptive management. The basis for this approach lies in the recognition that in natural and socio-economic systems as in urban systems, we often face incomplete information, uncertainty, unknowns, und unexpected events (Holling 1978). Nevertheless, we need to deal with uncertainty which requires the use of experiments allowing those involved in the experiments to assess successful and failing approaches (Walters and Holling 1990).

Adaptive management is a feedback-driven learning process (see figure 7) involving diverse stakeholders from different levels. If all stakeholders in a redevelopment process including the public sector demonstrate a level of flexibility and adaptability, the likelihood for succeeding in a very competitive regional and global market increases.

Figure 7: Adaptive Management Cycle
Source: http://www.fsl.orst.edu/ncama/intro.htm

Adaptive management is also a useful tool to build resilience in systems facing uncertainty (Folke et al. 2002). The term "resilience" was introduced by C.S. Holling in 1973 to better understand non-linear dynamics of ecosystems (Holling 1973). Today, the concept of resilience is also applied to socio-ecological systems. Resilience of social-ecological systems is determined by the magnitude of perturbations that they can absorb and still retain their overall function; the degree to which the system is capable of self-organisation; and the degree to which capacity can be built for learning and adaptation (www.resalliance.org). More resilient systems are able to cope with a higher level of disturbance and have the capacity necessary to re-organise when change is unavoidable (Quinlan 2003, p.4). Thus, managing for resilience can be an answer to the question of how to deal with change. If resilience and adaptive capacity are improved, vulnerability to change decreases.

5 CONCLUSIONS

Revitalising old, partially or fully abandoned and often derelict and contaminated industrial sites that are located in the middle of urban areas is and will remain an important topic for decades to come. Drivers of change in cities include changes in the global economy, a shift toward more service-oriented industry and a die-out of industrial sectors that have become obsolete. Cities with a high proportion of industrial sites in their midst are thus confronted with having to find ways and means to revitalise those areas, respond to changes and attract a diverse mix of uses to the site.

The two case studies of Berlin and Liverpool amply illustrate the challenges cities face when embarking on regenerating a derelict and contaminated site that also has a very poor image. The developer in close co-operation with the city of Berlin began to restore the site 'Am Borsigturm' in Berlin during a very turbulent period just after former East-Berlin was opened to the West. They simultaneously struggled with and benefited from the social and economic changes after the fall of the wall. A loss of jobs in the city in combination with residents moving to suburban areas to seek better opportunities contributed to worsening the situation. On the other hand, Berlin became a prime area for international, national and regional investment as it advanced to become the capital of Germany. The developer thus managed to realise a mixed use concept in only 10 years that resulted in new jobs, a balance of industry and SMEs and an attractive and more resilient neighbourhood popular with many Berlin residents.

The site 'Speke Garston' in Liverpool was in desperate condition after decades of economic struggles, high unemployment, high crime rates and numerous failed attempts to improve the situation. The influx of Objective 1 and national funding was the basis for the holistic approach embarked upon in the early 1990s. A developer company handling physical upgrades of the area and attracting new companies, an organisation responsible for establishing job training initiatives for locals and a housing association in charge of improving the housing stock were created to assume primary responsibility in regenerating Speke Garston. In less than 10 years, the three organisations were instrumental in creating long-lasting change. They created thousands of jobs, attracted companies such as Jaguar and SMEs to the site and substantially improved the physical appearance of the area. The process of adaptive change and regeneration is on-going and will continue for many decades and Speke Garston is bound to become an even more attractive working and living environment in the region.

All six case studies researched demonstrated the risks, uncertainties and challenges of each revitalisation project that need to be overcome and yielded numerous lessons learned in how to manage change in revitalisation processes. Visions and visionaries proved to be essential in guiding long-term revitalisation processes. In any successful regeneration project, stakeholders need to collaborate, co-operate and openly share information and participate in decision-making processes. Flexible and adaptive approaches were shown to yield resilient, diverse and mixed use urban neighbourhoods. Creating effective and long-lasting change is very much a long-term and highly complex process that requires many experts from a variety of organisations to work together collaboratively and in close partnership.

6 ACKNOWLEDGMENTS

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Intelligent GIS for Monitoring Systems Development

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1 INTRODUCTION

Currently GISs are being more widely used to solve problems concerning simulation of processes and situations in monitoring systems designed for different purposes. Meanwhile, as some sources note, application of universal GIS in monitoring systems is associated with a number of problems having different nature.

Development of mathematic, statistical and simulation models, data and knowledge bases, processing methods and then their integration with universal GIS results in the situation when cost of this work becomes equal and even exceeds the development cost of GIS itself. At the same time, development of a proper GIS accounting for all advantages, such as a complete source code and documentation set, do not always minimize the expenses while localizing the developed software even with one major customer.

Thereby an idea appeared to formulate several essential requirements to be met by the developed software for multi-purpose monitoring systems. Features of the development process are generally outlined by but not limited to the following requirements:

- easy and clear data and information access;
- smart and fast modification of the system's obsolete applications;
- quick integration of new applications into the work system;
- data standards and formats, and information support;
- reuse of software code and other resources;
- dynamic reconfiguration of the systems without new development and/or recompilation of the project on the whole;
- possibility of the IGIS operation on a separate PC, LAN and global networks.

These requirements result in considering GIS as a certain intelligent application with new properties, which satisfy the above requirements. From technological point of view, in order to develop similar GISs it is suggested to apply SOA concept, i.e. system decomposition into several services that enables receiving a system of relatively independent distributed applications that are as a rule independent of operating systems. Using of artificial intelligence systems based on the results obtained in expert systems is proposed in order to provide flexible adjustment of applications, realization of certain requirements and their change within certain limits even during the system's operation.

The paper's plan assumes consideration of the monitoring system (paragraph 2) as an automation object. Paragraph 3 considers the intelligent GIS concept. GIS construction on the basis of SOA concept is analyzed in paragraph 4. Paragraph 5 contains a version of intelligent GIS based on SOA concept. The conclusions demonstrate how the proposed technology meets the requirements of the above formed requirements for automation of multi-purpose monitoring systems.

2 MONITORING SYSTEMS

Monitoring concept and especially environmental monitoring quite often appear in specialized literature and great number of publications as well in mass media. This paper will consider environment oriented monitoring systems intended to support certain objects and/or processes. Supporting systems of different transport modes (air, marine, surface), environmental safety systems and some other can be assigned to such systems.

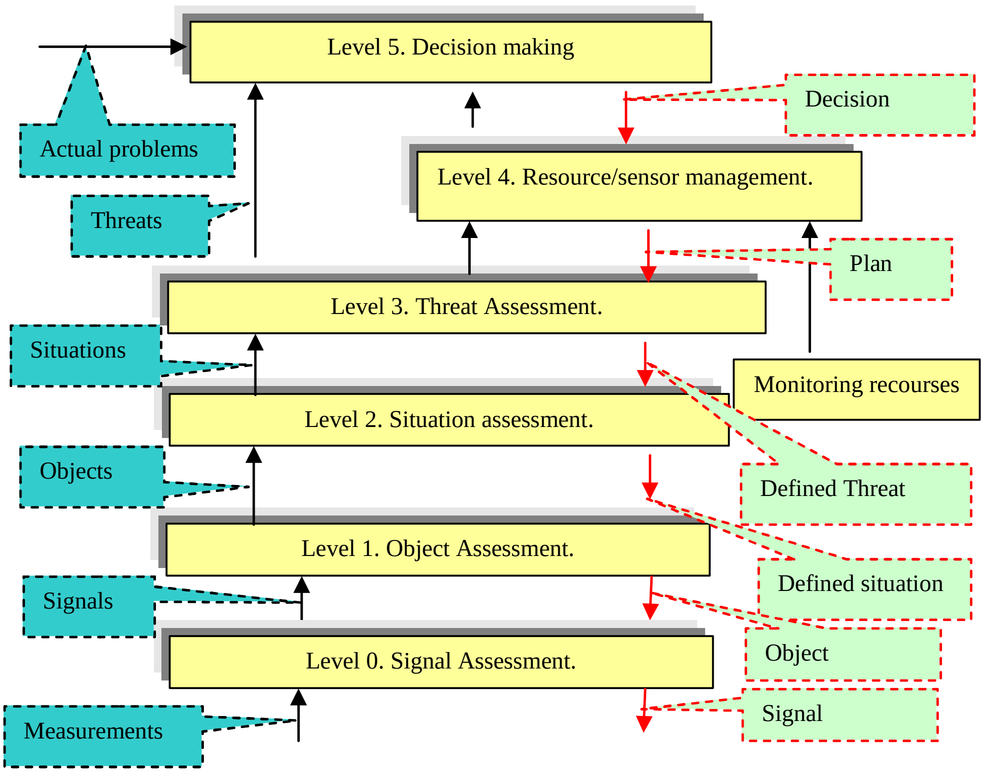
Specific but not complete characteristics of alike schemes are:

- the need to use different measuring elements for environment parameters and object parameters with given discreteness;
- the need to use diverse information of different nature from different sources, as a rule, multi-dimensional;
- the need to take decisions in a real time mode.

For the above systems the concepts like harmonization, integration and fusion of information (data) have a certain and determined sense. In this regard the main objective is an information fusion aimed to:

- reduction of data dimension (volume reduction);
- increase in accuracy and reliability of data (reduction of uncertainty);
- enhancement of data stability (correctness towards errors).

According to the main ideas of [6,8,9] a generalized model of information fusion for monitoring systems is shown in Graph 1. This model determines methodological and technical requirements for the developed computer facilities and systems including GIS.



Graph 1: Generalized model of information fusion in monitoring systems

This model became a foundation for verification of intelligent GIS development technology.

3 INTELLIGENT GEOGRAPHIC INFORMATION SYSTEMS

Challenges of the contemporary world such as nets of terrorist's organizations, refugees and immigrant's flows, drug traffic, ecological disasters, epidemic, computer viruses attacks – all these phenomena have a strong spatial aspect. Adequate studying of them requires spatial modelling and simulation. Purely mathematical simulation of spatial processes without visual representation ("blind" in a way), essentially decreases effectiveness of experts in discovering the patterns regulating these phenomenons. For visual representation of spatial simulation on the earth-scale Geo-information systems (GIS) are suited. GIS fast evolve from the simple browsers of electronic digital maps to the complex software applications capable of visual simulation of spatial processes in the real world. As level of the GIS applications is rising and their inner logic becomes more complex the use of conventional programming languages in their development turns into a constraining factor. They urgently need means of intelligent support, such as rule-based systems, ontologies, multiagent systems and other AI techniques, especially in the web applications.

Conventionally intelligent information technologies were used in the weakly structured domains where strict mathematical theories and detailed algorithms of the information processing do not exist. Numerous GIS applications are full of such domains. However, intelligent technologies can be applied to solve their inherent problems in geo-informatics, as well as to fast simulation and/or prototyping deeply parallel processes with quite well structured theories, like target detection, with good accuracy. For instance, if you want to control distances between 100 moving objects you have to check 5000 distances periodically. How often? It depends on a current distance between every pair of objects, their current speeds and many other factors. Algorithm would be quite complex for the conventional programming languages. Second example. How to represent a process of an oil spill after a disastrous collision of tankers? Every tiny parcel of oil is moving under influence of a sea current and a wind. Movement of the whole oil stain can be represented as an assembly of parallel processes. Recent expert systems use the famous algorithm Rete[1] specially designed to monitor hundreds of thousands parallel processes. Our research shows effectiveness of artificial intelligence technologies implementation for the simulation of complex spatial processes.

An adequate simulation of the complex processes in the geographical environment, such as the earth surface, world ocean, atmosphere an other, requires an intensive using of knowledge from the different fields. Developing of computer systems for such simulation must naturally include recent geo-information technologies, knowledge representation technologies and knowledge acquisition technologies. Intelligent geo-information system for modeling and simulation can be a final goal of this development.

Intelligent GIS is here defined as a complex software product including along with the GIS itself different artificial intelligence techniques for solving complex tasks including spatial simulation. These techniques are unified in a system based on a single knowledge representation and processing framework.

Central part of the IGIS is a *knowledge base* incorporating ontology, that is a framework for representing concepts and relations between them in an application's knowledge domain. Other part of the knowledge base is an object base, that is a storage of instances representing real objects in the application's domain. Universal IGIS must allow loading in the knowledge base different ontologies and object bases and thereby adapt to different domain applications.

Other important part of IGIS is an *expert system* or precisely knowledge inference engine. Usually this is a rule-based system capable of processing knowledge stored in the knowledge base. Rules themselves can be stored in the knowledge base as a part of the domain description. Knowledge inference engine can solve two tasks in IGIS. The first one is traditional for expert systems and consists in giving recommendations in the complex decision making situations. The second one consists in control of objects' complex behavior during simulation. Rete algorithm mentioned above allows to describe complex parallel processes by a set of distinct simple rules and simultaneously gives highly effective computer implementation of a simulation model.

Other parts of IGIS are traditional for GIS, namely, GIS Interface that is a software component for visual representation of the spatial data in different formats along with the objects stored in the knowledge base. Further are going different sources of the geo-spatial data and software components for information processing via traditional techniques.

Right now a common practice of the academic community is to share free not only ideas but also the software used in research and development. Main reasons for using free software packages in the research projects are as follows [12]:

1. Free of charge or low cost is obviously good. Besides, this fact allows trying different systems, selecting the best one, easy change from one to another. Expensive system as a rule fastens users to itself.

2. opinion; they readily include a new functionality upon the user's request.

3. In spite of widespread opinion, open source systems possess sufficient reliability, because in a process of the development they experience a hard testing from many voluntary testers.

4. Commercial software companies also publish free open source products to have their new ideas tested, and it is naturally indeed to use them in advanced research projects.

Distinguishable place among the open source packages distributed through the Internet occupy the programs written in Java programming language. Java programs are really portable and work on different platforms directly. Besides, Java language has many special features for an integration of different programs. Taking this into account, we developed a research prototype of IGIS for simulation and modeling using three open source software products in Java language distributed free through the Internet:

1. Knowledge base developing instrument Protégé [5]

2. Expert system shell Jess [4]

3. Geo-information system developing tool OpenMap [7].

Protégé has quite useful framework for augmenting functionality on a basis of loosely coupled software modules, called plug-ins. Now Protégé has about 60 plug-ins.

To support a visual computing simulation of the different processes we have also developed another plug-in for Protégé. Main functions of this plug-in include creation of moving objects with a binding to the geographical coordinates, control of a movement of these objects in accordance with their direction and speed in real or arbitrary time scale. More complex behavior is controlled by the expert system plug-in JessTab [2], connecting Jess expert system with Protégé. This plug-in is changing the direction and speed of the objects at the required moments in accordance with the specially defined rules. To display the movement of objects on a background of a digital map OpenMap software embedded in our plug-in is used. Visual effect of the movement is created owing to a fast redrawing of the object images and using of a double buffering. Such simulation subsystem allows to stop simulation at any moment and store the positions coordinates of the moving objects in a file for a further analysis or repetition of the simulation. It also has facilities for the manual control of an object's behavior and for getting information about them. Moving objects besides images (icons) can also have text strings and/or different geometric shapes linked to them. Geometric shapes can designate, for example, regions of actions. Regions can be of irregular shape and represent either natural or artificial entities, for example, atmospheric fronts or oil spills. These shapes can move and changes also irregularly in accordance with the rules, describing their behavior. That is also under control of the expert system. This plug-in is a base for development of specific IGIS for the different application's domains. It can be downloaded from our website.

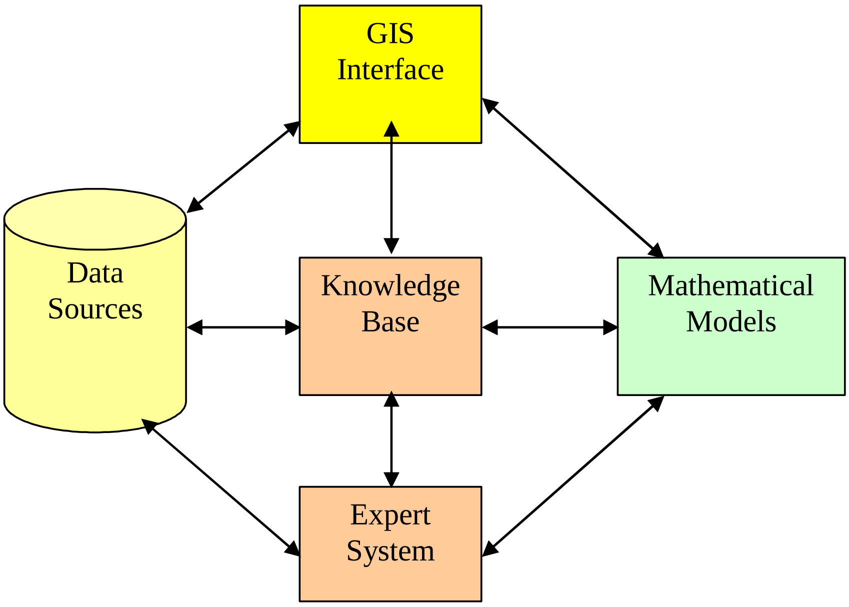
4 SOA AND GIS

Modern intelligent GIS developed as an interface for monitoring systems of different types and scales can hardly be represented as a self-contained program module. Application of intelligent GIS assumes consideration of most diverse factors, such as: obtaining at the earliest possible date reliable, variable in real time information from every possible source, presentation of information in visual form comfortable for perception. Besides, it should be understood that GIS interface can be used by hundreds of users, and in some systems the number of users can get up to dozens of thousands. And in order to meet the requirements of each of them the system has to adjust itself, to provide the required information space. Then a question arises – how should we effectively build up an intelligent GIS in order to establish productive, reliable and safe automated chains of those business-processes, integration of which is necessary for performance of our business functions? This is the Enterprise Application Integration (EAI) that has the basic IT-problems both of modern enterprises and monitoring systems for our case, and just at that spot the most effective solution tool is the service-oriented architecture (SOA) [14].

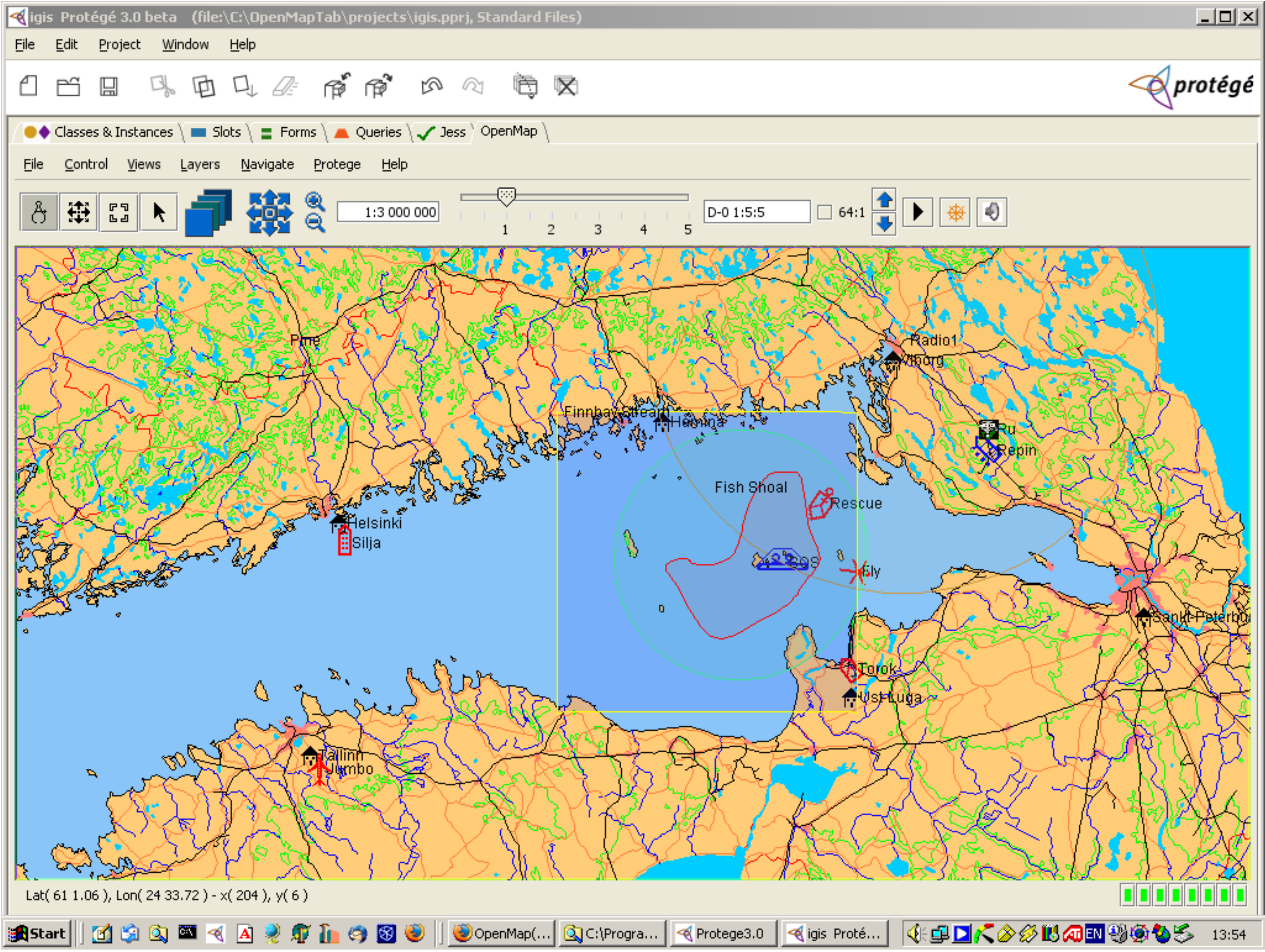
For the moment, SOA term has not been established. We can speak about SOA rather as about a technology development tendency for complicated systems than as about some technological standard. So, at present we can speak about certain backbone properties of SOA.

Architecture oriented towards services has four main characteristics:

- SOA is *distributed*. Functional elements of applications may be distributed as per the multitude of computing systems and may interact using local or global networks. In particular, Web-services enable using existing protocols (e.g., HTTP).



Graph 2: Architecture of IGIS



Graph 3: Interface of Intelligent Geo-information System

1. SOA is built using loosely-coupled interface. Usually applications are designed with a view to a stiff connection of all elements. As a consequence, the system should have an integral design, its changes during operation are problematic. Operation of components in loosely-coupled systems can be coordinated much easier and the systems can be easier reconfigured.

2. SOA is based on the *mainstream* technologies.

3. SOA is designed with orientation towards processes (process-centric) using services, which are individually oriented towards a solution of separate tasks (task-centric).

Thus, from functional point of view, intelligent GIS may be ultimately considered as a combination of interacting services, and this combination of interacting services can be specified by the term – service-oriented architecture.

A component model consisting of separate functional modules of applications called services and having certain as per general rules, interfaces and mechanisms of interaction is called: **Service-Oriented Architecture (SOA).**

SOA should correspond to the following requirements applied to modern state of business relations and information technologies, as well as tendencies of their mutual development:

1. maintain existing information systems and their joint effective application;

2. provide implementation of integration of different types:
   - *user integration* – to provide interaction of intelligent GIS with a specific personified user;
   - *application connectivity* – to provide interaction of applications on the intelligent GIS interface level;
   - *process integration* – integration of business-processes;
   - *information integration* – integration aimed to provide information and data availability;
   - *integration of new applications (build to integrate)* – integration of new applications and services into existing information systems.

3. provide consistent implementation of newly created and migration of existing information subsystems;

4. be provided with standardized technological supportability for realization, as well as with tools for development that can jointly represent optimal opportunities for repeated usage of applications, implementation of new and migration of existing information systems;

5. allow realizing different models to construct new information systems such as portal solutions, grid-systems and on-demand systems.

The present level of SOA development proves that the above requirements, in one or another respect, are met.

Over the last years some other construction technologies for distributed information systems were introduced, e.g., CORBA and DCOM, but solutions on their basis are noticeably loosing when compared with SOA especially in regard to such technologies as the information system development and implementation cycle, possibilities to integrate heterogeneous systems, etc.

Along with business reasons for extinction of previous distributed information systems' construction technologies there existed another technological reason of similar importance: these technologies had not achieved the required maturity level. They were promoted only by individual companies, and that restricted their expansion, no standards and technical documents describing application principles for these technologies and accepted by worldwide IT-community were developed.

During development of intelligent GIS on the basis of SOA, the following methodological and conceptual solutions and conclusions were also taken into account, e.g.:

- Open-source methodology;
- Application of generally accepted and frequently used technologies and standards: XML, HTTP, TCP/IP, SOAP, BizTalk [11];
- The offered solutions are being at the maturing stage that is required and sufficient to be successfully and sufficiently applied by a large number of ISV (Independent Software Provider) all over the world.

5 INTELLIGENT GIS ARCHITECTURE ON THE SOA CONCEPT BASE

A number of terms was specified with respect to intelligent GIS in order to form intelligent GIS architecture on the basis of SOA.

Service – a resource realizing business-function that has the following properties:

- it is retrievable;
- it is determined by one or several distinct technology-independent interfaces;
- it is loosely coupled with other similar resources and can be called through communication protocols providing a possibility for interaction between different resources.

Service-Oriented Architecture – this is an architecture of applications, where all application functions are independent services with clearly determined interfaces that can be called in the required order in order to form business-processes.

On the basis of the above determination the following intelligent GIS architecture in the basis of SOA concept was developed that is presented in Graph 4.

The center link of intelligent GIS is a tool intended to develop ontologyies and PROTÉGÉ knowledge data bases. PROTÉGÉ is an ontology editor, on the one hand, and, on the other hand, a storage for class instances used for monitoring classes. PROTÉGÉ architecture is shown in Graph 5.

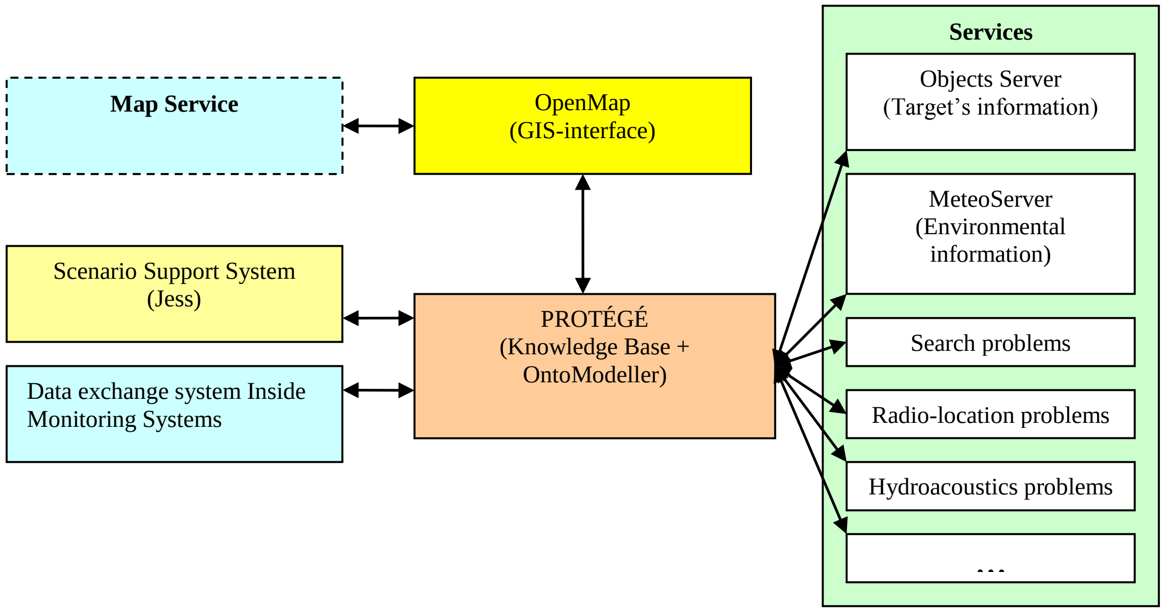
PROTÉGÉ is closely interacting with a program component of visual representation of OpenMap cartographic information. This component allows displaying the data contained in different formats, e.g., S57, VPF, etc.

Cartographic information update service is an instrument to maintain cartographic information in the actual state.

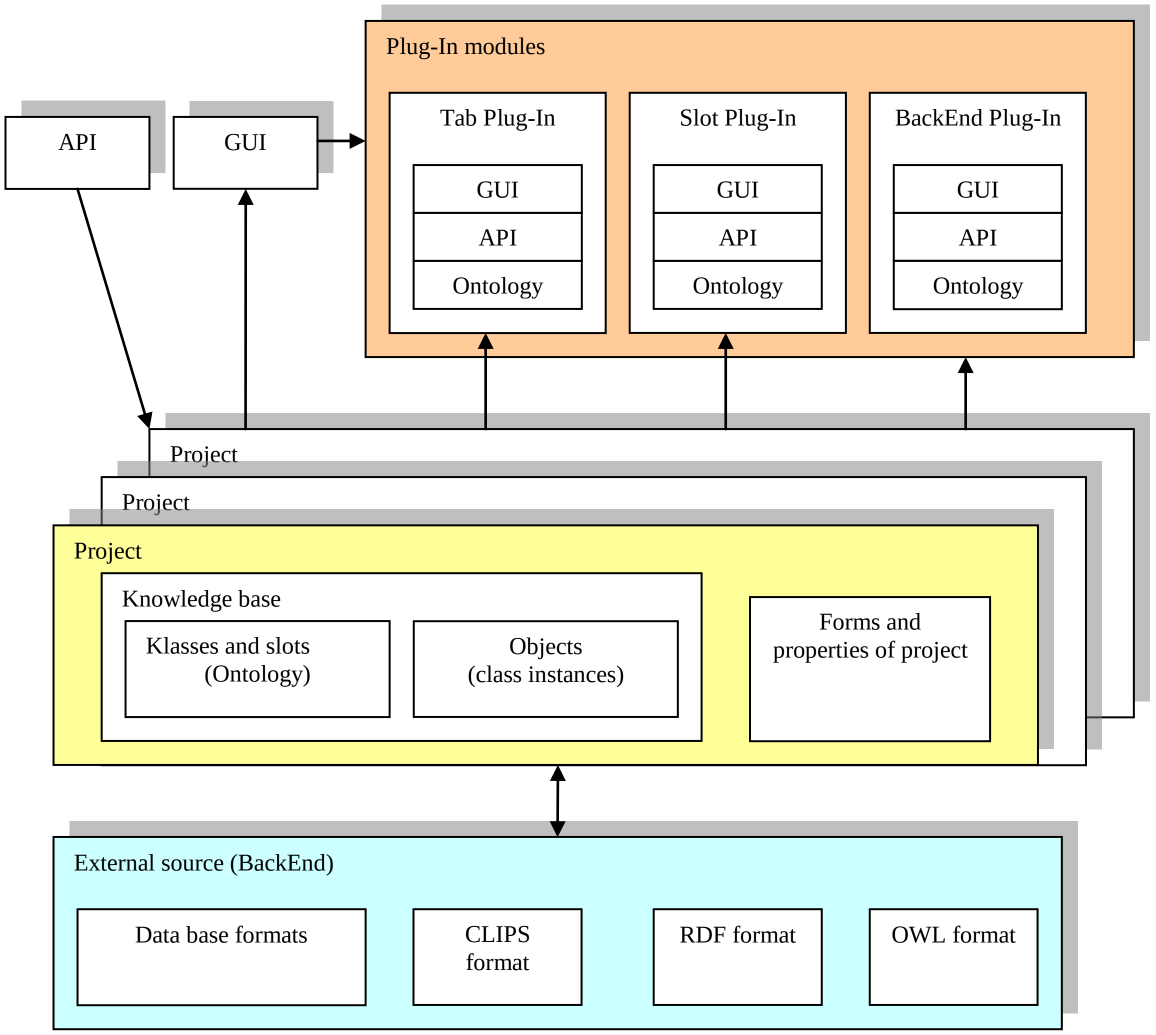
For instance, a user upon a receipt of a notification concerning the fact that cartographic information needs to be updated addresses this very service and receives information an updated information to be used in GIS-interface.

Service of information exchange between interacting monitoring systems or interacting subsystems provides exchange of documents and/or data in XML format as per the current situation.

Services such as visual libraries of functions, tasks of search that are designed for model support of decision making. The set of such services can vary depending upon the type or class of monitoring system.



Graph 4: Intelligent GIS architecture on SOA concept basis



Graph 5: Potege architecture

6 CONCLUSIONS

The method of intelligent GIS development proposed in the paper for multi-purpose monitoring systems can generally satisfy, the above stated requirements:

easy and clear data and information access.

smart and fast modification of the system's obsolete applications;

quick integration of new applications into the work system;

data standards and formats, and information support;

reuse of software code and other resources;

dynamic reconfiguration of the systems without new development and/or recompilation of the project on the whole;

possibility of the IGIS operation on a separate PC, LAN and global networks.

The program system developed with participation of the authors of this paper can possibly be considered as a case study. More detailed information is available at: http://niggis.iias.spb.su The core of the system is formed by the intelligent GIS incorporating along with traditional GIS-technologies the following ones:

A technology of ontology visual development for monitoring systems on the basis of Protégé-2000 using OWL;

System of data integration from different sources (World Meteorological Organization, S57, VPF data formats, etc) and their display on the basis of OpenMap;

Open development technology of expert systems on the basis of rules and objects using CLIPS and JESS shells;

Open technology for presentation of knowledge on the basis of ontology using instrumental means of Protégé-2000.

Advanced possibilities of intelligent GIS:

visual development of classes and objects of monitoring systems on the basis of metadata concept;

visual development of action scenarios of objects in geo-space environments;

playback of scenarios for object actions in real-time and indefinite scale of time with visual display in the form of signs at the background of an electronic chart;

presenting recommendations to decisions making persons in the process of the scenario playback during the investigative design of monitoring systems, business games, situation analysis and traning of users;

easy scalability (local PC, LAN and global networks).

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OpenGIS in action – Field-tested Web Map Services (WMS) and experiences with Web Feature Services (WFS)

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1 INTRODUCTION

The Open GIS Consortium (OGC) Web Map Service (WMS) allows for combined map images from different Web Map Services on the Internet. The Chamber of Industry and Commerce (IHK) for Munich and Upper Bavaria uses WMS in practice to reduce costs and work. The OGC Web Feature Service allows a client to retrieve geospatial data encoded in the Geography Markup Language (GML) from multiple Web Feature Services. The city of Munich, Department of Health and Environment (RGU) works on the implementation for their daily work. The usage of OGC-conformant Web Map Services (WMS) and Web Feature Service (WFS) will become the most important step in the development from a local to an integrated and distributed map service.

2 FIELD-TESTED WEB MAP SERVICES (WMS)

The IHK for Munich and Upper Bavaria, which represents the biggest among the 82 Chambers of Industry and Commerce in Germany attends to more than 280.000 companies. The IHK is a self-administering body under public law for any individual company of industry, trade and services. Every company in Germany is member of a Chamber of Industry and Commerce, except of crafts enterprises, professionals and agricultural enterprises. The Chamber of Industry and Commerce represents, democratically authorized, every particular industrial sector independent from the size of the enterprise. The main tasks are the representation of interests concerning economy, sovereign functions and assistance for companies. The IHK for Munich and Upper Bavaria uses a lot of different geo-relevant information for their work. Therefore GIS is an integrated module at the IHK Munich in three major services or websites.

- Site Information System Bavaria (SISBY)
- Network for Economic Developers in Upper Bavaria (Wirtschaftsförderer im Netz Oberbayern (W.I.N.))
- “Geoinfoservice” of the IHK Munich and Upper Bavaria

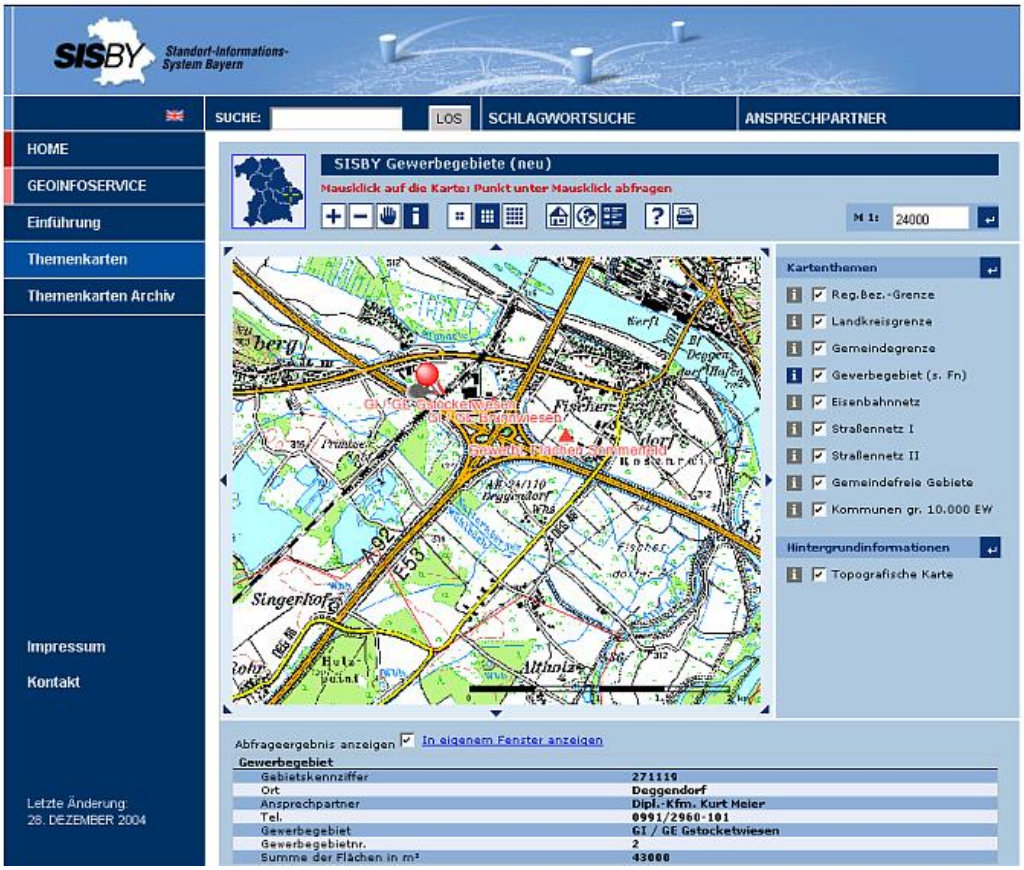


Figure 1: Internet-GIS-Viewer integrated in SISBY

For example (SISBY has already been marketing instrument of economic development for municipal industrial sites and properties in the Internet since 1997. SISBY consists according to the integrated IT- strategy of the IHK of five different modules: Database of industrial estates/properties, database of communal statistic, database of contact persons, content management system (CMS) and GIS. The modules are exclusivley used via web technologies with different depth of information for the extern customer service in the Internet and intern workflow demands for the IHK staff.

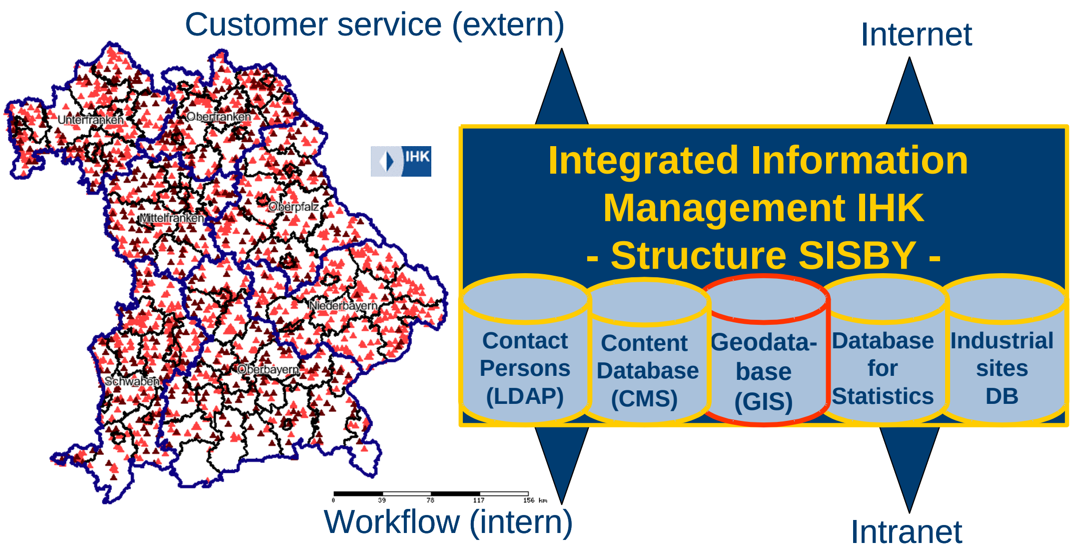


Figure 2: Schematised module model for SISBY

The offered geodata in SISBY with a purely web based Internet Map Service (IMS) covers the whole spatial extent of Bavaria (about 70.000 km²) with ATKIS 500.000 (Authoritative Topographic Cartographic Information system) a vector dataset with the basic transportation system, estate structure and the administrative subdivision. The TK 50.000 (topographical map) is also available in the application as a background layer consisting of more than 40.000 tiles. GIS in SISBY is designed multilingual and supports German and English at present.

What´s new? The interactive map "SISBY Commercial estates" integrates in practice the topographic map 1:50.000 (TK 50) of the Land Surveying Office Bavaria (BVV). The TK 50 is fully integrated into SISBY directly with the raster data from the server of the BVV. How does it work? The topographic map is integrated and displayed via the OGC-Geoservice (WMS). There is no difference for the user. Between the scale from 1:50.000 to 1:10.000 the TK 50 is displayed, just that it comes now automatically from the BVV. How was it up to now? Since 2002 the GIS in SISBY has contained already beside different thematic maps e.g. population, person employed, rates of trade taxes etc. the map of all industrial areas for Bavaria including the background layer for the TK 50. However in the past the IHK Munich had to maintain their geo base data, the topographic map by its own and got just one update once a year. Now the TK 50 is alway keeping uptodate by the BVV without any operating expense for the IHK.

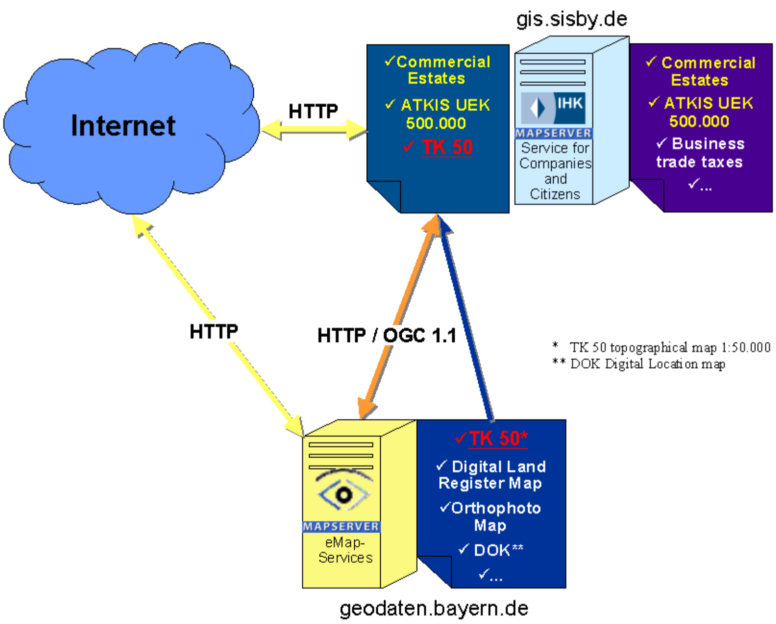


Figure 2: Schematic cascading mapserver enhancing geodata of the BVV with local layers in SISBY

What are the benefits? With this new geoservice the maintenance of the geo base data is outsourced to the specialists of the BVV and the geo base data can efficiently and economically be used in SISBY or in other map applications of the IHK. This practice in SISBY shows exemplarily the eGovernment oriented strategy of interoperability by standardized technologies like OpenGIS. In the co-operation of IHK and BVV valuable practical experiences for the geo information economy were made. In the future standardized geoservices in map-applications by e.g. enterprises and in the administration can be simply and economically used. Under the view of eGovernment geo base data as well as official statistical data and official directory services should be offered centralized to prevent inefficient multiple data storage and support information exchange between authorities/suppliers in the future.

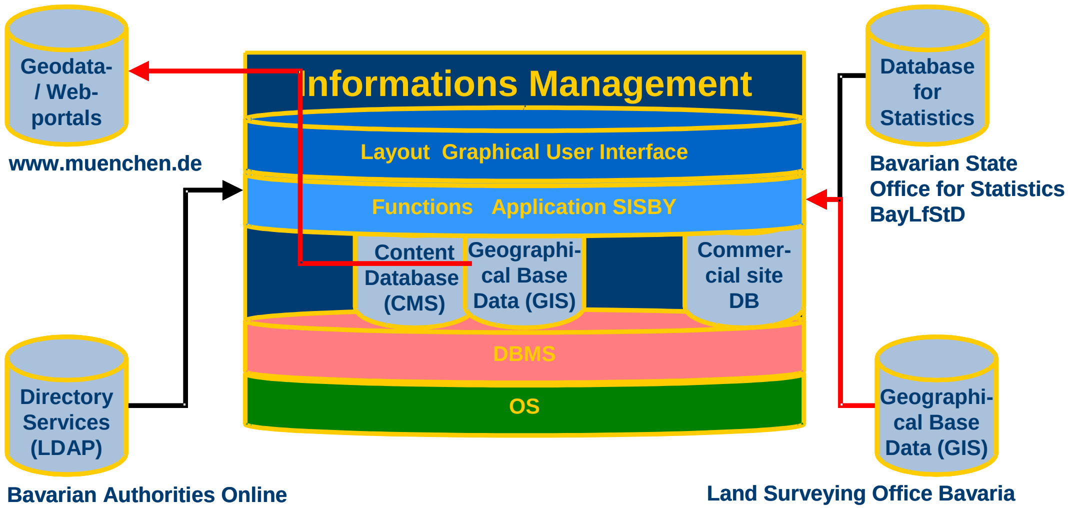


Figure 2: Schematic of future „eGovernment“ model for SISBY

3 EXPERIENCES WITH WEB FEATURE SERVICES (WFS)

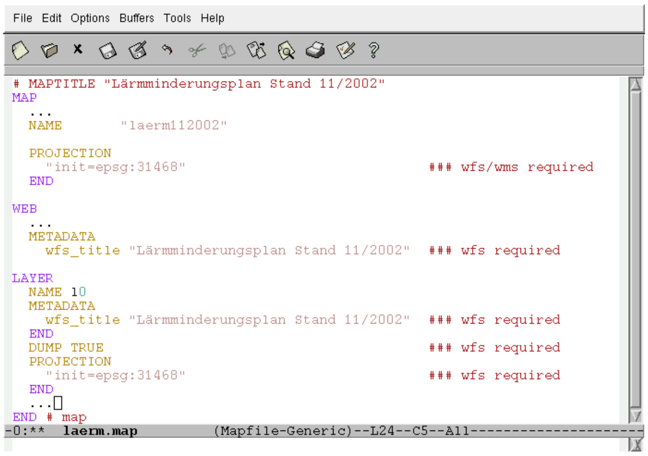
The Department of Health and Environment (RGU) as part of the administration of the City of Munich is responsible for environment protection and planning as well as running the public health system with 5 municipal hospitals. The initial paper based environment atlas formed the starting point for the now internet based map services. These are used for internal information and quality control systems as well as public information. In the environment atlas over 100 maps of environmental themes are shown, health reporting adds another 15 maps, tendency growing. Within the European Union funded project MILES (Managing Information for Local Environment in Sri Lanka) the OpenGIS infrastructure will be adapted for the building of an environment and information system for Sri Lankan municipalities.

WMS services already prove their suitability for simplification of internet map services integrating map images from different services, but they need additional service types when it comes to delivery of location based alphanumeric data. For this purpose, the RGU uses the OGC Web Feature Services standard. Unsimilar to Web map services, which offer transformed imagery from raster and vector data, Web Feature Services operate on vector based data sources only. Delivering the query results in XML format through the HTTP protocol, their Geographic Markup Language named XML dialect transports the coordinate data along with the alphanumeric feature data.

3.1 The Price

As the basis for the internet map services of both the RGU and the IHK is the University of Minnesota's (UMN) mapserver, the WMS server/client as well as the WFS server/client features only have to be activated at compile time. WFS requires no additional libraries to the standard WMS services.

The map specification files have to be enhanced by some WFS specific lines, which do not impede their normal use as normal mapfiles:



```
File Edit Options Buffers Tools Help

# MAPTITLE "Lärmminderungsplan Stand 11/2002"
MAP
  ...
  NAME       "laerm112002"

  PROJECTION
    "init=epsg:31468"                    ### wfs/wms required
  END

WEB
  ...
  METADATA
    wfs_title "Lärmminderungsplan Stand 11/2002"  ### wfs required

LAYER
  NAME 10
  METADATA
    wfs_title "Lärmminderungsplan Stand 11/2002"  ### wfs required
  END
  DUMP TRUE                              ### wfs required
  PROJECTION
    "init=epsg:31468"                    ### wfs required
  END
  ...
END # map
-0:**  laerm.map        (Mapfile-Generic)--L24--C5--All--------------------
```

The presence of a WFS for a certain map can be checked with a http request in standard OGC „getcapabilities“ format:

http://maps.local/maps/laerm112002?SERVICE=WFS&VERSION=1.0.0&REQUEST=getcapabilities

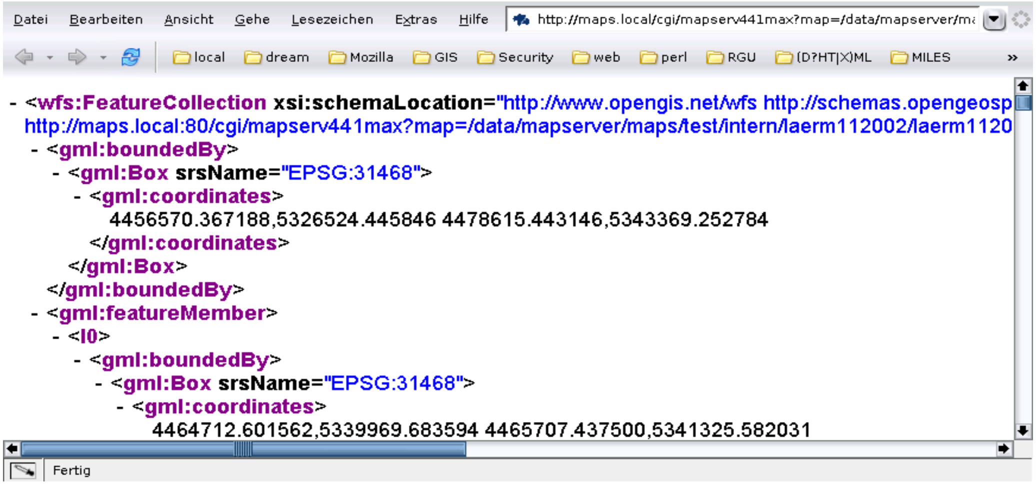
The actual call for data is done through a “GetFeature” call:

http://maps.local/maps/laerm112002?SERVICE=wfs&VERSION=1.0.0&REQUEST=GetFeature&TYPENAME=l0

Precondition for a call like this is, that the apache webserver's alias feature is used to implement a shortcut notation for the usual lengthy mapserver call.

3.2 Architecture

The getfeature-request returns data in GML format:



As today's browsers css (and more so xsl) capabilities are very limited, this returned data has to be reformatted on the server. The multi-tier architecture of RGU's and IHK's internet map service allows the additional implementation of a reformatting layer. PERL as the standard programming language for the application meanwhile has enough built-in XML features to make this task easy. In the final application, the user will see no difference between a native call for alphanumeric data and results retrieved through a WFS service call.

3.3 Security

OGC's implementation of WMS and WFS services would allow to set up 'fat clients', which retrieve native WMS results in image format as well as the GML data of WFS calls. The mapbender application (http://www.mapbender.org) is an example for this technique.

Unfortunately, in the current situation security of the data has high priority when publishing internet services. WFS return the coordinates of the data as well as the alphanumeric feature data, thus opening the door for anybody to save the raw data.

The current implementation of OGC's WFS in mapserver do not allow for access restrictions on the WFS level itself. Therefore security mechanisms have to be implemented to prevent the drain of the geographic data.

The RGU currently is checking two ways of achieving this:

- a filter chain in the apache webserver, where the UMN mapserver is used as a XML data source. It's output then is processed with XSLT spreadsheets, which, for example, just remove all vector data.
- Postprocessing of the results in the application to re-format the results before embedding ad presenting them to the users

The first technique would allow to publish WFS sources for other servers or clients. However, great attention has to be put on limiting the cpu load of those calls, as a request could easily cover the whole area of bavaria on several layers, resulting in gigabytes of data to be transferred.

The second technique is easier to implement and adapt, however it requires tight access control mechanisms on the WFS side to allow only requests from trusted clients.

4 CONCLUSIONS

The internet map services of RGU and IHK have proven their stability over years. WMS eases the cost as well as the maintenance burdens. WFS will add the necessary information level for intra-administration use, but requires more effort on the application side as XML on the browser side is far from beeing usable in a vendor independent way.

Administration itself unfortunately is quite slow in adapting WFS, the security issues adding their grain of salt to the difficulties. The openness and simplicity of OGC's WFS standard however gives the chances to many implementors to add this feature to their application and leaves room to use already present filtering and access control mechanisms in the most appropriate way for each implementation

The architecture of the internet map service of RGU and IHK has proven its flexibility when it comes to the integration of both WMS and WFS services with local maps. Sticking to the current way of server-preprocessing allows to maintain the high level of operating system and browser independence of this service.

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PostgreSQL Database: http://www.postgresql.org
PERL in the apache -Webserver: http://perl.apache.org
PERL programming language: http://www.perl.com
Site-Information-System Bavaria (SISBY): http://www.sisby.de
Mapbender: http://www.mapbender.org

🏆 **reviewed paper**

Future tools for area administration and public participation

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ABSTRACT

This paper presents a mapping of the online facilities concerning planning and geographic information that is currently offered for public participation at the Danish municipal and regional websites respectively. The Danish physical planning system has for the last 35 years consisted of three hierarchical levels: National, regional and municipal. The regional level has handled larger environmental issues and everything concerning planning and administration of non-urban areas; costal areas, nature preservation and restauration, agriculture, natural ressources, water quality etc. The Danish government has recently decided to eliminate the regional administration level and transfer the planning tasks to the municipalities, who has up till now almost entirely dealt with planning of urban areas. The problems and complexities that has to be handled in the open area planning differ from those concerning urban areas, often there are substatial conflicts between utilization and protection of the area ressources, and the municpalities needs to develop methods and strategies to handle these new tasks. Among the challenges is to offer credible and convincing information about the potential conflicts between nature protection and economic development. The purpose of the mapping is therefore to compare the tools applied to the different tasks – urban and non-urban - to clarify which kind of planning support systems the municipalities will need to develop to offer the same or better posibilities for the public to participate in the planning processes and discussions.

1 INTRODUCTION

All over Europe the transformation of the public sector to meet the requirements of e-government is high on the agenda. The core of e-government is to create better and more efficient solutions to administrative tasks through the use of information technology. Denmark has set the goal of being among the countries that are best at utilizing the digital transformation to create growth and welfare. The ambition is to utilize the potentials of digital society across all levels of government to organize the public sector in a more flexible and efficient way and with higher quality of service for the citizens. By implication, these goals should be reached without increasing the public expenditure. One means to decrease the expenses is supposed to be selfservice applications for citizens on the public authorities' webpages. This also applies to regulatory processes and administrative procedures involving geographic information, such as physical planning processes. Some processes and applications are fairly simple to digitise and arrange for selfservice; if the applicant fulfils the conditions permission can be expected offhand. One example of this is permissions for smaller construction projects in the urban area. For all parts of the urban areas straight rules an regulations are made telling clearly what is allowed in each local unit. In the preparation of the regulations (called framework regulations for local plans) all relevant plans and legal acts are taken into consideration and no further interpreation of the resulting regulations are needed. Contrary, when it comes to gaining permissions for area-use or construction in the rural area the situation is often much more complex, and every permission is based on individual judgement made by the professionals in the county administration. In each case the often contradictory interests of protection and utilization of the natural ressources in the area of concern must be balanced against each other. This balancing is often extraordinary complex as the weight of the individual elements vary in differing situations and determining factors depend on the very local conditions as well as overall considerations. Administrative procedures like that are not well fiit for selfservice via webpages, or would in that case require a very detailed regulation of the rural area. There is no tradition for regulations of such detail of the rural area in Denmark, and it would require a very comprehensive planning, which in many cases by far would exceed the actual needs, and furthermore could lead to many unnescesarry conflicts and problems.

In the year 2004 the Danish government has decided to implement a reform of the structure of the public adminsitration. For the last 35 years the Danish administrative system has been based on three levels of government; national, regional (the counties) and municipal. It has now been decided to eliminate the county level and transfer the administrative tasks partly to the state and partly to the municipalities, who in term should be bigger than they are today. For the physical planning this means an interely new structure, where the municipalities, who has up till now primarily been occupied with urban planning and local infrastructure issues, from now on must handle the rural area, nature and environmental planning. In terms of methods the municipalities are not geared for the new tasks, that imply a much more individual and judgement based administrative pracsis. At the same time grassroot organisations and local groups of citizens express concerns that the new municipalities will weight issues of nature and environment lower than concerns of economic development when competition on factors like retailing, business localisation and places of employment intensify among the new bigger municipalities. Consequently, there is a need for development of methods that aim at the following:

Effective and flexible tools for the regulatory processes of the area administration in the rural areas, and

Tools that provide transparent and credible insight in the municipal priorities concerning physical planning, nature conservation and economic development.

This paper reports on a research project that aims at elucidating and developing such tools and methods. The first step has been to monitor the diffusion of GI-based services offered on the municipal and county websites respectively. These services are classified in order to give an overview and make a comparison between the two levels of administration possible. Focus is then on the tools and services offered by the counties, in order to find which of these the new municipal services could be based on or inspired by. But first the Danish planning system will be briefly presented, as well as the basis and core content of the structure reform. Next the method for classifiing the tools and services will be presented, as it forms the basis of the survey design.

2 BACKGROUND

2.1 The Danish Planning System

Denmark has three administrative levels; national, regional (the counties) and municipal, each taking care of welldefined components of the big jigsaw puzzle of planning and administration of the society. The national level provides the legislation and marks out the overall strategic framework for the development of the country. These frameworks, known as national planning directives, are expressions of the current political visions of the overall development of the country. The counties are responsible for handling larger environmental issues and everything concerning planning and administration of non-urban areas; coastal areas, nature preservation and restauration, agriculture, natural ressources, water quality etc. The regional councils are responsible for the preparation of a regional plan that takes all these issues (and many more) in consideration. The plan must be renewed and updated on a 4 years cyclus and the intentions and visions in the regional plan must be in compliance with the present national planning directive. Urban planning and development are handled by the municipalities, who like the regional councils must renew and update their municipal plan on a 4 years cyclus. Regulations and purposes in the municipal plan must not be in contradiction with the visions and regulations in the regional plan, and in this way the counties serve as a watch-dog for issues that concern the larger environmental and natural structures. Furthermore the counties have a certain degree of veto power when it comes to proposed economic development in the municipalities that will have a large or negative impact on nature, environment or other sustainability issues of the region.

2.2 The Structure Reform

The current administrative structure consists of 270 municipalities and 14 counties. Since the forming of this structure in the late 60'ies the tasks of the public authorities on all levels have developed dramaticly, specially when it comes the the demands of the social and environmental sectors. This development has led to a situation where the physical size and economic capabalities of the municipalities and counties no longer match their tasks. Smaller municipalities (some with just a few thousands of inhabitants) do not have space in the budget to employ the necesarry expertise personal to handle new environmental planning and control tasks. The counties for their part have proved to be too small to handle the task of being responsible for the hospital service, a task that takes up more than 80 % of the counties' budgets. These facts are among the rational explanations to the coming reform of the administrative structure, in Denmark known as the Structure Reform. Other explanations are purely based in ideology and political visions and will only be touched in this paper to the extent they can explain the future structure as it currently augers.[1]

The future structure comprises 5 large regions and a yet unknown number of municipalities, probably about 100. The new large regions will no longer have an independent part to play in the physical planning. All planning will from now on be handled by the municipalities and by national institutions. The regions will play a part as formal watchdog of the municipal planning, but with no actual power of veto or political influence. This puts a very heavy burden of new tasks on the municipalities, tasks only the largest municipalities – if any at all - currently has the competence to lift. Although the new municipalities will be larger than the present they will not nearly match the volume of the counties. This still puts a limit to the number of specialised personel the municipal administrations can afford to employ to take care of the administrative procedures concerning area administration. A central premise for the restructuring of the public sector is that it should be carried out without increasing the public expenses, meaning the transformation should take place within the limits of the existing municipal and regional budgets. No one in their right mind can expect a process like that to take place without expenses, and the only way to balance the budget will be to decrease the number of employees in total.

2.3 New tools needed

This is the background of a situation where the coming new municipalities have a huge need for new efficient methods to handle their current planning tasks and new knowledge and methods to handle their new area administration tasks. Furthermore there is a need for the municipalities to forestall any critique from the citizens about centralisation of the power and lack of democratic influence. Local communities and grassroot organisations fear that the new municipalities will be apt to sacrifice the considerations of nature and inveronment to the advantage of economic growth and commercial interests. To avoid these accusations the municipalities need to offer the public credible information and tools for participation in planning processes. Generic terms for tools that might cover many of the above mentioned needs are Webbased Planning Support System (WPPS) (Peng, 2001) or internetbased Public Participation GIS (PPGIS) (Carver, 2001), (Weiner et al., 2001). Of special interest are applications that can support and communicate processes and decisions that are based on judgement rather than strict rules and regulations. A number of architectures and implementations of WPSS and PPGIS have been suggested in the litterature, such as (Geertman, 2002) and (Rinner, 2001). These will obviously be considered in the present research. But the author takes the starting point in an assumption that the ones most familiar with the tasks and their handling are the existing municipalities and counties, respectively, and that technology-leading municipalities and counties already have developed aedequate tools for many of the tasks. Hence first step towards a design of future tools for the area administration and public participation would be to:

identify existing examples of best practice on municipal and county level, and

[1] It must be noted that there are substantial disunities between the government and the opposition about the future arrangment of the planning system, specially the role of the new larger regions. The government has enacted their proposed model with a narrow majority with the support of a radical right wing party. Elections for the Danish Parliament must be hold during 2005, and should the current opposition win, they are very likely to change substantially the appointment of tasks concerning physical planning giving more power to the regions.

analyse the difference between the municipal tools and the applications developed by the counties in order to clarify which kind of planning support systems the municipalities will need to develop to offer the same or better possibilities for the public to participate in the planning processes and discussions.

The remainder of this paper will report on a survey of the relevant applications found on the webpages of the municipal and county administrations. As the applications in focus are offered by Public Authorities (PA) on their WEB sites and offer acces to Geographic Information (GI), they will be termed PAGIWEB for convenience.

3 THE SURVEY METHOD

During a few weeks in September 2004 all municipal and county websites were visited and any instances of PAGIWEB was noted and classified due to their characteristics. For the classification a method described by (Campagna and Deplano, 2004) was used. The method is based on an adaption of a taxonomy aiming at defining the level of service of a WPSS proposed by (Peng, 2001). The revised taxonomy made by (Campagna and Deplano, 2004) reflects a reality with a less extensive implementation of public participation than presumed by (Peng, 2001). The used taxonomy has the form of a bidimensional matrix whose variables are content and technology, called CTM (Content/Technology Matrix). The content levels, C1-C4 varies from general information concerning an area or territory, over planning documents, raw downloadable data to bidirectional informational tools. The Technology axis comprises 5 steps, T1-T5, moving from static maps in html or PDF documents via more and more sophisticated and dynamic tools to advanced WPSS functions. The two axis' form 20 cells each comprising a characteristic combination of information content and applied technology. As shown by (Campagna and Deplano, 2004) with regards to the Italian case study using the CTM it is possible to classify the PAGIWEB in a way that makes comparison easy between institutional levels, between different countries, and in different time steps. Tabel 1 shows the C and T levels of the matrix and the generated matrix cells.

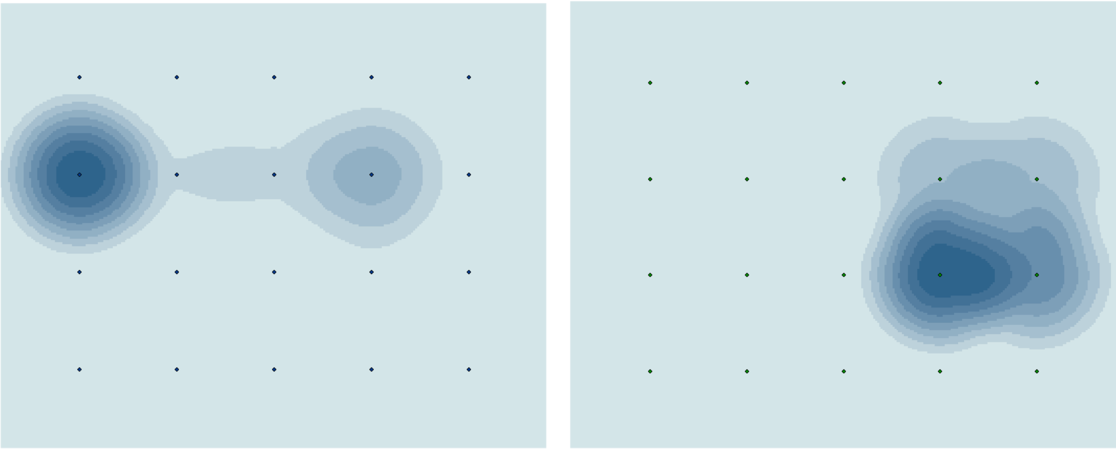
Content\Technology	T1: Web browsing, static maps (HTML and PDF)	T2: Interactive map images	T3: Highly interactive, dynamic maps, mulitimedia, 3D, VRML	T4: Basic web-GIS functionality, search, query and analysis	T5: Advanced web-GIS functionality, 2 way communication
C1: General information of city or area, turistmaps etc	C1T1	C1T2	C1T3	C1T4	C1T5
C2: Plans and planning information, information about environment and nature	C2T1	C2T2	C2T3	C2T4	C2T5
C3: Raw data, downloadable in GIS or tabel format	C3T1	C3T2	C3T3	C3T4	C3T5
C4: analysis tool, focused bidirectional information flows	C4T1	C4T2	C4T3	C4T4	C4T5

Tabel 1 The elements of the CTM – Content/Technology Matrix. After (Campagna and Deplano, 2004)

4 THE RESULTS

171 municipalities offered some kind of PAGIWEB on their website, ranging from basic static maps in local plans and municipal plans in PDF documents to advanced web-GIS applications with feedback tools. All 14 counties have implemented web-GIS to provide plotowners, agricultural consultants, property handlers, windmill owners, municipal authorities and other professionals with updated information about regulations and zonings in the rural area. The functionality and level of sophistication of the county PAGIWEB varies slightly but they are all in the lower right part of the CTM.

The CTM classification method has proved to be a useful way to relatively fast build an overview of the diffusion of PAGIWEB. The scales of content and technology, C1-C4 and T1-T5 are nominal in nature but do also imply a clear progression towards more advanced tools and higher levels of interaction and participation. Although the allocation of the PAGIWEB to the specific cells in the CTM rely on judgement, and thereby is prone to a slight subjectivity, it is fairly easy to determine which cell a certain PAGIWEB falls into. Hence the resulting classification can be considered quite consistent. To ease the comparison of the resulting matrices a spatialised representation is compiled by calculating the cell density of the CTM. The results are shown in figur 1 and commented in the following two paragraphs.



Figur 1 Spatialisation of the CTM on Municipal level (left) and County level (right). Each dot represents one cell in the CTM

4.1 Municipal level

The results on the municipal level is shown in tabel 2. The spatialisation of the municipal level CTM results in a very uniform shape with the main weight centered on the C2T1 cell and a smaller accumulation around C2T4. To put it short this reflects that the Danish municipalities who offers PAGIWEB either do this in form of master plans and local plans in PDF-documents or as relatively advanced municipal web-GIS' including planning zones and related information and documents. Some municipalities have both a masterplan in PDF and a web-GIS and in that case they are categorised in the highest of the two categories. The web-GIS' found at the municipal websites are very similar in structure and functionality and must be considered a reflection of the products the GIS-vendors currently offer. There are only a small handful of firms selling these solutions in Denmark, and it can not be concluded from this first survey wether the functionality the webGIS's encompass reflects the needs and commands from the municipalities or rather shows what the vendors are capable of delivering. A small number of municipalities have developed their own systems (or developed further the standard solutions) to better meet the requirements of a planning information and participation system. An example of this is the municipality of Aalborg that offers access to statistical information, gives tools for analysis based on the users own preferences and offers the data for download in tabular formats as well.

The near-absence at the municipal level of PAGIWEB in the C1 category is worth noticing, and two explanations come to mind. One is that very general purpose static maps might not have been identified as PAGIWEB in the survey. The other is that municipalities that are aware of the importance of communicating via maps and GI very often focus this communication on themes related to planning and thereby move to category C2. Each municipality is only classified once and always in the highest achieved category of PAGIWEB found on the entire website.

Content\technology	**T1**	**T2**	**T3**	**T4**	**T5**
C1	2	0	1	0	0
C2	94	11	12	37	3
C3	0	0	0	4	0
C4	0	0	0	0	0

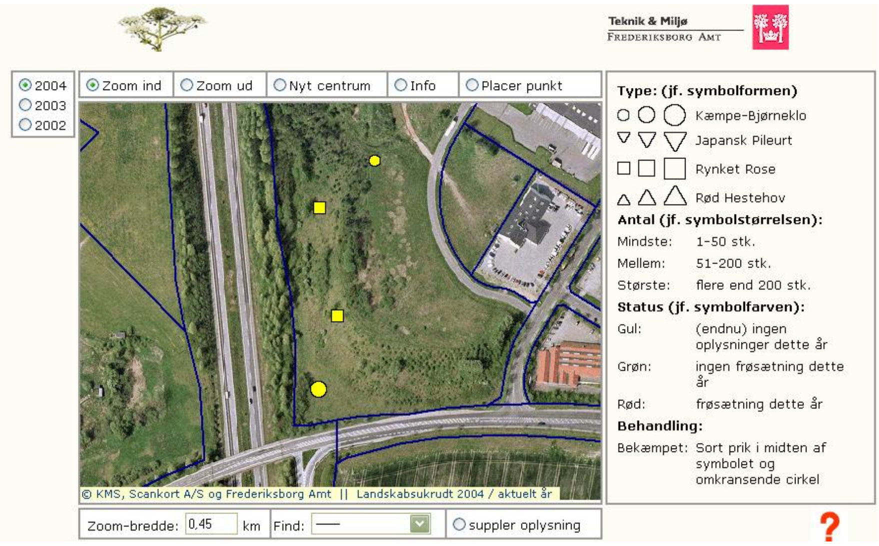
Tabel 2 Results of the survey at the municipal level, number of examples

4.2 County level

The results on the county level are shown in tabel 3. As mentioned above all the counties are represented, and although some of the counties had more than one application each county is only classified once, as was the case with the municipalities, according to the highest achieved level of content and applied technology. Not surprisingly the standard and sophistication of the county PAGIWEB are generally higher than the municipal applications. 10 counties offer their GIS data freely for download in XML/GML or software specific formats (MapInfo or Arcview). In the download sections the counties usually also links to freely downloadable GIS-viewers like ArcExplorer or MapView. These services are partly a consequence of the Aarhus convention (UN ECE, 1998) that assures citizens in ratifiing countries free access to data concerning their local environment. Formally seen this obligation is already fulfilled by the web-GIS, and the download option provides citizens with the necesarry skills a valuable extra basis for participating in planning processes. The download option only covers data that the county itself produces, as copyright agreements for the basic maps usually do not make such a free service possible.

4 counties have applications where the citizens are encouraged to make online registrations of occurences of hogweed and other kinds of weed that spread vigorously in the uncultivated parts of the rural areas, see figur 2. These are so far the only instances of PAGIWEB where the citizens can act directly as data suppliers. A number of the municipal web-GIS' as well as most of the county web-GIS offers functions for "redlining"; digitalisation or marking of an area in the map and provides guidance on how to attach a screenshot of such a redlining to an email to the admnistration for commenting and questions. In this way the citizens can augment

their comments and questions with GI but they do not directly supply the application with new information content as it is the case in the hogweed registration. With the evolving WMS and WFS technology it must be expected that functionality where the citizens can digitalise and submit GI directly online will be an obvious part of future PPGIS, and for that development a closer examination of the experiences with the hogweed registrations should be made.



Figur 2 Online tool for registering occurences of i.a. hogweed. The citizens can place a marker where the weed has been observed and supply additional textual information about the observation.

Another application worth mentioning is the 3D-model of North Jutland. In October 2002 the 3D-application was launched, using the TerraExplorer from Skyline software systems. In this application the users can fly above and investigate the entire region of North Jutland visualised in 3D by an orthophoto mosaic draped on a dhm. The application admits the user to "fly" from one address to another, circle round specified targets and navigate freely in 3 dimensions. Buildings are extruded from the orthophoto as blocks, based on polygonal information from technical maps. This gives a rough but yet realistic impression of the surroundings. Different themes can be applied to the model, such as tourist information (with links to relevant webpages), bicycle routes, nature camp sites for hikers etc. But the model was also used for visualising different scenarios in the planning process of a large wind mill farm. In combination with electronic meetings these scenarios were valuable suppliments to the more traditional means of debate and participation in the planning process.

All counties specificly stress that the data in the PAGIWEB are purely consultative, several of the themes are not precise at a detailed level and the shown registrations do not per se constitute a legal binding or regulation on the property. In these and similar ways the counties implicitly try to communicate the complex nature of the judgement based administrative processes and the fact that the maps can not be interpreted directly as a guarantee for permission or rejection in any specific case. The question is wether the non-professional users will understand these distinctions. And if they do, will they understand it too, if a future municipal web-GIS have the same sort of declaration following some of, but not all, the data?

Content\technology	**T1**	**T2**	**T3**	**T4**	**T5**
C1	0	0	0	0	0
C2	0	0	0	2	2
C3	0	0	0	6	4
C4	0	0	0	0	0

Tabel 3 Results of the survey at the county level, number of examples

5 DISCUSSION

The higher sophistication of the county PAGIWEB compared to the municipal PAGIWEB is not suprising. The combination of physical size, complexity of tasks and economic capacity in the counties were fundamental determinants that the counties' departments for nature and planning were among the pioneers of GIS use from the very beginning, and they still mark the lead of geo-tool implementation in Denmark. A strong professional network between the GI-professional in the counties have further served to consolidate this, taking advantage of synergetic effects of common data models, application development etc. The CTM clearly reflect this fact, and also shows a will from the counties to do more than just inform the public. This attitude aught to be adopted by the municipalities in the future, as the situation at present clearly shows a tendency towards informing the public rather than involving the citizens actively in the planning processes, at least when it comes to the implementation of relevant GI-based tools. Unfortunately, this is not just a simple matter of implementing the aedequate technology. When it comes to a thing like offering the municipal data freely for download, legal, institutional and economic hindrances block the way. 35 years of authonomy, and a huge variance in the size and capacity of the municipal administrations across the country has not led to a synergetic cooperation like the one on county level. Merging 270 municipalities to about 100 is not going to be an easy task, and among the GI-professionals in the municipal administrations there is a clear recognition that a smooth transformation can only be accomplished on basis of a sound, common (geo)data model. A common data structure based on the recommendations from the INSPIRE network has been proposed, and it can be hoped that the implementation of such a datamodel can ease also the implementations of more advanced PAGIWEB at the municipal level.

6 CONCLUDING REMARKS AND FURTHER INVESTIGATIONS

At this point it can be concluded that the PAGIWEB at the municipal and county level to a great extent reflects the tasks of the respective administrations, and that the counties due to their capacity and professional networks have been able to implement PAGIWEB of much higher and more consistent sophistication than the municipalities. The basic functionality of webGIS offered on municipal and county websites are not substantially different, the difference here arise from the thematic layers and their properties and the fact that the counties make a serious effort to warn the public not to take the information in the maps too literal, so to speak. But in addition to the basic webGIS functionality many of the counties offer tools that substantially expands the public’s options to take an active part in the planning processes. Further investigations in the presented research project will take these tools into closer considerations in order to evaluate their feasability and applicability to the new municipal level of administration. So far, the CTM mapping and comparison has laid a valuable ground of overview of the diffusion and standard of PAGIWEB at Danish municipal and county websites.

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CENTROPE_MAP: Building a Cross-Border Geo-Data-Infrastructure

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Providing a high-quality spatial data infrastructure and efficient tools for spatial analysis with new information and communication technologies are fundamental tools for political and economic decision support within the increasing competition between European regions. For a common development of the Centrope region, cross-border access to adjusted and standardized spatial data sets is essential. In the framework of the EU-Interreg IIIA-Project "Building a European Region", a political and institutional basis and a reliable cooperative structure will be elaborated. (www.centrope.info). Centrope MAP is a pilot project within the main subject area „Regional development and transportation".

The enlargement of the European Union with 10 accession countries mainly located in middle and eastern Europe is seen as a challenge and development chance for Austria and the bordering members. Beside the Vienna Region consisting of the Austrian states Burgenland, Lower Austria and Vienna the Centrope area also includes the neighboring Jihomoravsky (South Moravia) and Jihocesky (South bohemia) regions in the Czech Republic, the districts (Kraje) Bratislavsky and Trnavsky in the Slovak Republic as well as the regions (Megyek) Moson-Györ-Sopron and Vas in Hungary.

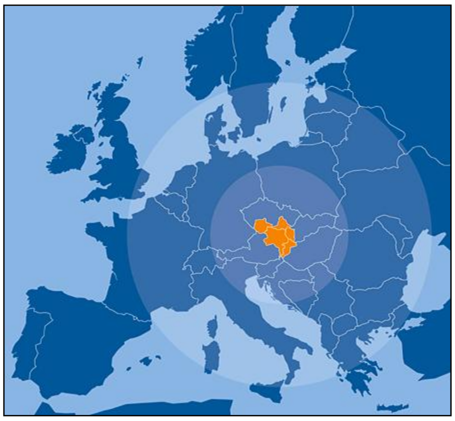


Fig.1: Centrope region - Geographic Overview [Source: http://centrope.com/static/files/centrope/centrope_region.jpg]

The economic region Centrope is pursueing a joined marketing with the slogan „4 Countries – 1 Region". The modified motto: "*4 countries – 1 region – 1 digital geodataset!*" can be stated as a common goal for the digital information system Centrope.

On behalf of the public planning association PGO, a cooperation of the three planning divisions from the Austrian states Lower Austria, Burgenland and Vienna, a digital base map for the Centrope region has already been generated. During this first project period the integration and harmonization of spatial data focused on the Austrian states. The process of standardization as well as cooperation initiatives for easier data access and data exchange have already been a demanding challenge on Austrian level. Centrope Map picks up basic principles from the base map for the development of a regional spatial data infrastructure and pursues the active integration of new data and know-how.

The pilot scheme includes the establishing of a technical framework which allows distributed data management within the whole region in the midterm. Therefore a data and knowlege exchange project webpage is developed based on a content management system. The webportal includes a „Online Search" function for the given metadata describing Spatial data sets. Furthermore an OpenSource MapServer for the visualiszation of topographic data. Another aspect of the project work is the description of possibilites for the integration of permanent monitoring data. Integrating spatial monitoring applications allows the data use for szenarios and development predictions. In the long-term the initiative aspires a data management with full interoperability of systems and formats, based on international standards. This would also include a consistent metadata documentation as well as general agreements on data provision and data use.

Therefore the implementation includes the following work packages:

- Development and further extension of spatial and attibute data for the entire Centrope region
- Harmonization of data formats and procedures for a common intraregional data use
- Implementation of a basic online spatial data catalogue
- Configuration of an Internet Map Server for visualization of regional spatial data
- Consulting on the potentials of integrating spatial monitoring data for planning purposes
- Networking and international communication with stakeholders from all parts of the Centrope region

With respect to INSPIRE guidelines on European level, Centrope MAP project should be built on the following key principles:

- Data should be collected once within the region and maintained at the level where this can be done most effectively.
- Spatial information and related attribute data on the Centrope region will be combinable from different sources and can be integrated by many users and applications.
- It must be easy to discover which geographic information is available, fits the needs for a particular use and under what conditions it can be acquired and used
- Geographic information needed for planners decisions and good governance at all levels in the region should be abundant and widely available under conditions that do not restrain its extensive use.

This principles are related to political and legal agreements which are cannot be part of the project.

Info an the actual project status is available at: http://www.multimediaplan.at/PROJEKTE/CENTROPE_MAP/

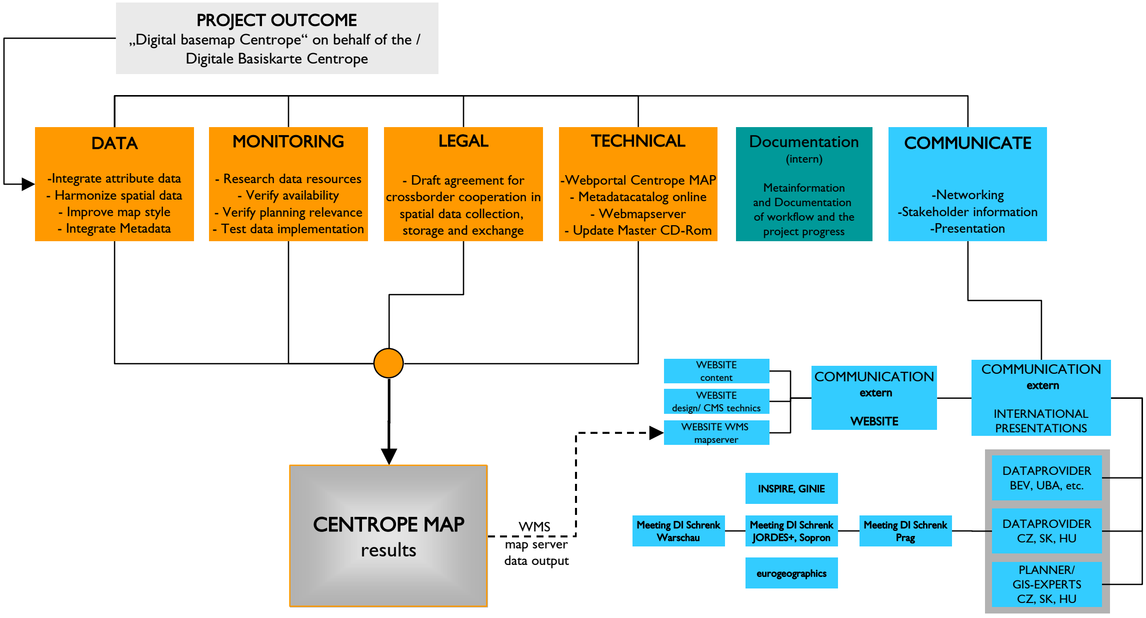
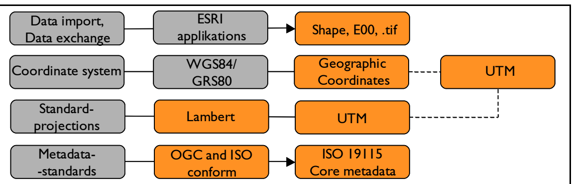


Fig.2: Project structure and consulting tasks

LAND (NUTS 0)	NUTS 1	NUTS 2	NUTS 3			LAU1 (NUTS 4)	LAU 2 (NUTS 5)	
AT	Gruppen von Bundesländern	Bundesländer	Gruppen von Bezirken		Bezirke, Gemeindebezirke (Wien)		Gemeinden	Zählsprengel Zählbezirke (Wien)
CZ	Území	Oblasti	Kraje			Okresy	Obce	
HU	Statisztikaí nagyrégiók	Tervezési-statisztikai régiók		Megyék + Budapest		Statisztikai kistérségek	Tele-pülések	
SK		Oblasti	Kraje			Okresy	Obce	
Macon Data			regions	provinces		districtis	Municipalities	



	De-facto Standards	IT-Standards	GIS-Standards
Content	Shape, E00 DXF	XML, UML	DKM (AT) GML
Inter-operabilität	.NET Java	HTTP, HTML, XML, u.a.	OGC-WMS SVG

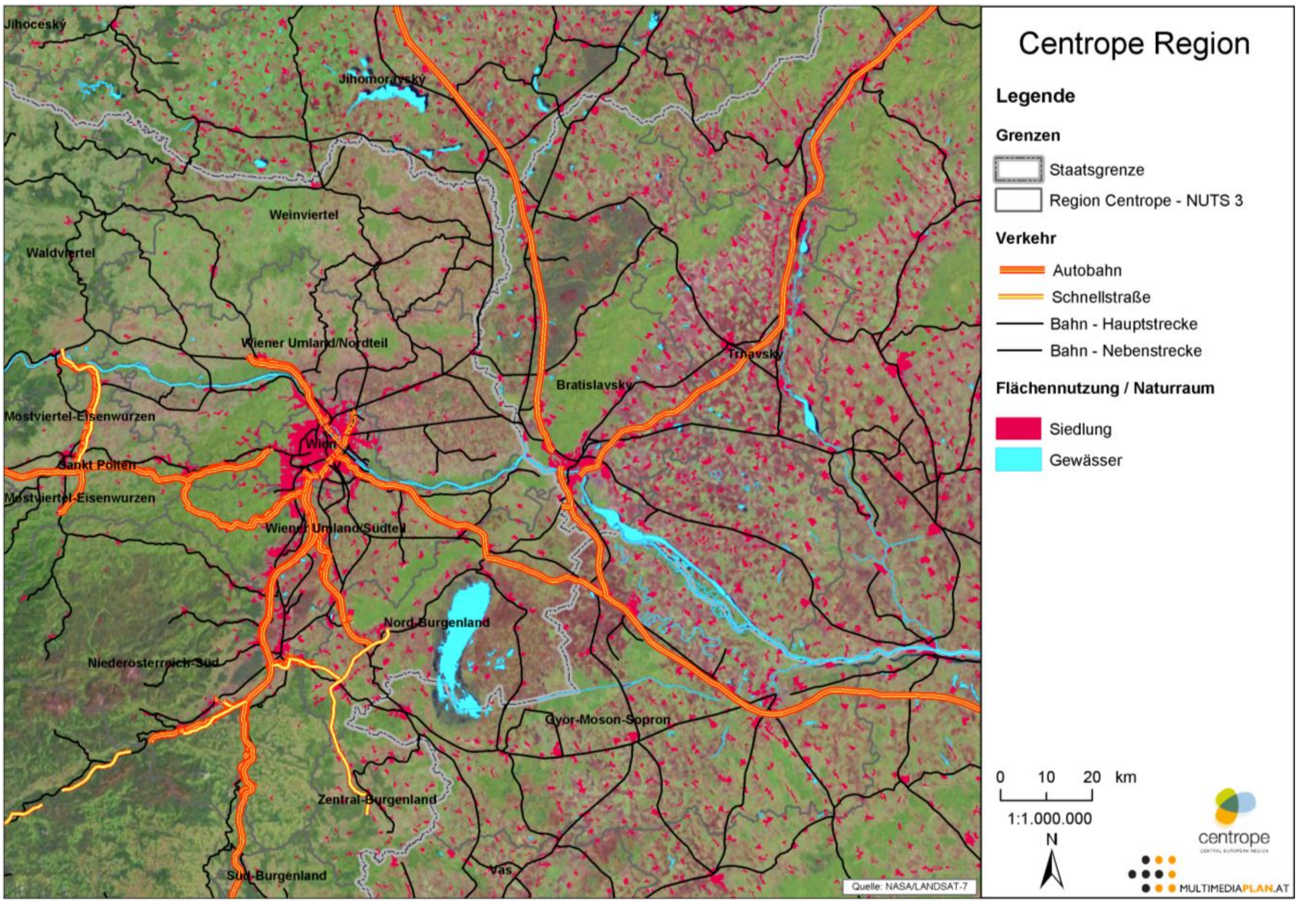
(Quelle: ESRI)

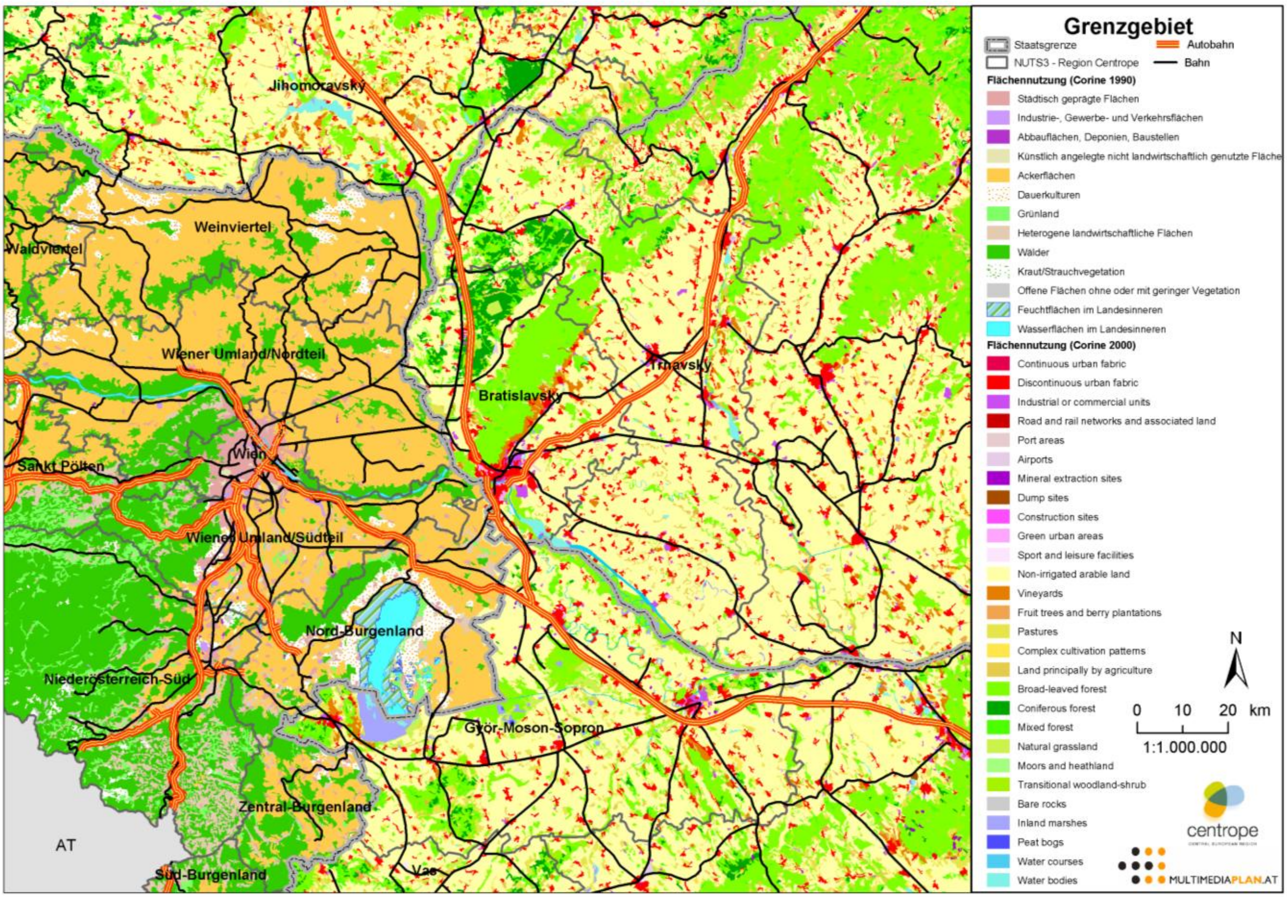
		W	NÖ	B	AT	CZ	HU	SK
Allgemein	Fläche	+	+	+	+	+	+	+
Umwelt	Flächennutzung	~	~	~	~	~	~	~
	Umweltdaten	0	0	0	0	0	0	0
Demographie	Bevölkerungsdichte	+	+	+	+	+	+	+
	Bevölkerungszahl	~	~	~	~	+	+	+
	Bevölkerungsentwicklung	+	+	+	+	~	+	~
	Wanderung	+	+	+	+	+	+	0
	Bildung	~	+	~	~	0	0	0
Infrastruktur	Abfallwirtschaft	+	+	+	+	~	~	~
	Energieverbrauch	0	0	0	0	0	0	0
	Verkehr	0	~	0	+	~	~	0
Versorgung	Gesundheit	~	~	~	~	~	~	~
	Bildungseinrichtung	0	0	0	0	0	0	0
	Wohnqualtität	0	0	0	0	0	0	0
Wirtschaft	Arbeitslose	+	+	+	+	+	~	+
	Erwerbstätige	~	~	~	~	~	~	~
	Kennzahlen	~	~	~	~	~	~	~
	Wirtschafszweige	+	+	+	+	0	0	0
Verkehr		~	~	~	+	0	0	0

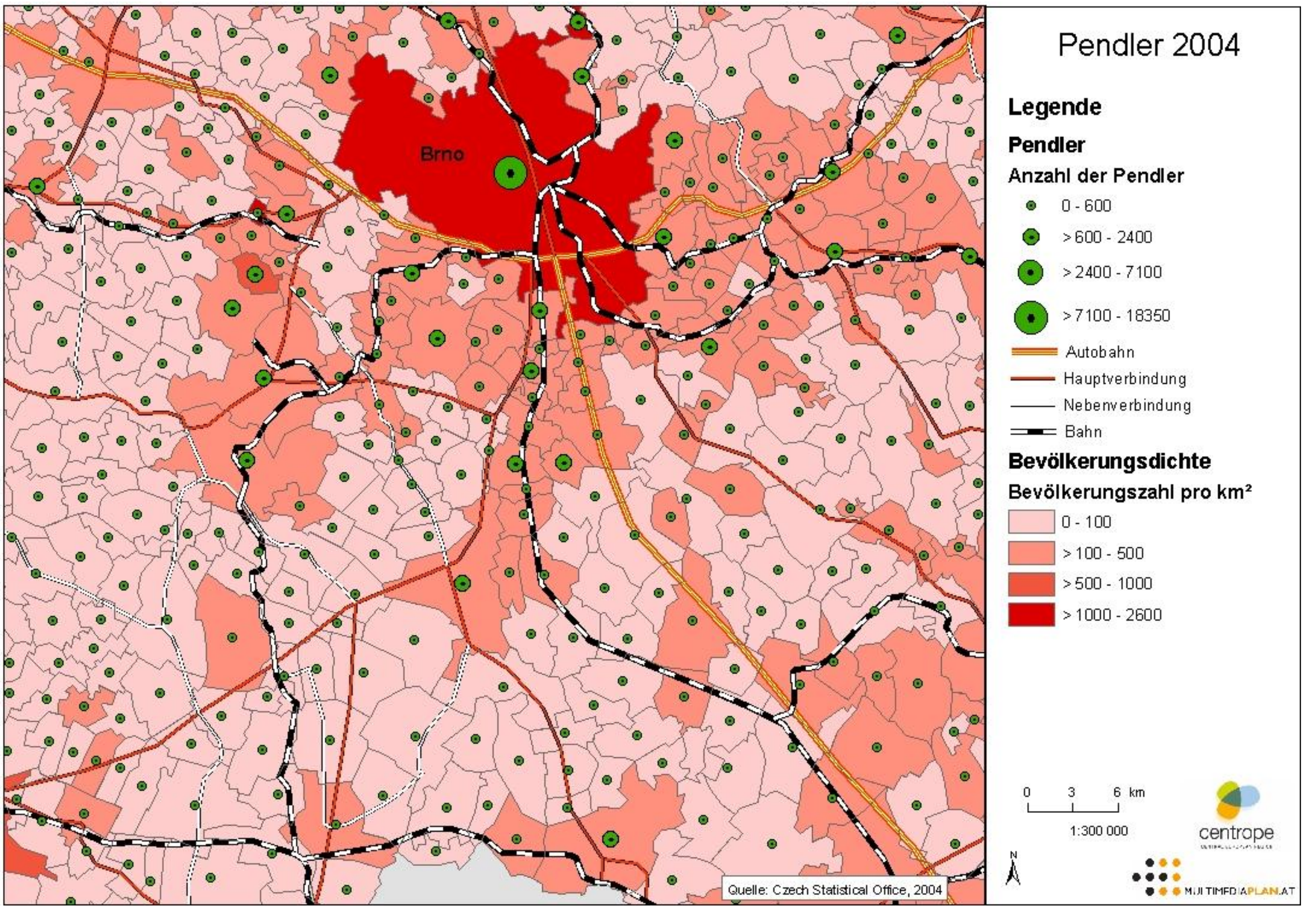
		W	NÖ	B	AT	CZ	HU	SK
Infrastruktur	Bahn	+	+	+	+	+	+	+
	Energie	0	~	0	0	~	~	~
	Kommunikation	0	~	0	0	0	0	0
	Luftfahrt	~	~	0	0	+	+	+
	öffentlicher Verkehr	+	0	0	0	0	0	0
	Straße	+	~	+	+	+	+	+
	Versorgung	0	0	0	0	0	0	0
Naturraum	Atmosphäre	0	~	0	0	0	0	0
	Biosphäre	+	+	+	0	+	+	+
	Hydrosphäre	0	~	+	0	+	+	+
POI	Allgemein	0	0	~	0	~	~	~
	Katastrophenschutz	0	~	~	0	0	0	0
	Kulturlandschaft	0	0	~	0	0	0	0
	Soziale Infrastruktur	0	0	0	0	0	0	0
Realnutzung	Realnutzung	+	+	+	0	+	+	+
Rechtlich	Land- und Forstwirtschaft	0	~	0	0	0	0	0
	Natur	0	+	+	0	0	0	0
	Raumordnung	~	~	0	0	0	0	0
	Wasser	0	~	+	0	0	0	0
Siedlung	Bevölkerung	+	+	+	+	+	+	+
	Siedlungsraum	0	~	~	0	~	~	~
Topographie	Topographie	0	~	~	0	~	~	~
Verwaltung	Allgemein	+	+	+	0	+	+	+
	Spezifisch	0	~	0	0	0	0	0
Wirtschaft	Arbeitsmarkt	~	0	0	0	0	0	0
	Betriebe	~	0	0	0	0	0	0
	Finanzen	0	0	0	0	0	0	0
	Tourismus	0	0	0	0	0	0	0

Fig.3, 4, 5, 6: Systematically structuring existing and needed information and building on standards is crucial for project success

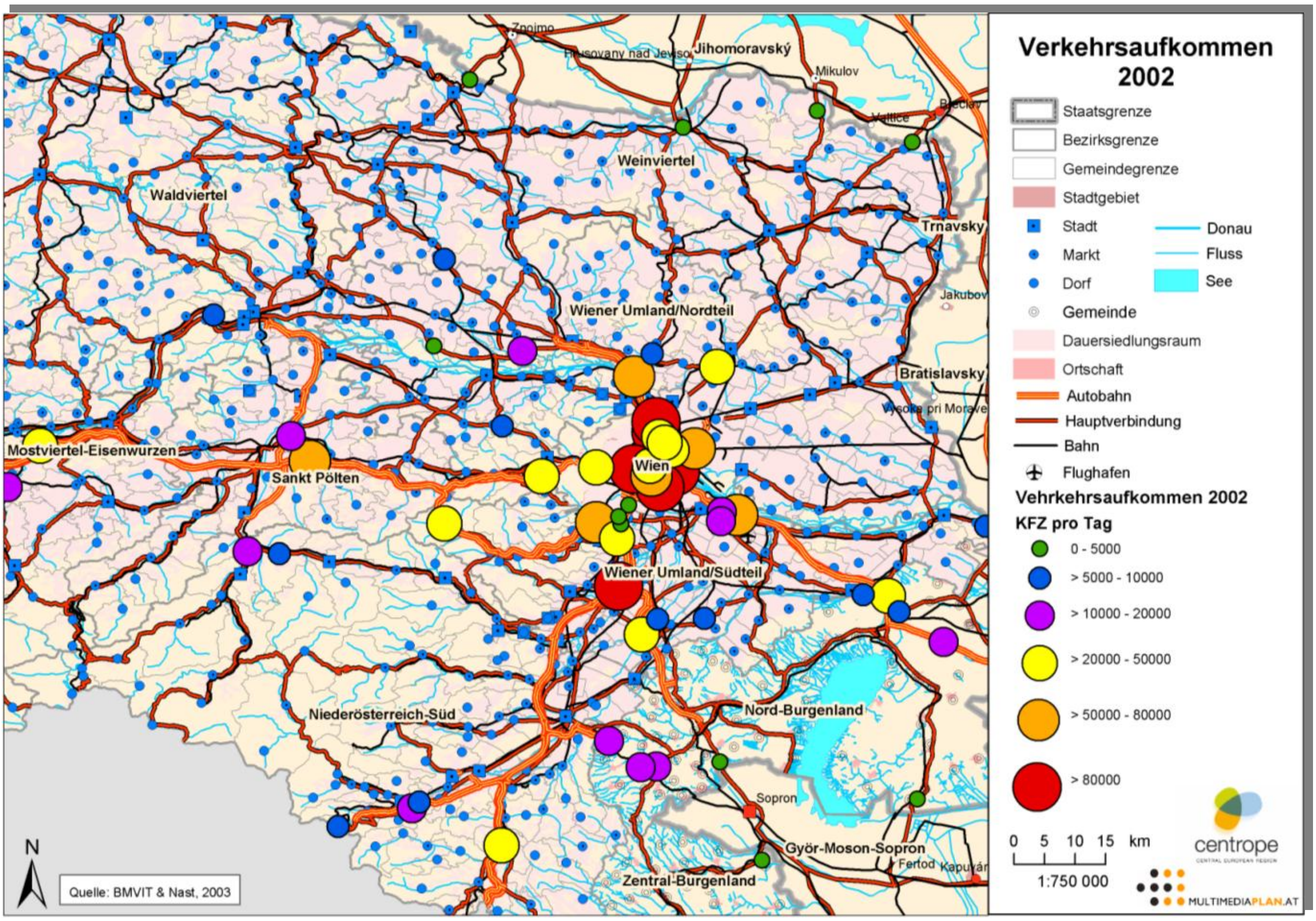
Fig.7, 8, 9, 10: Actual examples from CENTROPE MAP







Brno
Pendler 2004
Legende
Pendler
Anzahl der Pendler
0 - 600
> 600 - 2400
> 2400 - 7100
> 7100 - 18350
Autobahn
Hauptverbindung
Nebenverbindung
Bahn
Bevölkerungsdichte
Bevölkerungszahl pro km²
0 - 100
> 100 - 500
> 500 - 1000
> 1000 - 2600
0 3 6 km
1:300 000
centrope
MULTIMEDIAPLAN.AT
Quelle: Czech Statistical Office, 2004



Verkehrsaufkommen 2002
Staatsgrenze
Bezirksgrenze
Gemeindegrenze
Stadtgebiet
Stadt
Markt
Dorf
Gemeinde
Donau
Fluss
See
Dauersiedlungsraum
Ortschaft
Autobahn
Hauptverbindung
Bahn
Flughafen
Vehrkehrsaufkommen 2002
KFZ pro Tag
0 - 5000
> 5000 - 10000
> 10000 - 20000
> 20000 - 50000
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Weinviertel
Waldviertel
Wiener Umland/Nordteil
Mostviertel-Eisenwurzen
Sankt Pölten
Wien
Wiener Umland/Südteil
Niederösterreich-Süd
Nord-Burgenland
Sopron
Györ-Moson-Sopron
Zentral-Burgenland
Bratislavský
Trnavský
Jihomoravský
Mikulov
Znojmo
Quelle: BMVIT & Nast, 2003

Dichtung of Standards and *Wahrheit* of GIS Data for Spatial Planning: Cross-Border Case

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1 REASONS LEADING TO STANDARDISATION

After information technology has enabled developing huge data storages and their remote providing and sharing, the value of informatisation consists increasingly in networking hitherto individual, *ad-hoc* data sets in multiple information systems. The economic aspects of data development and maintenance make data managers think about sharing and providing data sets for secondary use. In fact, most data sets are built secondarily upon another data; only minor part of data is entirely "purely primary" ones. However, the secondary and, more generally, multiple data use by numerous users emphasises the need for their transferability from original, primary manager and user to other subjects: secondary users of primary data, those who use the primary data for creating secondary data, "tertiary" users of the secondary data, etc. This ultimately leads to effort to establish and to enforce standards for data. Decision-making is a special case of use of GIS data. Here the accuracy, updateness and reliability are the pre-requisites for correct decisions. Procuring, management and dissemination of such data needs special standards and special procedures to prevent damages. In the public domain, this is the case of the data entering the legal decisionmaking process. This all requests for legal instruments to enforce the specific standards on the part of those who originate / procure the data. Thus, the state can develop the environment for intragovernmental standardisation and transfer of GIS data relevant for planning and subsequent decision-making. Outside the public domain, data producers are not subjected to the standardisation imposed by law. However, their standards may be driven by demand, discipline and technology. As such, the standards will be part of a company strategy to retain its market share and to guarantee to their clients the continuity of their products use.

1.1 Dichtung of data standardisation

Multiple sharing of data supported by information technologies will improve the economy of data acquisition, updating and management. This will motivate data managers to keep their datasets updated and thus improve the quality of information for all users. In the field of management, the continuously updated databases may change the very system of planning and decision-making towards continuously updated strategies supporting operative decisionmaking. In the domain of data procured within public sector, the assumption is that those public data that are designated to be distributed will be certified concerning their quality and conformity with the standards. These data will be considered and treated as public goods and therefore it will be convenient when the public authority will systematically maintain its quality and stability. The high quality of public data will be transferred into derived datasets. That kind of standardisation is top-down, administration driven. On the technology side, market forces will make virtually all GIS technology producers offer similar functionality. The only way how to increase the use of their technology is to lower the transaction costs of data use by agreement to standards. Both for non-public data producers and technology producer, this will be market forces that will make them standardise their production in bottom-up manner. As it happened with railways in the 19th century and electricity networks and telephones in the 20th century, numerous formats of GIS data will merge in a single standard or a single transferable format.

1.2 Benefits and perspectives of GIS data standardization

A deeper analysis of reasons for GIS data standardisation may reveal several streams of benefit:

- interoperability by technical homogeneity of data – standardized exchange format is the precondition for building up distributed data stores
- interoperability through common structure (syntax) of data – topological as well as attribute description
- retaining semantic value of the entering and outcoming data by common ontology, e.g. using unified terminology The data standardisation has twofold perspective: syntax and semantics.
- The syntax perspective focuses on interoperability of various information systems (exchange of data between various systems) and the processing of different data by one information system. The main stress is placed on the formal grammar of information that would enable streamlined machine processing of data and the automatic interoperability

  of GIS. As most operations of GIS are automated, one needs to be sure that the data sets of different origins entering the process are logically compatible. The logic consistency of the data processing is the necessary prerequisite for receiving meaningful results at the end of the processing.
- The data semantics is always closely linked to the ontology of particular disciplines. It cannot be detached / separated from the assumptions, missions and practices of those disciplines independently from the other perspective, which is the semantics of data.

While the syntax perspective is central for IT and GIS experts, it is the semantics that is very important for secondary professional data users.

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1.3 Potentials, constraints and bottlenecks

The process of standardization in general brings various potentials and constraints:

Potentials:

•standards enable to apply the information technology in solving real problems by standardised problem situations with standard solutions.

• standards rationalise the behaviour of individuals so that they do not interfere each with other in their effort to solve the problem; in this way, the standards are a prerequisite for the effectiveness in attaining pre-defined, shared aims.

Constraints:

• standardisation tends to reduce the description of the problem into limited set of standard elements; consequently, only a selection of "standard", i.e. pre-defined and well-known problems is solved, which could further prevent from identifying "non-standard" problems and/or "hidden" sources of problems.

• sanctions for not respecting standards may hinder the creativity in solving problems.

Standards are efficient as long as the problem is "clearly-cut" and its solution can be attained by a pre-defined procedure. Within these constraints, the following "standard" pattern of problems and their relevant "standard" approaches for solutions can be summarised:

problem	„standard" approach for solution
users lack orientation in the information environment	• common data patterns, formats or their description procedures of their creation
automatic processing of data is impossible because of incompatibility of input data and the program that process them	• interoperability by technical homogeneity of data • common exchange format (XML)
data cannot be compared because of different procedures of their creation	• standardised procedure for data creation •common ontology and unified terminology for retaining semantic value of the data
normative knowledge that directly influence our behaviour is missing.	• coordination of the behaviour of individual actors • standards based on agreement and/or enforcement

1.4 Wahrheit of GIS data standardisation

The nature of GIS data makes their syntax standardisation economically constrained. The various aspects of their geographic and topologic quality, etc. and diverse GIS formats / software of origin are extremely costly to be transformed to a unique standard. Secondly, the need for GIS data standardisation itself can hardly bridge the gaps between particular disciplines, their professional concepts, viewpoints and foci.

2 METADATA STANDARDISATION

2.1 Dichtung of metadata standardisation

As there is not and obviously cannot be a kind of general uniform quality format of GIS data, the effort for standardisation has focused to metadata. Metadata seems more productive and, consequently, effective to provide potential data user a most complete, relevant, comprehensible and true information on the data comprised in a particular GIS data set. General, standardised metadata can describe the data syntax. The accessibility of metadata by users should be quick and user friendly. To attain this objective it is helpful to create stable pattern between the expectations on the user side and the metadata content and structure on the producer side. The metadata standards therefore specify the obligatory and mandatory issues that cover all aspects of described data. When the metadatabases are restructured and their content completed according to those standards, the positive effects in terms of decreasing costs of metadata creation and maintenance and increased rate of their usage arrive.

2.2 Goals and efforts

The standardisation of metadata should lead to following goals:

• to neutralise technical problems – the main objective is to ensure the interoperability of numerous data stores; the metadata creation and maintenance can be partly automated

• to guide the search for information – the standards will ensure that user will know in advance what data characteristics the metadata covers. In this case the metadata specify mostly technical information. The information on the data semantic is represented only by category "keywords".

Unlike the data syntax, the data semantics cannot be fully reflected by general metadata standards. In effect this is not their task, ISO standards build up general, universal platform for data exchange. ISO standards on the other hand are not the closed system, it is rather system of rules that enable to extend their extend so, that the standards would cover also the issues of more specific domains.

The ISO/DIS standard distinguishes the core metadata that offer the information crucial for technical exchange and automatic processing of data, and community profiles that should serve particular communities of professional users of GIS data. There are several efforts to develop an international standard for metadata, e.g European EU CEN 12657 and world-wide ISO/DIS 19115 Geographic Information – Metadata: the latter seems to be a groundwork for the future unification even in Europe as the process of acquiring has started as European standard. The ISO metadata standards offer description of geographic data generally but it also enables to build community profiles with information for specific users. The general metadata descriptions relates to the techniques of GIS data production and use. They are for biggest part technical specification of datasets. The rest of the general standard of metadata addresses the accessibility and management of data. However, the approach is generalist for the information on the data content.

2.3 Wahrheit of metadata standardisation

However precise the standards of metadata aim to be, no one has been approved and accepted as binding standard yet. Instead, national standards have been developed here and there, making the issue of future shift to a uniform international standard even trickier. The presently existing metadata obviously do not comply with the formal requirements of the ISO metadata standard as well as any other generally acceptable standard for the description of geographic data. It would require a lot of time and resources to achieve any kind of such standard for the existing data. The cost-benefit ratio can be very disadvantageous for the primary producers of standardised metadata as they will not be immediate receivers of the benefit. Positive externalities will not arrive as long as the standards will not be broadly accepted and implemented. Obviously, the full scope of the standard may prove to be achievable only for the metadata on basic geographic GIS data, while the secondary data created on the background of the basic data may make reference to their “parent” data set. With different pace of updating of the “parent” and secondary data, the value of metadata cannot be overestimated but it will be difficult (and costly) to achieve the appropriate standard generally. Probably this will be only a fragment of GIS data that will be described by standardised metadata even in future. This may be the case of statutory, legally defined registered data sets of information systems for public administration, for which the fully standardised metadata will be provided, based on a legal enforcement. In this respect, this is mainly the task for public sector to start the implementation of metadata standards. Beside the statutory, legally registered authoritarian data, a wide scope of privately created information systems is emerging, designated for market. Here the market laws on demand and supply enter the scene. The competition for customers may make the data managers / providers / suppliers to comply with metadata standards, but only in the case of data designated for wider market, and in rich informational communities where costs of primary data acquisition will be low and quality information based on the data will be highly priced, frequently needed data will be worth describing by standardised metadata. But wherever the information market is weak and imperfect, monopolist behaviour of suppliers can be expected and, consequently, the data description by metadata will be weak and incomplete.

3 THE CASE OF INFORMATISED SPATIAL PLANNING

3.1 Dichtung of informatisation of spatial planning

With help of information technology, spatial planning can easily make available data created in the domains of demography, general statistics, environmental protection, monument conservation, transport, water management, energetic, etc. This will save a lot of tedious hunting for particular data and make the saved time available for analyses that will improve the quality of planning process. Information technology can also disseminate the information elaborated by planning to all stakeholders and to general public. Internet can make access to the data instant and easy. It has also potential to establish a two-way communication on planning and development issues between planners and stakeholders. Thus, information technology can contribute to a more democratic, responsive planning.

3.2 Specifics of spatial planning in the respect of information

The Royal Institute of Town Planning defines spatial planning as “management of environmental change”. To be able to manage, planners need information in a broadest sense of the word. Information science distinguishes several levels of items in information management (Laurini 2001):

- data – strings of digits, letters or any other symbols without any semantic connotation
- information – the data that have a meaning for their user
- knowledge – the application of information that supports reasonable decision-making.

Only data and information is the concern of this paper. While data can be transferred and processed again and again, information is rather specific to the individual data user and to the intended use of knowledge. John Zeisel (Zeisel 1981) recognises two types of information in planning:

- information that describes planning proposals – in the form of written guidelines or more physical and concrete plans.
- information used to test and to choose the right choice / solution.

Spatial planning discipline is analytical as well as design discipline and the use of data and information in planning is twofold:

- Planners collect various data, mostly from other fields of enquiry (geography, sociology, environmental sciences...) and they analyse their relevance to the problem in their hands. The outcome of the analyses is planning information and as such it should help stakeholders of development to make proper individual decisions.

• On the other hand, planners propose solutions of the problems in the form of plans. This is the act of design, which is a kind of outgoing data produced by planning.

The table below confronts the nature of data with their testing in the process of planning:

nature of data	**information to test with**	**nature of test**	**information to be tested (alternative proposals)**
GIS objects – their geometry and topology, their geographic referencing	existing physical objects and phenomena that are possible to represent by points, lines, polygons or that are sampled into raster geographical data	existing physical objects and phenomena that are possible to represent by points, lines, polygons or that are sampled into raster geographical data	depiction of the proposal in the form of GIS objects
depiction of the proposal in the form of GIS objects	depiction of the proposal in the form of GIS objects	GIS methods of spatial analysis plus non-spatial analysis	the properties of proposal
non-geographical data	properties of abstract objects that are not possible to represent as GIS objects. Some of those properties can have spatial impact related to GIS objects	non-spatial analysis and human judgement	• proposed image of future state • qualitative aspects of proposal • written record only

Planners use all the above stated information to propose solutions for problems. GISs offer variety of spatial analysis tools. They are centred to analyse spatial relations between objects. The GIS can be also very well combined with other kinds of models that represent non-spatial aspects (economy or demography). On the other hand GISs are based on the assumption that we are explicit in the spatial extent and impact of described or prescribed phenomena. Quite frequently planners are not capable to express these aspects clearly enough, to make them operational so that they can be used in GIS analysis. Then non-rational kind of test must persuade about the rightness of the proposal. Mostly subjective human judgement based on experience is used, or confrontation of the proposal with existing standards, guidelines and specifications. It is obvious that the judgement cannot be reduced just to the information that is possible to represent by means of GIS.

3.3 The nature of the information that spatial planners use

For the application of general concepts of data, metadata and their standardisation in the environment of spatial planning, analysis was made of the kinds of information spatial planners need, seek and use. The analysis showed that the data entering spatial planning convey various quality of information with different prospects of validation. Most incoming data can be comfortably placed in one of the following categories:

character	**the reality presented**	**origins of data**	**validation**
hard	physical reality	modelling physical reality	easy to validate by eyewitnessed confronting the model with the reality
	legal reality	derive from law	confronting the data with relevant legal instruments
soft	values, opinions and judgments	enquiry or other sociological research, informal interviews, studying media issues, etc.	depends on the method but it is always restricted to certain space and time
	Intentions – declarations of intented change	Plans, strategies, projects	If the intentions are projected into material form (plan) than they can be tested on the backround of other information

Outgoing data and information

character	The reality presented	Data	validation
Hard	Analyses as outcomes of research	Obserbation and/or by experimental manipulation with the objects or logical inference	Scientific tests and proved analyses
soft	Planned (future) physical reality: it can span from the edge of “hardness” to mere vision	(statutory) plans, projects strategies, prognoses visions	Belief that plans will come true; the risk that they may not be “true” in future depends on the power of those who are expected to implement the plan in question

In fact, only the "hard", quantifiable data and logic transformation has been the domain of GIS. The other information has had to be supported by other techniques and technology so far. This existing shortcoming of GIS data should be taken in consideration in every effort to conceptualise a GIS-based planning process. The "hard" data can be subject of formal standardisation. Here, metadata can be a great help to classify the data. For the data on physical reality, the main focus of the metadata is in general, i.e. discipline-free, description of the GIS data (topology, geometry, time relevance). For the data on legal reality, one needs to understand their meaning for decision-making. The "soft" data, however they can be geo-referenced, can hardly be somehow standardised. Their metadata can be reduced to the description of their origin, showing also their nature / reliability) and use for planning and the description on the incoming data processing.

3.4 The information and power environment planners face

In the relation to information presented and decision to be taken, spatial planners can run into following scenarios:

- hard data + rational analysis – syntax of the outcome can be standardised; the syntax quality of data produced by secondary analysis derives from the poorest quality of the entry / incoming data sets; the data semantics can be derived from the incoming / entry data
- hybrid or soft data + rational analysis – syntax of the outcome is unclear, semantics varied
- lack of data – rational analysis is incomplete or impossible; the outcomes are intuitive

In most planning assignments, the entry data are of varied syntax, some of them may be outdated or otherwise imperfect. Often, planners cannot rely on "hard" data only. Consequently, the syntax perspective of the outcoming planning information can be hardly standardised by rational, scientific analysis only. Moreover, any case of planning is challenged by limited power to implement the outcoming knowledge. Even the fully standardised outputs will not make "reliable" planning product. The essence of planners' skill is to recognise and distinguish the category of data s/he deals with and to understand how much power is available to implement the plan.

3.5 Transfer for secondary analysis and use of data in planning

Spatial planning is a typical secondary user of the data made for another use. It frequently uses the GIS data originally developed for cartography, environmental monitoring and protection, transportation, etc. The background data transferred from other disciplines make the base and background for planning analyses and then for the outcoming planning information. Sometimes the background data serve as containers that are filled by additional factual data needed for the planning analyses. As such, meta-information on the transferred data and standard transfer of them are the prerequisite for the estimation of the quality of analyses made upon them. The issue of standardisation that would support the data transfer by creating transparent mechanism of it emerges as another dimension of the standardisation. In the inter-territorial transfer the relevance of planning-relevant data to particular tiers (national, regional, local) of planning is important. Each of the tiers places own priority on different particular issues.: The national and regional tiers emphasise inter-regional or, respectively, intra-regional balance, economical competitiveness, and higher-level infrastructure. The local tier is more focused on attributes of physical environment, visual aspects of environment and social interaction in the space. As it was with the data standardisation in general, also the standardisation of data transfer has syntax and semantic perspective. More to that, the transfer from one discipline to another and the transfer between different (legally) institutional and national (language) territories can be distinguished. The following morphological table combining the perspectives and transfers stated above implies four different limits to the use of data:

	syntax perspective	semantic perspective
inter-disciplinary transfer	narrow focus of standards on general geographic use	barriers / gaps between professional concepts
inter-territorial transfer	diverse regional / national standards different scales of the tiers of planning documents	language barriers between territories

4 WAHRHEIT OF INTERDISCIPLINARY TRANSFER OF DATA

Interdisciplinary transfer of information is a crucial problem for spatial planning not only in syntax and semantic perspectives as described above but also in terms of a (dis)balance between information coming in the system of spatial planning and information provided by spatial planning for the use of other disciplines and users. What is critical is not the interdisciplinary nature of the discipline alone, but the need of data supplied from other disciplines. The discipline is a "net importer" of GIS data: spatial planners need a lot of "hard" GIS data from outside than endogenous "hard" data created by the discipline itself. Also the application of spatial planning-born GIS data outside the discipline is much less than the "import" of them by planning. This makes the position of spatial planning on the "GIS data market" extremely weak.

4.1 From "hard" metadata to "soft" metadata?

Most effort in the hitherto informatisation of planning has revolved around the technology of data accessing and transfer. We showed that increasing concern concentrates around the elaboration and providing of data on the data through metadata. However, the standardisation of metadata has definite limits both in the standardisation of their context and the extent of data sets that can be reasonably equipped by metadata. The exploding number of data and the diversification of their origin and shape bring another problem on the scene: how to get oriented in the maze of data to reach the data relevant to the individual case of planning problem.

Here, portals seem to be certain help, by enabling link to data providers. The problem rests in the selection (and selectiveness) of the information provided by portals, partly reasoned by certain quality criteria that may be applied for the placement of the link on providers and on data. As planners need and also have to use also non-standard, “soft” and fuzzy data (usually not equipped with relevant metadata), this data may be disqualified from the portals. On the other hand, if admitted, they may be misleading as for their (not indicated) quality. Accepting that not only standard, “hard” data is acceptable in the community of planning, also not only standardised metadata should be accepted. They should be communityspecific. They may not provide full scope of information needed by data users but they should convey the basic information on to what kind of risk a user is exposed by using them as a model of reality.

4.2 Community profile: The way how to cope with the specifics of planning in its informatisation (?)

A great deal of GIS data relevant to spatial planning was originally produced for a specific use and for a single specific “primary” user who ordered for the making of the data. The primary user of the data needed a certain scope of meta-information, and this is what the primary user as a client ordered from the data producer. As long as the data was not offered to a secondary user, no standardised metadata was required. Therefore planning needs a lot of additional meta-information of semantic character, specific for the use within the discipline. Using the ISO/DIS metadata standard, the Community profile of metadata should facilitate the interpretation of data by community of users to get the discipline-specific metainformation. In the description of the syntax perspective, it should be focused on the import of data from the domains of other disciplines. For the specific case of spatial planning as a receiver of data of heterogeneous quality and relevance from diverse disciplines, the semantics of the transferred data to fit to the spatial planning discipline ontology and the methods that spatial planners use is a major issue. It remains a matter to be disputed whether or not, or to which extent the community metadata profile should provide that kind of meta-information. Maybe it should just guide the users to get the information by themselves. Unlike the general metadata description, the community profile should be developed and managed by planners, no matter where the data may originate. In the syntax perspective of the data description, the community profile of planning will include mostly the items already included in the general ISO/DIS metadata core or standard (Maier, Čtyroký, Vorel 2003): title, alternate title, category of topic, geographic extent, scale of resolution, data description with attribute structure, type of spatial representation, time relevance, date of data acquisition, data quality (completeness, semantic correctness), spatial reference system, data language, format, management of and access to data, lineage of origin, source lineage, date of metadata updating, and some more, less important for planning use. Problems emerge when non-standardised data, mostly not equipped with metadata are to be used by planning community. Here probably a certain basic set of metadata would be helpful to describe the potential use for planning but there is no standard way how to develop, verify and manage it. The interest in metadata is on the part of planning community but the major part of the needed information remains in the domain of the data originator. The semantic perspective deserves special attention in the respect of the planning community metadata profile. However, it is doubtful to which extent the semantics-oriented metadata should be developed, not to interfere with case-specific and user-specific matters.

4.3 From metadata to meta-knowledge?

Metadata describe the properties of data but the properties of data plus data is not information yet. In order to get information, the ontology, i.e. the meaning of the objects that are represented by data is necessary: the way the objects are conceptualised, the constraints for their interpretations, and the definition of concepts that are represented by data. There is a debate whether the ontology should be part of metadata or if this is the role of meta-information. The ontology is usually at least partly included in the metadata as key words that define thematic area to which the data make reference. The definitions of the vocabulary terms that create ontology cannot be in metadata as they are specific to various uses of data. These definitions should be in the meta-information. To use the information and data in solving our problems we need knowledge. The knowledge consists of assumptions, theoretical statements and normative guidelines (methods). The knowledge is necessary for the use of data and information, but it is not the property of any of these. The sources of knowledge are different. The knowledge is proper to each person and is shared in domains of specific disciplines.

A knowledge base that would guide the use of data and information could consists of (Turban and Aronson in Laurini 2001):

- Behaviour descriptors and beliefs
- Vocabulary definitions
- Objects and relationships
- Procedures for problem solving
- Heuristics and decision rules
- Typical situations
- Hypothesis (theories)
- General knowledge of the world
- Facts
- Constraints
- Processes

The description of the knowledge base would be the role of meta-knowledge. The metaknowledge cannot be part of metadata or meta-information. The knowledge base as well as meta-knowledge should be built by community that share the knowledge and it should evaluate the theory and methodology in relation to the problems to be solved. The following table summarises the previous discussion.

nominal level	meta-level	the role of meta-level	who creates meta-level
data	metadata	Proconditions for data storage, transfer and automatic processing	Producers of data describe the properties of data
Information	Meta-information	Precondition for understanding the meaning of data	Users of specific ontology domain
Knowledge	Meta-knowledge	Describing the effectiveness of the knowledge use when solving the problem	Problem solvers evaluate the knowledge base

The metadata are created by data producers as only producers are knowledgeable of data properties they create. The meta-information is created by users that share the common ontology. Every ontology conceptualizes the perception of problems. The symptoms of the problem are confined into categories that serve our decision-making. The knowledge bases and meta-knowledge guide the ontology users in connecting the named symptoms with specific action. Once the ontology is established, it is the independent, objective, categorical system of concepts that can be made public. It can guide the data producers in the creation of data and organizing their meanings in reference to chosen ontology. The meta-information is more general and less abstract than the meta-knowledge. Several disciplines (or knowledge bases) can use shared ontology defined by meta-information. The meta-knowledge is created by users of knowledge: the professionals and scholars. Only users of the knowledge base can evaluate the efficiency of knowledge base in guiding them to the right solutions. Every new or updated knowledge creates new ontology and therefore inform the meta-information level. All three levels: metadata, meta-information and meta-knowledge play different roles, they are created for different purposes and often by different communities of experts. The community profile of planning should focus on the meta-information level. It should be created by planners with regards to other ontology.

5 CONCLUSIONS

The reality of GIS data diverts from the wishful thinking of GIS standards. This makes the challenge of the muddling through in the GIS not temporal but constant issue. This is not an unknown situation for planners who got used to incomplete, heterogeneous and outdated data in their everyday practice but is difficult to swallow by more "technically perfectionist" GIS experts. Also the general standardisation of the description of data by metadata has own limits. It does not fit to non-standard, imperfect data. On the other hand, planners need certain orientation in the maze of data, even on the imperfect data. A flexible description of these data, open and relevant both to the data and their users, could be a part of the community profile of metadata. The ultimate use of data is to develop the relevant and useful information and knowledge from them. The exchange of data, information and mainly knowledge needs support by structured descriptions, each related to one of the mentioned levels: data, information and knowledge. Standards can never cure our world of the chaos that is connected to the usage of data. In the planning profession, managing incomplete information environment is an everyday business.

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ERA-NET TRANSPORT – paving the way for joint European transport research

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1 INTRODUCTION

Spatial planning is the horizontal discipline in Europe which regulates spatial developments, on different geographical levels, particularly concerning the human basic needs and basic functions – housing, labour, leisure and transportation. The field of long term and short term challenges as well as different complementary approaches, like bottom-up and top-down approaches pose a heavy but interesting challenge for scientists, planners and civil servants who work in this field.

One of the relevant fields of research concerning spatial planning is mobility and transport research. Within the Sixth Framework Programme for Research and Technological Development (FP6) of the European Commission mobility and transport research is a major topic. Furthermore a new instrument of European research policy the ERA-NET scheme is heading towards the coordination of national research policy activities (e.g. Transport research funding programmes).

Real models – unreal world! This real ERA-NET TRANSPORT (ENT) initiative actively participates in framing the future transport and mobility research. Spatial planning will be effected by the outcome of research projects funded by future coordinated and cooperating national transport research activities between European member states over the short-term and medium-term, referring to prospective mobility research, infrastructure and vehicle technologies development or research in transport infrastructure capacity management -planning and -administration.

2 THE EUROPEAN RESEARCH AREA AND THE ERA-NET SCHEME

Europe has a long-standing tradition of excellence in research and innovation, and European research teams continue to lead progress in many fields of science and technology. However, the centres of excellence are scattered across the continent and all too often their efforts fail to add up in the absence of adequate networking and cooperation. In the past, collaborative actions have been initiated at European and Community level, but now is the time to bring our endeavours together and to build a research and innovation equivalent to the "common market" for goods and services. That structure is called the European Research Area (ERA) and is regrouping all Community supports for the better coordination of research activities and the convergence of research and innovation policies, at national and EU levels.[2]

The European Research Area's core message is the need to overcome the traditional fragmentation of national research efforts in the EU through better coordination and cooperation to build a research and innovation equivalent to the "common market". Therefore the Sixth Framework Programme for Research and Technological Development (FP6) launched a specific programme "Integrating and Strengthening the European Research Area" within the ERA-NET Scheme is financed.

The ERA-NET Scheme is about the coordination and cooperation of national and regional research programmes in Member States and Associated States, in any field research. As such it aims to bring together research programme managers at the national and regional policy level, who are either working in the Ministries or in funding agencies and are implementing programmes on behalf of the public administration. The main objective of ERA-NET is to step up the networking and foster the implementation of joint national and regional research programmes by pooling scattered human and financial resources. The idea is to improve the efficiency and effectiveness within the ERA.

3 ERA-NET TRANSPORT IN GENERAL

3.1 The policy goal

ERA-NET TRANSPORT is set up for the period 2004-2007 with the objective to strengthen the European scientific base and to support the structuring of the European Research Area within transport research. It is focusing transport research covering all transport modes, geographical scales (nationally and regionally) and thematic range of transport research.

The long-term vision, also beyond the project period, is to improve the outcome of transport research activities in terms of quality, efficiency and effectiveness. The vision behind ERA-NET TRANSPORT can be described as a coordinated and cooperative European framework for transport research policy, where regional, national and European organisations coordinate, cooperate or even integrate their activities, on a voluntary basis, in line with their respective sovereign competencies and interests.

The framework shall be designed to offer benefits to transport research programmes at the different levels, offering various possibilities for cooperation between programmes all the way to joint research programme design and mutual opening of existing programmes. The conceptual framing – the thematic areas, the policy instruments, the combination of funds and the participation of different countries – are not defined yet. Guidelines for establishing proper procedures heading towards successful joint research activities will be recommended and tested by ENT to bring forward this vision of future transport research programming in Europe. This means the opening up of national research programmes to participate in the development of a joint vision, joint procedures, joint programming and joint project management in the field of transport research.

[2] European Commission, http://europa.eu.int/comm/research/era/index_en.html, Dec. 2004.

3.2 The consortium

Cooperation in transport research policy in Europe is already taking place in several ways, like in the EU framework programme, and other policy networks of transport research organisations and actors that supports research cooperation.

However, the focus of ERA-NET TRANSPORT is to support and coordinate research activities between the Transport, Technology, Innovation, Science and Research Ministries and research programme management organisations of the EU member states. With its activities ENT brings together all relevant players in the field of transport research policy like public and non-public authorities, funding bodies, technology agencies and research institutions.

The consortium originally consisted of 11 partners from 9 European countries, but actually, after the first enlargement procedure at the beginning of 2005, it comprises 13 partners from 11 countries. These are namely Austria (The Austrian Federal Ministry for Transport, Innovation and Technology (bmvit), Unit III/I7 - Mobility and Transport Technologies), Belgium (The Federal Public Planning Service Science Policy), Finland (The Ministry of Transport and Communications), France (The Ministry of infrastructure, transport, housing, tourism, and the sea (METLTM/DRAST) and Institut des sciences et des techniques de l'équipement et de l'environnement pour le développement (ISTED)), Germany (The Federal Ministry of Education and Research (BMBF) and TÜV-Akademie Rheinland GmbH), Netherlands (The Ministry of Transport, Public Works and Water Management), Norway (The Ministry of Transport and Communications), Sweden (The Swedish Agency for Innovations Systems (VINNOVA)), United Kingdom (The Department for Transport), Poland (The Ministry of Scientific Research and Information Technology) and Denmark (The Ministry of Transport).

The pre-requisite for participation for the partners was the existence of national transport research programmes or for the new member states existing transport research activities. In the case of Austria it is the transport research and transport technology research programme "Intelligent Transport Systems and Services (IV2S)", which is planned for the time period of 2002-2006. This national programme is donated with about 35.000 T€ and divided into three sub-programmes, namely the A3-programme (Austrian Advanced Automotive Technology), the I2-programme (Intelligent Infrastructure) and the ISB-programme (Innovative System Railway). A3 aims to improve the competitiveness of the automotive supply industry by the promotion of cooperative research and development projects and to create new knowledge towards cero-emission vehicle technology. I2 aims to support Austrian enterprises in the development and testing of system-integrated transport Telematics applications. The range of projects goes from intelligent transport systems (ITS) to transport related intelligent infrastructure projects. ISB aims to increase the efficiency and attractiveness of strategically important fields in the railway sector of Austria. Due to these transport research related and development funding programmes Austria has the possibility to structure the future coordination and cooperation models, guidelines and procedures as well as topics very actively. The future impacts of the ERA will be noticeable firstly on the national transport related research scene and industry and secondly on the regional, national or European choices of location, for example of the automotive, rail or Telematics industry or supplying industry and SME's. Furthermore IV2S has a strong focus on mobility and transport research financing in the above mentioned sub-programmes, not only R&D, but also research studies concerning problem solutions for specific topics in transport.

4 STATE OF THE ART OF THE DIFFERENT WORK PACKAGES

ENT consists of 6 work packages which are separated by the different tasks which are the "development of model procedures and rules", the "identification of areas for cooperation", the "implementation of coordination and cooperation mechanisms", the "dissemination" of results, the "coordination of network activities" and the "contract and consortium management".

4.1.1 Development of model procedures and rules (WP1)

The aim of this work package is to create a framework for joint European transport research policy. It will provide analyses of different national transport research programmes and set up criteria for cooperation which will lead to guidelines for possible cooperation mechanisms between national or regional transport research programmes. The unit Mobility and Transport Technology (Abt. III/I7) of the bmvit is responsible for this first work package. The work package leader is Dr. Andreas Dorda.

As a first overview WP1 drafted a report[3] of actual patterns and mechanism of cooperation in national transport research policy concerning especially political and institutional activities. It consists of two main parts, firstly the country descriptions of Austria, Belgium, Denmark, Estonia, Finland, France, Germany, the Netherlands, Norway, Poland, Sweden and the United Kingdom, in terms of a comparative benchmarking, and secondly the collection of key-player diagrams, which show the major national key-players involved in the several described transport research programmes.

For this overview the model of the policy circle is used as a structural element. The applied policy circle describes three main periods and outlines six stages in a circular policy process:

1. *Policy formulation* (= policy description and policy determination).
2. *Policy realisation* (= policy implementation and policy dissemination).
3. *Policy learning* (= policy evaluation and policy monitoring).

The period of *policy formulation* is significant for setting direction and for policy orientation. At the policy description stage, e.g. visions, political agendas and overall political goals are set up, while at the policy determination stage detailed target setting and strategic planning is conducted.

[3] Kropf H., Seibt C.: 2004.

In the *policy realisation* period the implementation of research programmes and the dissemination of the research outcomes is central. At the policy implementation stage e.g. research programming modalities and research topics are defined and funding models and budgets are negotiated. At the policy dissemination stage research results should be published and distributed in a comprehensive knowledge transfer and a wide information diffusion process.

The *policy learning* period refers to the fact, that policy processes are non-deterministic but complex. At the policy evaluation stage research programme and project results are assessed concerning the program or project objectives. Or at the policy monitoring stage, policy performance and societal aspects are assessed along the process. The outcomes are addressed to the policy formulation period.

The competencies of the ministries and funding organisations are lined out and the formal and informal cooperation procedures are described. For example at the policy formulation period mainly the ministries are in charge involving several stakeholders from diverse institutions in "new modes of governance" while in the policy implementation and dissemination stage (=policy realisation) in most European countries funding bodies and research agencies play a major role, although the ministries hold the main responsibility. The dissemination stage does nearly not exist in the most member states. The policy learning period refers to the idea of a reflexive policy process which passes back experiences and results from the ongoing policy initiatives to the development of future policy activities.

4.1.2 Identification of areas for cooperation (WP2)

The second work package has to develop a shared perspective for European transport research and has to identify the research topics for cooperation and integration. Therefore trends in the demand for transport research in the longer term and possible areas for cooperation are identified in the first report[4]. The Dutch colleagues from the Ministry of Transport, Public Works and Water Management and the Transport Research Centre (AVV) are in charge of this work package.

The "transnational transport research roadmap" identified 6 possible research areas for cooperation, which are based on analysis of 235 available transport research programmes. These areas have been separated into 48 specific fields. These six areas for transport research are identified in a negotiation process in the ENT consortium. The identified major areas are namely "Economic benefits through integration, interoperability and intermodality"; "Efficiency improvements through transport and infrastructure management"; "Efficiency improvements through intelligent transport systems"; "Economic benefits through pricing and taxation"; "Environmental improvements through vehicle technology" and "Safety and security improvements through transport and infrastructure management".

Based on these consultation and the first results of a Delphi survey concerning transport research technologies, further analyses, explorative workshops and policy seminars will be carried out and organised.

4.1.3 Implementation of coordination and cooperation mechanisms (WP3)

The main aim of this work package is to set the conditions and to provide the support for the implementation of coordination and cooperation activities. The guidelines, procedures and criteria provided by WP1 and the identified transport research areas and reports provided by WP2 are the bases for the implementation of joint activities for trans-national transport research programmes. In targeted workshops (TWS) the most promising research topics will be determined heading towards joint activities. The first research cooperation topic was based on workshop results of the *European Platform for Transport Research (EPTR)*, which organised several workshops among programme managers and policy makers in 2003 and 2004. The first chosen research topic was "ITS and reliability of passenger transport", which will lead to the first joint activities in European transport research.

5 JOINT ACTIVITIES OF NATIONAL TRANSPORT RESEARCH POLICIES

ERA-NET TRANSPORT deals with the entire transport research policy circle. That means it deals with the strategic policy level, the programme development and implementation level and the project level in transport research.

On each stage of the transport research policy circle cooperation is actual possible. ENT specifically focuses on the policy implementation stage (transport research programming process). For appropriate coordination activities at the policy implementation stage five levels of cooperation are identified.

The 5 levels of cooperation are:

Exchange of information (knowledge exchange) on policy objectives and goals as well as research programmes and projects, research results are exchanged openly (e.g. at conferences, workshops or via the Internet), as well as information on programme structures and programming mechanisms.

Joint project definition and clustering, the projects remain independent and financed by national sources, but common goals and a common approach are defined in order to integrate the project results.

Joint projects, joining the activities in one project with one management and one budget.

Joint programme implementation, National programmes or part of such are coordinated in time and modalities. The outcome can be joint projects or pure national projects. All researchers are funded from their own country.

Joint programming, research areas, modalities and a financing model are established among the participating countries. A joint call is carried out and the best research proposals will be financed

Due to the fact of diverse national transport research policies and research funding systems in Europe many barriers (legal, financial, administrative etc.) may and will occur and have to be taken seriously into consideration defining criteria for trans-national transport

[4] Halbesma S.: 2004.

research. The formulation of these criteria will need detailed preparation heading towards acceptable guidelines. ERA-NET TRANSPORT defined the highest level of cooperation – as the ultimate ambition – namely the creation of multi-lateral transport research funding programmes with joint calls, joint evaluation procedures and a common funding budget by the end of the five year period.

For further information regarding ERA-NET TRANSPORT please visit the webpage www.transport-era.net.

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The Social Construction of Virtual Cities – A Strategic View for Urban-Technological Development in Europe

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1 INTRODUCTION

The massive diffusion of new information and communication technologies (ICTs) – especially the more recent development of mobile and wireless technologies – has necessitated a through re-conceptualising of the relations between space, time and technologies. City-makers and urban scholars currently face an enormous challenge, as new notions of space and time increasingly call into question old paradigms. This process in turn affects the way ICTs are dealt with as part of government, planning and policy agendas. This 'paradigm challenge' affects the whole range of issues related to the analysis and management of spatial, economic, political, social and cultural aspects of contemporary urban life, and constitutes perhaps the main task in thinking through relations between cities and ICTs.

In their pioneering work *Telecommunications and the City*, Graham and Marvin (1996) introduced an element of order to the chaos of ideas and assumptions about telecommunications. They organised its impacts on crucial sectors such as the economy, social and cultural life, urban environments, infrastructure, urban physical form, and planning and governance. A whole chapter was dedicated to the conflict between old and new paradigms. Importantly, the challenges are grouped into three categories, namely the 'challenge of invisibility' (the non-physical aspect of ICTs), the 'conceptual challenge' (especially concerned with ideas of space, time and cities), and the 'challenge to urban planning' (the conflicts between the modernist city and the post-modern networked city).

Based on this and other contributions, the purpose of this paper is to attempt a demarcation of the conceptual challenges posed by the clash of ICTs and cities. More specifically, the aim of this paper is to establish the theoretical foundations for the understanding of this complex relationship and, at the same time, to look into more detail at two cases of urban-technological development in Europe: Newcastle upon Tyne in the UK and Antwerp in Belgium.

In addressing these issues, this paper analyses some of the ways in which ICTs are producing complex conflicts between traditional and new paradigms of space, time and technology, and creating some conceptual dilemmas for an integrative development of technologies and cities. For this analysis, I will concentrate in local government actions towards integrated urban and technological strategies, in the field known as urban technology.

The approach I have taken is supported by the theory of Social Construction of Technologies (SCOT), a paradigm that sets out to explain the most intimate political and social relations involved in the introduction, acceptance and absorption of technological artefacts within a social context. I believe that this approach offers an invaluable tool for understanding some of the dilemmas presented to local authorities by the socio-technical process of building the virtual city.

To address these issues, this paper is divided in four parts. The first is driven by the complex range of challenges to traditional paradigms of space, time and cities, especially those faced by planners and city-makers. Secondly, I draw my analysis of the two case studies based on SCOT and the specific historical conditions of each case. The third part concentrates on the analysis of what has been found in Newcastle and Antwerp in terms of visions and interpretations to the relations between ICTs and cities, towards an integrative urban-technological strategy. Finally, in the conclusions, I briefly put the previous parts together in discussing the strategic approaches for ICTs of Newcastle and Antwerp and their relative advantages.

2 PARADIGM CHALLENGES: UNDERSTANDING ICTS AND SPACE

To comprehend the very concept of space, there is a need to first understand what the space is made of. According to Santos (1997) in *A Natureza do Espaço* (the nature of the space), space is an indissociable, but also contradictory, conjunct of 'systems of objects' and 'systems of actions'. In other words, this is what makes the space a multiple and heterogeneous entity: objects and actions, fixes and flows. The space is thus neither only physical nor only social, but the two always together:

> Systems of objects and systems of actions interplay with each other. On one side, systems of objects drive the way in which actions are done and, on the other side, systems of actions lead to the creation of new objects or affect pre-existent ones. That is the way the space finds its dynamism and changes itself. (Santos, 1997: 52)[5]

ICTs were added to the conglomeration of systems of actions and objects which together are considered to make space a couple of decades ago. Information and communication technologies are increasingly considered part of the sum of actions and objects that make up our daily lives. At home they are in the living room, the study and the kitchen. They are at work, on our desks, on our laps, and on our way to work. They entertain us. We even wear them. So, to understand space, we need to understand ICTs and their influence on urban lives.

ICTs and their effects are extremely difficult to pinpoint, partly due to their invisibility. Unlike transportation and other traditional types of infrastructure, ICTs rely on underground or covered networks of fibres optics, radio signals, microwaves and satellites.

These particularities mean that everything associated with the relation between ICTs and cities tends to be conceptually complex and vague. Historical neglect towards the study of these relations and changes in the way space is perceived, provoke a paradoxical complexity/vagueness. This, in turn, generates and disseminates extremely disparate interpretations of and theoretical approaches to the subject of telecommunications and cities.

[5] Translated by the author from the original text in Portuguese.

In addition, and partly as a consequence, there is currently a significant challenge to urban planning and governance (Bonnett, 1999), as these areas experience an arduous transition from the modernist industrial city, with its rules and methods of control, to the post-modern networked city and its mobile, fast and invisible elements.

The difficulty pinpointing ICTs' effects and infrastructure make their relation to cities a very 'slippery' phenomenon from a theoretical and empirical point-of-view. Urban scholars and, especially, city-makers find it enormously problematic to specify the precise characteristics of the new networked city. This is, in part, due to the lack of physical and visible elements in ICTs, and because of the new possibilities for services and infrastructure in the local context. In sum, this slipperiness stems from the invisibility/intangibility of ICT developments, and the advent of new systems of infrastructure and services.

Pragmatically, this sometimes results in local authorities and planners experiencing problems raising the proper resources or support for more proactive initiatives. This is because, when trying to justify high investment on ICTs, they cannot always show improvements statistically. The demonstration of a cost/benefits relation is not very straightforward to demonstrate in the case of investments in telematics developments.

Positive or negative aspects of a new park, bridge, road, or council house development could easily be noticed by planners, local authorities and by the population. The amount of money invested or spent on these types of urban development can be very clearly calculated. It may also be easy to determine the most direct environmental, social and economic impacts of some of these initiatives.

In contrast, developments regarding telecommunications are perceived only if they involve physical changes like digging up roads for cable installation, or putting up new street-equipment or buildings especially designed for the use of ICTs, etc. Sophisticated infrastructures (like satellites, radars, wave-generators, etc.) and the flows produced by ICTs (such as microwaves, electromagnetic signals, and above all information) are usually silent and unnoticed by those who run and use the cities, accustomed as they are to the visible and 'noisy' stuff of the industrial city.

Since a great deal of work on urban studies traditionally relies on 'physicalities' – visible and tangible things like the physical space and traditional infrastructures –, invisibility seems to be a very common embedded challenge to the paradigms that underpin the contemporary organisation of urban space:

> Urban studies and policy tend to be dominated by a concern with the visible, tangible and perceivable aspects of urban life […] Given this visual preoccupation, it is easy to diagnose the virtual invisibility of telecommunications in cities as a key reason for the curious neglect of telecommunications issues in cities. (Graham and Marvin, 1996: 50)

Thus, if it is hard for scholars and researchers to 'touch' and 'see' ICT applications and infrastructure, it is even harder for planners and local authorities to overcome this paradigm of invisibility and intangibility. For those who deal daily with traditional urban problems – like traffic congestion and the maintenance of transportation links, problems with water or electricity supply, or urban violence – it may be too difficult to understand the complexity and virtuality of electronic networks carrying no more than invisible signals from one computer to another. It may be even more difficult for them to predict the real economic, political, social, cultural or spatial consequences of the introduction of such new technologies to the functioning of cities.

Due to this invisibility, networked ICT infrastructures are usually taken for granted. In addition, changes in the standards of national telecommunications monopolies in the past have made it difficult for local authorities to intervene directly on this issue. Perhaps as a consequence of this, some commentators have noted a tendency for planners and policy-makers to overlook ICT matters.

These challenges directly contribute to city-makers' lack of awareness about virtually every aspect of ICTs. The fact that connections are rarely made between ICTs, land use and transformations of urban form means that city-makers are often unfamiliar with many aspects of urban technological development. Consequently, city-makers are as unable to see telematics applications and infrastructure as they are to take action about them.

2.1 Challenging urban planning and governance

As ICTs affect the way space, economy and life style are understood, they also influence the way cities and municipalities are managed and governed. City-makers have played an important role in shaping and controlling cities since late nineteenth century when urbanism established its roots, both as a science, and as a vital practice for urban life generally.

However, the practice of planning has been too much attached to industrial ideas of space and cities from the mid-20th century. The bases for urban planning have a strong relationship to modernism and the industrial city. As new notions of space and time have influenced every aspect of contemporary society, perhaps they should likewise influence the way urban space is governed and planned.

Places may nowadays be functioning in different ways within and between cities, but planners are still using concepts, methods and policy instruments developed during and for the modernist period of industrial cities. Planners and planning departments are increasingly loosing their importance within contemporary public administration, as exaggerated reliance on technical and design practices continues to fragment the public treatment of space.

This process is being affected in such a way that only urban design, transportation and infrastructure issues are entrusted to planning departments, with little or no consideration of social and cultural implications. Koolhaas and Mau (1995) argue that planners and, in fact, urbanism are outdated, and that both failed to keep pace with the rapid modernisation of urban space. Ultimately, they argue, planners simply cannot cope with the complexity of the contemporary city:

> The transition from a former position of power [during the industrial and the modernist era] to a reduced station of relative humility is hard to perform. Dissatisfaction with the contemporary city has not led to the development of a credible alternative; it has, on the contrary, inspired only more refined ways of articulating dissatisfaction. A profession persists in its fantasies, its ideology, its pretension, its illusions of involvement and control, and is therefore incapable of conceiving new modernities, partial interventions, strategic realignments, compromised positions that might influence, redirect,

> succeed in limited terms, regroup, begin from scratch even, but will never re-establish control. (Koolhaas and Mau, 1995: 965)

This seems very contradictory when compared with the important role that planners should be playing. In fact, the point is that, while hardly working on their daily activities, planners have been acting more as technicians than as social scientists because of limited resources, restricted conditions and a general unawareness of the concepts and consequences linked to the development of ICTs in cities.

'Proactive' planning initiatives related to ICTs, tend to appeal to the ill-grounded utopianism of technological deterministic approaches. This, in turn, tends to create more distrust and scepticism from other municipal departments and civil servants about the involvement of planning in urban-technological strategies.

Distinct departments in the city have, obviously, different notions about ICTs and their influence on urban affairs, which leads to a weakened planning department that forms a smaller part of an administrative structure that may itself be fragmented.

So perhaps planning and planners are not to blame; alternatively, no-one may be to blame. Can organisational fragmentation in fact be traced to the variety of visions and interpretations? Can such variety be the cause of the fragmentation of the very notions of space, time, technology and governance themselves, reflecting on the process of policy-making?

The consequences of such a fragmentation may be on the one hand a failure to understand the city in the light of the transformations brought about by the development of ICTs, and, on the other, neglect of the complex economic, political, and social and cultural relations present in the urban space on the part of planners.

The contemporary city has new elements that need to be considered in the arrangement of urban space. Planners and planning officers are still trying to catch this momentum. Commentators like Koolhaas and Mau (1995) maintain that new methods, instruments, organisation, and indeed a new urbanism have to emerge to cope with the complexity, flexibility, and new concepts inherent in contemporary urban space:

> If there is to be a 'new urbanism' it will not be based on the twin fantasies of order and omnipotence; it will be the staging of uncertainty; it will no longer be concerned with the arrangement of more or less permanent objects but with the irrigation of territories with potential; it will no longer aim for stable configurations but for the creation of enabling fields that accommodate process that refuse to be crystallized into definitive form; it will no longer be about meticulous definition, the imposition of limits, but about expanding notions, denying boundaries, not about separating and identifying entities, but about discovering unnameable hybrids; it will no longer be obsessed with the city but with the manipulation of infrastructure for endless intensifications and diversifications, shortcuts and redistributions – the reinvention of psychological space. (Koolhaas and Mau, 1995: 969)

3 THE SOCIAL CONSTRUCTION OF URBAN TECHNOLOGY

The comprehension of such contradictory coexistence of complexity and vagueness is a key stage in the process of overcoming the historical neglect of ICTs by the public sector. So how could this be explained theoretically? The concepts embraced by Social Construction of Technologies (SCOT) theory are seen as crucial here.

This theory is important because it demystifies the idea of aseptic technologies, of technical elements without more important and intrinsic roles in society. The idea is that of technologies or a set of technologies (or 'artefacts' as they are called by Bijker, 1987; see also Bijker, Hughes and Pinch, 1989) with a range of complex social, economic, political and cultural roles, that is to say, a socially constructed development of a certain technology.

In other words, introducing new technologies to be absorbed by society implies considering all sorts of interactions and manoeuvres by what Bijker (1987) calls 'relevant social groups', so that these technologies would occupy their space in time (in terms of practical use). In socio-technical terms, this process is regarded as the stabilisation of a certain artefact, where society has come to a consensus about the meaning of this artefact and has, thus, incorporated it in a series of social activities.

For instance, in terms of urban technology, the introduction of a new initiative or project – in terms of regulatory policy and effective implementation – by local authorities would necessarily involve a number of disputes, political and social interactions, along with the technical development. These 'games', according to SCOT, happen all the time and everywhere related to the artefact to be introduced. Thus, this new initiative would involve disputes inside and outside the local authority's sphere: among politicians to launch the idea, for example; among officers and civil servants; between all of the groups, and among the general public and third parties involved.

Another concept borrowed from SCOT which can be very useful here is that of 'interpretative flexibility' (Pinch and Bijker, 1989). This concept offers an explanation for why so many 'languages' are spoken by actors within the events of a socio-technical process, generating complexity and vagueness.

Interpretative flexibility deals with the variety of visions and interpretations given to a certain artefact within a given social context. In the example mentioned above, thus, politicians, officers, civil servants, and the population would have their own idea of what the initiative being implemented might mean in terms of shape, characteristics, functions, use, consequences etc. Even within each of these groups, there might be another range of interpretations. According to Pinch and Bijker (1989), each interpretation of an artefact depends on how a 'problem' and respective 'solutions' are realised by different actors.

If the development of urban-technological strategies (such as building the virtual city) was considered, being socially constructed, as an artefact, the ways in which social actors understood and acted upon this development would become extremely relevant to its acceptance and power of endurance.

Possible questions about the interpretative flexibility of such a strategy would be: What does this strategy mean for the different social actors involved? What does it mean for officers and their departments, for politicians, citizens, and third parties etc.? What are the problems and solutions to be dealt with by the different actors? How can the dominant social group cope with such a variety of visions for delivering a single strategy? In the end, is the strategy satisfactory to all sectors involved? Does it fulfil the variety of interpretations?

The confusion, complexity and vagueness of the concepts related to ICTs and their impacts on the notion of space seem to be directly connected to the enormous amount of interpretations of ICT initiatives by different actors. As long as they do not understand what ICTs are, they will also have a different vision of what ICTs can be used for. Accordingly, Pinch and Bijker (1989: 41) argue that 'different social groups have radically different interpretations of one technological artefact'.

In the specific case of virtual cities or urban-technological strategies, this would mean a diverse range of virtual cities, or a number of alternative strategies; one for each social group or one for each conjunct of problems and solutions. Why, then, is the concept of interpretative flexibility relevant to the attempt to explain the dilemmas of urban-technological developments in this context?

A proper answer to this question must come from the two case studies of Newcastle and Antwerp. In general terms, however, interpretative flexibility helped us to map out the variety of major interpretations of the virtual city and ICT initiatives in these two cities. Social actors and technological entrepreneurs (the people who lead the idea of a certain implementation) can be identified in order to identify distinct visions and discourses. This shows how a possible dominant model may or not prevails over other visions to result in a single strategy. So, what would be the outcome of such dispute of different interpretations?

A decisive aspect of the challenge to understand virtual cities and the network society is the recognition of local strategies for the use, implementation and management of ICT developments. In other words, to fully comprehend the virtual cities phenomenon, we need also to understand urban-ICT strategies (and to discern between their different levels of implementation: local, regional and national). Yet, I suggest that special attention has to be given to some crucial dilemmas involved with the promotion and social construction of such strategies. Uncovering these dilemmas and barriers can be useful for further policy implementations that may be more integrated (in terms of traditional urban and ICT policies), more efficient and more adapted to the diversities of different localities. In this sense, the way local authorities manage interpretative flexibility and a possible democratic construction of urban-technological strategies has proven to be one of the most influential dilemmas.

In order to find out more about the way local authorities organise themselves to consider different visions of the city into a city-wide strategy, I draw my analyses upon a cross-country study of two European cities. The first is the city of Antwerp in Belgium, handpicked by its well developed and acclaimed projects, initiatives and policies dedicated to ICTs. On the other hand, in order to show some contrasts, the city of Newcastle upon Tyne in the U.K. was chosen because of its similar conditions to the average of the medium-sized cities in Europe where two distinct realities coexist: a convergent willing and relative success on the implementation of ICT initiatives on one side; and a coordinated struggle for the reaffirmation of their national and international economic relevance in times of industrial decline on the other.

3.1 Newcastle: a case of fragmented structure

Newcastle upon Tyne is a city characterised by the struggle of its local authorities, development agencies and population against the decreasing number of jobs and quality of life that affects the whole North East of the country. In recent times, as with most cities in this region, Newcastle and its economy were dominated by heavy industry, especially coalmining and ship-building.

This dependence of the city's economy on heavy industry has had a long-term effect on its image, and on citizens' confidence in the local authorities' ability to reverse the economic crisis in the region that followed industrial decline. Newcastle has entered enthusiastically into the race for competitive advantages to attract people to live in the region, with particular emphasis being placed on incentivising clean, high-tech industries to relocate themselves in the North East. The recent history of Newcastle has been driven by this, a fact which is reflected in the development of ICTs, which has tended to rely on regeneration projects, and initiatives to rebuild the image of the city.

The constant attempts to rebuild the city's image are a feature of urban renaissance and urban regeneration discourses that have in turn provided strong motivations for the implementation of ICT initiatives. This sense of renewal stems from the economic development premise that Newcastle has to get rid of its image of a depressed former industrial city with poor quality of life, in order to advance as a new city of the 21st century. Champion (2002, p.90) identifies this process of redefining the economic basis of the city and region as one affecting the British urban system as a whole since 1950:

> 'De-industrialization, involving a massive shake-out in manufacturing and mining employment, with the biggest relative effects impacting on the places that had the greatest specialization in these sectors, most notably the larger towns and cities in northern Britain.'

The urban regeneration discourses, ideas and strategies emerged with full force during the 1980s and 1990s as an attempt to 'rebuild' cities and re-arrange local economies. The ideas embedded in urban regeneration proposals brought about a strong sense of renovation. With the advance of information and communication technologies, the convergence of media, and the development of other new technologies, this will for renewal seems also to have been renewed. ICTs are a great motivator for regeneration projects, and may be used to attempt to trigger shifts in the local economy. The use of ICTs for boosterism is apparent in the local actors' discourses and perceptions as a vision of urban regeneration.

ICTs were and are still the 'product of the moment' for cities, so Newcastle had no option but to adopt a proactive discourse. The economic development agenda based on regeneration has always been the most important focus for the council. It was therefore natural that telematics technologies should become a major player in the game of local boosterism following the entrepreneurial imperative.

This impetus continues today under the umbrella of the City Council's Going for Growth initiative. Ideas of renewal, renaissance and regeneration are exactly what the 25-year strategy Going for Growth is based on. ICTs are a very small part of the whole project, and ICT projects are scattered through various initiatives and parts of the council.

These projects and visions are also, in fact, reflected in the fragmented way in which ICTs are implemented by the City Council through its management structure of six directorates. Projects, apart from bigger cross-division ones such as Going for Growth, are usually defined and carried out internally within the directorates and divisions. ICT projects are no different. They are, therefore, developed almost in isolation across the divisions of the council. This means that projects are developed without attention to mutual interaction. In this way, even costs, benefits and budgets for ICTs are extremely difficult to pinpoint.

To try and generate an overview of this situation, the council has implemented what is called the E-Services Panel, which is made up of City Councillors and directors of some divisions. It is aimed at the discussion and approval of ICT projects. However, the analyses and deliberations of this panel tend to follow predominantly economic factors rather than social, cultural or even spatial ones. In the end, the panel becomes dependent on priorities setup by other departments, and tied to the management structure of the city itself.

The management structure of the city (as with many others in the UK), follows a 'silo' distribution model, so that the resources and targets are vertically distributed between the six directorates and their respective divisions. There is thus no global budget established especially for ICTs.

Each one of the six directorates has its own projects related to the use of ICTs for different purposes, each therefore has its own separate budgets. These are, in turn, part of one departmental budget. Karen Brown, Coordinator of the Virtual Newcastle Initiative, expresses her concern at not having an ICT-dedicated agency and points out the contradictions of the silo structure:

> 'I think that the notion of one organisation looking at the best uses of resources doesn't exist in Newcastle. This may be caused or linked to the political organisation of local authorities in the UK and the silo structure of the funding structure.' (Brown, 2002)

The historical approach to ICTs, and their symbolic meaning as an investment attractor points towards continuity in terms the way telematics technologies are developed as part of entrepreneurial and business-focused strategies. If this general historical perspective prevails, Newcastle is likely to continue to figure in the crossfire of fierce competition among urban centres.

Finally, what I want to make clear is that all the historical and local aspects discussed above – mainly of economic relevance – directly contribute to the shape of the social construction of ICTs in the city of Newcastle.

The fragmented and dispersed way in which these technologies are scattered across the structure of the council is the result of a situation historically and socially constructed. The process of re-imaging the city was crucial on relating ICTs with the entrepreneurial imperative, place-marketing strategies and a business-focused vision for the future of the city.

3.2 Antwerp: an integrated and centralised strategy

Antwerp, at the heart of Flanders, is one of the biggest cities in Belgium, with one quarter of the Flemish population, and is strategically positioned at one of the corners of the region so-called Flemish Diamond.

Apart from its economic importance for Flanders and Belgium, the city has also become synonymous in Europe with innovation, and with the successful implementation of ICTs, being a founder member of the steering committee of TeleCities. It is undoubtedly the most advanced city in Belgium to make extensive use of ICTs for public administration.

Local authorities in Antwerp regard ICTs as a central issue for the future of the city, and have created a specialist agency dedicated to ICTs, Telepolis.[6] This semi-independent agency is responsible for the coordination, use and implementation of ICT initiatives in the city, the modernisation of the city administration, the management of infrastructure and contracts related to ICTs, and for urban-technological policy-making.

The early development of ICT initiatives in Antwerp – particularly infrastructure – was heavily influenced by the political and administrative restructuring of local authorities in Belgium. The regional devolution process of the early 1980s triggered a process of intensive introduction of ICTs by the city administration in Antwerp. This was mainly due to a merger of nine neighbouring localities into a sole municipality, Antwerp.

In the late 1970s, the Belgian government decided in favour of the amalgamation of cities with less than 5,000 inhabitants, reducing the number of municipalities in Belgium from 2,359 to only 596. Because of its much larger size compared to other Belgian cities, Antwerp managed to postpone the amalgamation until 1983.

With this urban amalgamation in place, the political strategy immediately adopted by the local authorities was the decentralisation of public services and administration across nine city-districts. The argument was that one city council alone could not deal with a newly-created municipality that had grown overnight from about 150,000 to about 500,000 inhabitants, with few new resources added.

Behind this argument were concerns over the growth locally of the extreme right wing party, the Vlaams Blok, which increased its percentage of votes from 17.7% in 1988 to 33% in 2002. This situation, apart from justifying the political decentralisation, also forced the democratic parties to form a coalition in the city council and districts to ensure a strong opposition against the Vlaams Blok, which was called the *cordon sanitaire* (Van Assche, 2002). Decentralisation was thus the only way around political and

[6] In October 2003 a merger between Telepolis and the IT department of the city of Ghent created Digipolis. The two biggest cities in Flanders joined forces for the constitution of an inter-municipal agency. As this happened after data collection and analyses were already finalised, the discussions presented in this paper concentrate on the role of Telepolis as a municipal semi-independent agency.

financial problems that had arisen over night, and was envisaged by local authorities as an adjunct to the establishment of the *cordon sanitaire*.

From the beginning, ICTs were seen as an enabler for the profound administrative changes involved in decentralisation. Bruno Peeters, the Alderman for Communication, Governmental Organisation and Decentralisation at that time, argues that:

> 'Without ICT we would never have been able to have [accomplished the political and administrative reform]. It was done in six months; the decision was made in only two days by the city council, and was accepted by the ministries and by the union within three months [referring to the creation of the informal councils].' (Peeters, 2001)

ICTs worked for Antwerp as an integrative instrument because of their capacity to improve communication between different departments of the city and between 'district houses' (the political and administrative headquarters for a given district). Telepolis is the physical and institutional result of the evolution process of Antwerp's urban-technological approach, and it is Telepolis that provides Antwerp's differential in terms of strategy. It is a unique case of a strong and relatively independent public body being created to deal exclusively with ICT issues. The creation of a central agency like Telepolis is not a common phenomenon in the recent history of urban-technological developments in Europe, although it is being emulated here and there on a small scale.

Therefore, in Antwerp, some social groups have tended to envisage ICTs functions and capacities as a means to enable the ongoing political reforms of the region and the country. Thus tremendous efforts have been and are still being made to establish a solid and integrated urban-technological strategy – together with its physical and institutional enabler, Telepolis – in order to facilitate the settlement and absorption of the new political structure.

Politicians and civil servants in favour of more in-depth use of ICTs in public administration set out to sell their idea by organising an ICT strategy incorporated by a public ICTs agency. The idea was to integrate as much of the city administration as possible in order to facilitate political decentralisation. The strategy resulting from these twenty-year social and political changes was the establishment of the ICT-agency (Telepolis) and a mutual commitment from the city administration and this agency in terms of budget and services.

In order to maintain this structure and therefore stabilise the urban-technological strategy, every six years (the period for local elections) a political agreement is discussed by the councillors, aldermen and mayor, to establish general functions and missions for Telepolis. One alderman is designated to deal with Telepolis and the political agreement, while the college of aldermen tracks accomplishment of the general goals established by the agreement. Internally, Telepolis also produces an annual operational plan that is meant to match the requirements agreed politically (defining projects, initiatives and priorities for the entire year). This process illustrates the dialectic exercise that is the merger between traditional policy-making and ICTs policy-making.

Finally, it should be stressed that the specific political and social configuration in Belgium and Antwerp contributed a crucial element to Antwerp's proactive approach to urban-technological strategy. This is not to say that the devolution and the subsequent local political decentralisation processes were the only influences on Antwerp's history as regards ICTs development. However, these particular facts played a significant role in the constitution of the current integrative strategy.

4 MANAGING VISIONS: A STRATEGIC VIEW OF URBAN TECHNOLOGY

Despite being way ahead other cities like Newcastle, the approach in Antwerp does not escape the common characteristics that affect other cases. Similar dilemmas have been found, especially those regarding interpretative flexibility and the wide variety of visions regarding ICTs and their possible impacts on cities. A striking similarity was found among actors' discourses of both cities.

The major difference then is the way these aspects and the visions that give rise to them are articulated and incorporated by groups inside local government for transformation into actions. What I want to sustain is that there are some dominant aspects within actor's discourses that go against the apparent cohesion of the strategies, and so, present some possible conceptual barriers for future developments.

To analyse social groups' discourses, twenty-nine key actors within and outside local government where interviewed between 2001 and 2003 for both cases. Priority was given to the following groups: representatives of the most directly involved departments or divisions of local government, officers and civil servants involved in related projects, officers from the planning departments, politicians, regional development agencies, members of the regional and the national government, and representatives of the private sector involved with relevant initiatives.

What appeared to be considered dilemmas and barriers confronted by Local Authorities as they seek to integrate urban and ICTs policy-making, were classified according to three major groups. First, and perhaps most importantly, there is a simultaneous conceptual complexity and vagueness involved with the introduction and application of ICTs to deal with urban issues. In this case, interpretative flexibility represents the most influential dilemma confronting local authorities as they attempt to develop an urban-technological strategy. While a plurality of visions may be beneficial for a democratic construction of initiatives, it may prove difficult to handle and translate into strategy.

Apart from interpretative flexibility, two other groups of dilemmas for the development of urban-technological integrative strategies can be related to a range of intra and extra-local aspects. They were identified as endogenous and exogenous influences to the urban-technological development. Interestingly, both cases seem to be influenced, on different levels, by three major endogenous and three exogenous elements. The identified endogenous elements are: internal administrative and political disputes within local government; integration, coordination and control over the implementation of projects and initiatives related to ICT; and private sector influence on the public administration. And the three exogenous elements are: political and administrative conflict with upper level governmental stances; the increase of regional competitiveness (especially among European Union State Members); and the entrepreneurial imperative.

Back to the first and more influential group of dilemmas (the blurriness of ICTs and cities), a strong presence of elements typically linked to technological determinism was verified on most of the interviews carried out. A parallel divergence between actor's discourses and reality was also evident. There is a general imprecision about what ICTs, their related initiatives and policies can represent for the city in terms of an urban strategy. Once again, interpretations and the subsequent ways in which the local authorities and policy-makers address issues related to ICTs play an important role in defining how these new technologies are socially constructed in the city, and even regionally and nationally.

The local society in both cases has different perceptions of how the set of technologies that form ICTs might be defined, let alone an urban-technological strategy itself. The search for a common basis for interpretations is inherent to the strategy. Everything is part of the complex local socio-technical development of ICTs. This implies the existence of groups, actors, interests, coalitions, dominant visions, initiatives, and strategies which interact to form local government's current approach to ICTs.

Interpretative flexibility is thus something normal, necessary and inevitable in the process of developing technologies. The distinctiveness of the cases of Newcastle and Antwerp lies in the ways that divergent visions are translated to other groups, incorporated and finally implemented. Independently of the stages of development each of these two cases are, it was possible to identify five dominant aspects in the key actors' discourses:

- The organisational aspect, where ICTs are referred to simply as a tool to modernise back-office activities, as well as a way to deliver services more quickly and efficiently (and also customised). The e-government agenda is prominent here, as is a strong vision of the administration as a corporation.
- Tackling the digital divide. Here, as with the organisational aspect, ICTs are used to modernise practices and methods primarily in education, with the discourse of solving problems like ICTs illiteracy, and tackling the digital divide.
- The aspect of substitution ('physical replacement'), where ICTs are seen as a set of technologies capable of replacing physical dislocations with remote interactions/consultations/negotiations.
- The aspect of planning involvement. This is particularly noticed where the planning department participates on the process of incorporation and implementation of ICTs policy-making only marginally. The vision from planning officers has proved to be limited in terms of spatial impacts of ICTs upon the urban environment.
- The propaganda aspect. It is characterised by the symbolic vision of ICTs as clean, modern, and high level technologies (invoking much of the science park culture). In this way, ICTs are referred to as a technical fix to urban problems (Graham and Marvin, 1996) and as an attractor of social, cultural and economic developments and quality of life.

Perhaps the most important question to be asked here is: are these aspects and the visions they influence incorporated by the initiatives which are implemented and prevail?

Looking at the structure in which the initiatives are developed from the early stages of negotiation, Newcastle and Antwerp are very different from each other. Fragmentation dominates the scene in Newcastle, while in Antwerp, a highly integrated approach prevails.

First, in Newcastle, visions for a particular initiative are dealt with on a small scale, in terms of directorates and divisions. Interpretations representing different units tend not to collide on their way to becoming an action or policy. They are 'canalised' from the early moments inside the responsible unit, through to implementation, usually by the same unit. So, once a project is defined by a certain unit responsible for its implementation, it tends not to be influenced by other units' visions, as there is little interaction between them.

Second, in Antwerp, demand and ideas for initiatives are the sole responsibility of Telepolis. The local government and city departments need to report to Telepolis in case of a certain demand or problem related to ICTs. Telepolis will then, through its officers and technicians, study the case and promote further development. ICT initiatives are discussed between Telepolis representatives and the city departments on a weekly basis. Political agreement and Telepolis's operational plan are the formal motors for this centralised and integrative strategy.

Interpretative flexibility is thus a clear challenge for local governments' urban-technological development of ICTs. According to the cases studied, managing the diversity of visions for ICTs produces different results in terms of ways that actions are structured and put in place. This is not to say that high levels of interpretative flexibility will prevent local authorities deploying ICT initiatives. The historical and technical conditions, together with the three groups that represent possible dilemmas and barriers, form the basis for the particular social and political relations that give the current shape of urban-technological strategies in Newcastle and Antwerp.

5 CONCLUSIONS

We saw that two major similarities coexist with two contrasts in the case studies of Newcastle and Antwerp, as regards the development of urban-technological strategies. Similarities refer to the projects implemented and to the dominant aspects of interpretative flexibility; while contrasts refer to different local conditions and the shape of the strategies (the way interpretative flexibility is taken into account). We should therefore ask ourselves what is it that makes that two cases which are differently structured and under different local conditions subsequently develop such similarities in terms of interpretative flexibility and projects.

This seems to be related to urban governance as a whole. In terms of the projects, the most conspicuous ones are well-known and publicised cases of urban propaganda in the race for the 'innovative city'. It is not a surprise that cities try to develop very similar projects to compete for funds and inward investments against each other.

Economic development and urban competitiveness play an important part on determining how local authorities will approach and develop certain subjects. In this case, ICTs have proven to be a golden key 'to be in the short-list of a company that wants to invest abroad', as De Gersem (2003) remarks in the case of Antwerp. The discourses then could not be different, resulting in similar dominant aspects for the interpretative flexibility of both cases.

So, what would be considered a differentiator for cities in times of economic development and urban competition? I believe that Antwerp represents a much stronger case in this sense as this city includes technological development and ICTs in the agenda of urban development. Integration seems to be a better option to avoid strategies being over-concentrated on economic development.

For listening to the different departments in the city and being closely related to the city administration, Telepolis in Antwerp incorporates problems and solutions of other social groups to its own vision of urban-technological development. Although none of these groups figures as a major player within the city-wide strategy itself, they feel themselves represented by the vision of Telepolis. This is the case of the planning department, for instance. This department does not relate to the ICTs strategy in any particular way, but that they said to be considered by Telepolis on what they understand is their role in urban technology (even if it seems to be restricted to GIS applications).

The strategic model based on integration and centralisation of urban-technological policies with the support of a dedicated agency appears to offer more possibilities of realisation for the public interests on the implementation of ICT initiatives.

However, the implementation of such strategy does not, by itself, guarantee either a successful result or the austerity of the implementation and management of ICT policies, let alone real comprehension of the extension of the related phenomena. Local and historical conditions also play a decisive role in defining the urban-technological strategy.

What we can learn from these experiences is that, from new administrative methods to improvements in information and service delivery, and the conception of different regulatory policies, planning and governance practices, city-makers would need to understand the importance of a democratic construction of the virtual city to avoid the aggravation of problems like social exclusion and polarisation:

> Given the opportunity presented by a new communication media and channel for delivery of services, surprisingly few governments have actually taken advantage of the potential offered by networked technologies and the Internet, beyond static 'homepages' […] While the interactive nature of these systems presents tremendous possibilities in terms of true citizen policymaking, significant institutional and political barriers exist. (Baker, 1999: 5-6)

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Intra-metropolitan location for global production: Case of the IT Industry in Bangalore City

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ABSTRACT

This paper, based on qualitative research, presents the scenario of intra metropolitan location of firms of the Information Technology industry in Bangalore. A detailed study of the location history of eight Software and Information Technology Enabled Service firms, with varying attributes such as age of firm, type of work undertaken, ownership etc., is used to create a theoretical model of shifting location within the urban fabric. The findings discussed in the paper are compared and contrasted with those discussed in existing research on location of producer services, in order to differentiate patterns arising from firms which are engaged in globally outsourced production especially in the Information Technology sector.

1 GLOBALISATION OF THE INFORMATION TECHNOLOGY INDUSTRY

Internationalisation of the semi conductor production industry from the United States to East Asia, after the 1960s, was a cost cutting strategy in view of stiff competition from Japanese low cost production. The dispersal of production in this high tech industry has often been cited as the basis of contemporary globalisation. The US semiconductor firms that were, till the 1960s, concentrated in the Santa Clara Valley (later called the Silicon Valley) dispersed labour intensive production to East Asia to take advantage of the cheap skilled labour. The process initiated by Fairchild Computers in Hong Kong gradually spread to Taiwan, South Korea and Singapore (Henderson, 1989). Though the 'Asian Miracle' cannot be attributed to one single factor, 'East Asia succeeded, in part, because it provided strategic, selective and consistent support to industries which were in the best position to facilitate their economies' transition from a labour-intensive to a knowledge-intensive industrial structure' (Hanna et al, World Bank, 1996, p ix).

Success of the IT strategies of the East Asian economies acted as a demonstration effect for other developing countries as strategy to 'leapfrog' into an information society without going through the process of routine industrial growth. This has led to the creation of new technology hubs in the world which don't necessarily lie in the developed world. Regions within developing countries have been promoted as technology hubs and are being linked together in a network for global production of information technology and services. The Human Development Report of 2001 mapped the global network based on a study by the Wired magazine that ranked technology and innovation agglomerations in the world on the basis of a Technology Achievement Index which shows the disparity and marginalisation of economies from the 'IT revolution'. Being set in a developing country context, new regions of technologically advanced production such as Campinas and São Paulo, Brazil; Bangalore, India; Kuala Lumpur, Malaysia; Gauteng, South Africa; and El Ghazala, Tunisia have emerged as players in the global market.

After the East Asian economies, the phenomenal growth of the IT Industry in India is cited as a successful example of tremendous growth and opportunity. The IT Industry that expanded rapidly in India after the 1991 economic reforms has attracted the attention of the global economy for its potential for expansion and rate of growth. 'The industry generated 330 billion Rupees (USD 7.7 billion) in 1999, 15 times the level in 1990, and exports rose from USD150 million in 1990 to nearly USD 4 billion in 1999. One study estimates that this could rise to USD 50 billion by 2008, leading information technology to account for 30% of India's exports and 7.5% of its GDP. Employment in the software industry is projected to rise from 180,000 in 1998 to 2.2 million in 2008, to account for 8% of India's formal employment' (HDR, 2001, p37).

2 BANGALORE AND ITS ROLE AS AN OUTSOURCING DESTINATION FOR IT

Bangalore City, located in the southern State of Karnataka in India has acquired international acclaim in the last 10 –15 years and is often know by its many sobriquets such as 'Silicon City of India', 'IT Capital of India', 'Technology Hub' etc. Its transformation from the 'Garden City' and the 'Pensioners Paradise' to the 'Silicon City' has been a steep curve of change effected in the last decade. The size of the export related IT industry in Bangalore has increased from 13 firms with an export output of 1.19 million USD in 1991-92 to 1322 firms and an export output of 4099.66 million USD in 2003-04. The composition of exports in 2003-04 consisted of Embedded and System Software, Enterprise Application Software and Telecom (76%), IT Enabled Services or Business Process Outsourcing (13%) and Others (1%) (all data from STPI, Bangalore, 2004).

Texas Instruments was the first transnational software firm in Bangalore which set up operations in 1984. Unlike popular belief, the high tech industry is not a remarkable shift for the city. From the early 1950s the city was developed as a centre for scientific innovation, research in aeronautics and electronics and public sector industries that were linked to the research facilities. In addition to this, technical education institutions were located here even before Independence by visionary Maharajas of Mysore (princely state which the city was a part of). The already established scientific milieu, research tradition and skilled manpower from the educational institutions are cited as the factors of advantage for the city which facilitated its shift from a centre of public sector research and production to the global economy (Parthasarathy, 2000). With an established tradition of high technology production in the public sector and education institutions training highly skilled labour, the city was a natural choice for the location of the offshore software production industry (Lateef, 1996; Heitzman,1999). In evidence of this, Texas Instruments, sourced its initial labour from the scientific pool available at the Indian Institute of Science in Bangalore (Parthasarathy, 2000).

The first transnational firm locating in Bangalore acted as a precursor to other such firms creating confidence in investors to locate in the city. Thereafter agglomeration economies were set in place for future investments. The nature of the industry changed gradually from research and development to execution of software designed elsewhere and most recently to back office services. As a result of the diversification, which is criticised by some as a 'moving down the value chain' (Saxenian, 2000; Parthasarathy, 2000), there is wide variety of firms located in the city. This fact is also illustrated by the composition of exports from the city. A significant development in the IT industry in Bangalore has been the growth of domestic firms such as Wipro, Infosys and Satyam Computers

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into large multinational firms as a result of the boom in offshore business coming to India. It is these firms which have moved up the value chain and have taken up end user application products and services.

3 SELECTION OF FIRMS FOR STUDY AT INTRAMETROPOLITAN LEVEL

In order to get a wide mix of firms for the study of intra metropolitan location in Bangalore, the criterion adopted was based on a classification given by India's National Association of Software & Service Companies (NASSCOM). The classification groups firms according to their share in the total software exports from the country.

Segment	Share of Exports (2001 -02) %	Total Revenue (million $)/ Characteristics	Selected Case Firm	Revenue of firm (2001- 02) (million $)*
Tier 1 players	33-35	Above 200	Wipro Ltd.	418
Tier 2 players	33-35	20 – 200	I flex #	68
MNC backends	14-15	Captive Offshore Dev. Cen.	IBM	170
Small/ Startup players	14-15	Less than 20	V Moksha Mind Tree Info Quark	10 17 0.08
Focused Service Players	3-4	Focused on particular domain and deriving at least 50% revenue from	First Ring Acusis	8.5 Not completed year of operation at time of data collection
Product + Service Players	3-4	More than 50% revenue from software products	I flex #	

* Calculated at exchange rate of 1USD= Rs. 47, # Included in two segements because of nature of production

Table 1: Segments for Case Study Selection (Adapted from NASSCOM, 2002)

As illustrated above, the firms for case studies have been selected as per the export segments in the existing pattern of the industry in the country. The 8 case studies vary according to the level of revenues, ownership, and types of products. They are all export oriented firms with the majority of the production being for an external market. In that sense they may all be considered 'global firms'. All the firms have a considerable presence in Bangalore with their Head Quarters/ India Head Quarters located in the city. The oldest firm is Wipro Ltd. which began operation in the Software sector in 1983 and the newest being Acusis which began operation in late 2001.

For the purpose of clarity 'firms' in this paper will be distinguished by the nature of their production – *Software* firms include all such firms that undertake production of programming applications for end users or do production of applications/ parts of applications on contract by other firms. *IT Enabled Service*(ITES) firms are those firms that provide services enabled by communication technology for labour intensive back office operations. These operations may involve direct contact as in the case of Call Centers, Customer Service or may relate to back office functions for bookings, medical transcription etc.

4 LOCATION PATTERN OF THE IT INDUSTRY AT METROPOLITAN LEVEL

History of the IT industry in Bangalore in its present export oriented form can be traced to the mid 1980s. The firms as well as the business has since expanded and transformed with 4 major identifiable shifts brought about change in communication infrastructure, public policies and establishment of the credibility of India in the world market. The four phases of growth have been: Phase of initial MNC location (mid 1980 - 91), Phase of 'body shopping' firms (1991-96), Phase of Offshore Development Centres (1996-99), Phase of Product Development and ITES (1999-present).

Each of these phases has been characterised by location diversification in the city. In the first phase, the concentration of offices was in the CBD. This was the location where most office space was available and the rents were affordable to firms. In the second phase, when space was constrained in the CBD and the wireless technology used in the Satellite station required clear sight access for contact, dispersal of firms took place to the South and South East of the city. Secondary Business Districts (SBDs) also developed around the main CBD. In the third phase, after a crash in real estate prices and large over supply of space, high quality office space developed by the government in the form of an advanced Information Technology Park began to attract firms. Smaller firms which could not afford the high rents in the CBD, SBD and peripheral Technology Parks started to locate in residential properties which were converted to office space. Thereafter, the slowdown in the global business environment has made firms as well as developers more cautious. Large firms are still consolidating offices by opting for campuses in suburban locations. Developers are entering into more innovative lease agreements which ensure that space is leased and the construction is built to suit the needs of the lessee.

When the spatial typology of agglomeration of firms is analysed, four major areas of concentration can be identified each of which represents a unique urban pattern. These areas are:

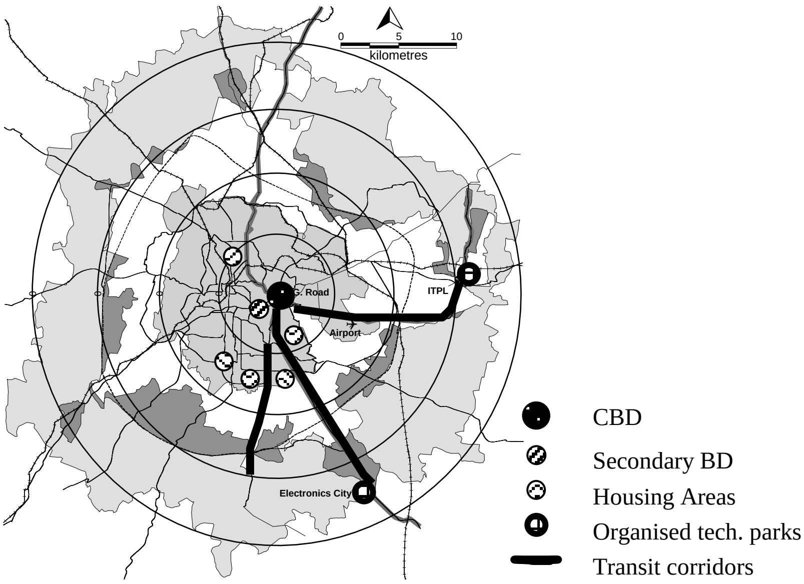
CBD and the SBDs

Municipal area in the South and East Quadrant

Along major highways leading out of the city (suburban)

Special zones or locations in the periphery (peripheral)

The CBD and SBDs are characterised by multipurpose office complexes which might be occupied by single or multiple tenants which are not necessarily IT firms. While the CBD is also a recreation and shopping destination, SBDs are primarily locations for offices and ancillary support services. Municipal areas in the south and east quadrant are planned residential neighbourhoods developed during the 1960s - 80s by the Bangalore Development Authority. Plots planned for single unit row housing have been modified by IT firms and are used as office space. The strip development along major highways leading out of the city mainly in the South and South East direction is a case of suburban agricultural land bought over by developers and converted to offices in the form of customised campuses for large IT firms. Special zones in the periphery are exclusive developments for the promotion of the IT industry and are linked with specialised incentives and infrastructure. Two existing Technology Parks have already been operational for the last 5-7 years and the State is in the process of extending the localised area of the Technology Parks in the form of an IT corridor. The following Graph 1 illustrates the location of areas of concentration of firms in the Bangalore Metropolitan Area.



Graph 1: Areas of Concentration of the IT Industry in Bangalore

Concentration of firms in the metropolitan area of the city, as well as the development of infrastructure for the IT industry has lead to two distict urban phenomena – these are *Multinucleation* and *Peripheralisation of Commercial and Retail Space*. As firms seek out areas for expansion and dispersed location, the city has changed from a single core CBD to multiple commercial and retail cores. In addition to this, new and high quality development of infrastructure and commercial space (linked to investment incentive) by the State has resulted in increased property prices in the periphery. Land values and rents in these Technology Parks are at competitive levels of the CBD, leading to an increased peripheralisation of offices and retail activities. The following sections of the paper illustrate these processes of urban restructuring with respect to spatial decisions taken in the selected firms. The sequence of spatial decisions taken by the firms studied is used to formulate a theoretical model of location of IT firms at an intrametropolitan level.

5 EVIDENCE FROM SELECTED FIRMS – SEQUENCE OF INTRAMETROPOLITAN LOCATION

From the eight selected firms, the sequence of location of only five are discussed here in detail.. Of these three are Software firms while two are ITES firms. Though the theoretical model proposed at a later stage incorporates spatial decisions in all the case study firms, they are excluded here owing to their shorter time span in the city and hence not displaying a diverse range of location change.

5.1 Spatial decisions and location change in Software firms

The first Software firm selected for discussion is **Wipro Technologies** Ltd. The firm belongs to large business group which diversified into Information Technology in 1983 with the setting up of a subsidiary. The city of Bangalore had been the Head Quarters of the business group for thirty years before the IT firm was set up. Hence, Bangalore was also its natural choice as Head Quarter for the new firm. Initially, the administrative office was located in the CBD and the Software Development Centers in three other Development Centers around the CBD. The period from 1985 - 95 was a testing phase for the firm and no major investment in property was made unless the certainty of growth in this sector was established. Till 1995, the firm had grown from 30 employees to almost 2000 employees. These were divided by 300-400 persons in the 4 offices in the CBD. The period from 1995-96 brought about a shift from purely Onsite to Offshore software production by Wipro. Once the credibility of the firm had been established clients were willing to totally outsource the projects and increase the Off shore element in the projects. Since expansion in the CBD was restrained by the phenomenally high rental and lack of large floor space, the firm chose new Development Centers in the residential areas while maintaining the corporate office in the CBD. The first significant shift outside of CBD was to two offices in a residential neighbourhood in the Municipal Area. As and when large projects were acquired by the firm, a new space was leased in the proximity of the earlier Development Centers and an ODC (Offshore Development Center) established. The ODC is a model of functioning in which the Offshore Office becomes an extension of the office of the client and all systems are set up as replicas of the client. The office thus is required to be segregated from the other project offices either physically or through electronic security systems. Therefore, Wipro developed a network of development centers in the city and chose even later not to consolidate them in a single physical location. Subsequently, as the IT industry boomed in 1996 and the firm had established its brand name, Wipro started a phase of investing in property in the city. They undertook two major projects - one, to own and develop the largest Development Center in the periphery in Special Economic Zones, and two, land was purchased along the proposed peripheral Ring Road for a consolidation of the Corporate Head Quarters of all the businesses in a single location. In late 2001, both projects were completed and the Corporate Head Quarters of all Wipro companies were moved to the peripheral location about 12 kms. from the Municipal Area boundary.

To summarise the location history of Wipro Technologies in Bangalore, the firm which was set up in 1983, has moved towards a suburbanisation of control functions and dispersal of development centers with its expansion over the last 20 years. The last 4 -5 year period has been marked by a consolidation of the Corporate Head Quarters in the peripheral location of Sarjapur Road from the earlier CBD locations. The Development Centers on the other hand have been further expanded in dispersed locations in the residential areas with an addition of large centers in the special export promotion zones. In the current scenario, the largest development centers are located in the Special Economic Zones with two more Development Centers proposed in the same area. However, excluding the Development Center in the special zone and the CBD, the other 8 Development Centers and the Corporate Head Quarters are all concentrated within a 20 kms. radius of the city. The current size of the firm in Bangalore is 5000 employees and the total built space occupied is 122,629 sq.m.

The cycle of location of the firm can be divided into the following three phases:

- **Phase 1**: Initial location of HQ and Development Centers in the CBD and Secondary CBDs in Commercial Complexes
- **Phase 2**: Expansion of Development Centers into independent buildings and com¬mercial space in Residential Area
- **Phase 3**: Decentralised Development Centers in various locations both suburban and Municipal Areas and centralisation of Corporate Head Quarter in suburban location.

The second Software firm is the wholly owned subsidiary of **IBM** International. IBM which has been in the city for the last 10 years has a number of large offices all over the country but still decided to locate its Head Quarters for the India operations in Bangalore. In 1993, when it started operation in Bangalore, the firm came in as a joint venture between the Tata Group (Large Indian business conglomerate) and IBM International. The firm then occupied an office space owned by the partner firm in a prime commercial complex near the Airport. This office remains until today the Registered Office of IBM India. In 1997, the stake of the Tata Group in IBM was reduced to 20% and IBM Global Services was extended to India. This was the time that software development was taken up in India and the firm leased two office spaces for Development Centers, one each in the CBD and the secondary CBD. In 1998, the ownership was transferred completely to IBM International and the firm became a fully owned subsidiary. At the same time, in order to expand the IBM research and development located in Bangalore, the firm made a decision to consolidate its space in the city. A long term lease agreement was made with a builder and landowner for a space about 10 kms. from the CBD along the corridors leading to the Special Economic Zones. The agreement involved the renovation of an existing building to suit the needs of the firm and a special agreement for future expansion in the land abutting the building. Though the firm had two options for sites for a consolidated campus, the second one being along an alternative corridor at a distance of about 15 kms. from the CBD, the current site was selected due to the easier terms of lease agreement which involves minimum permanent commitment and the choice of employees to stay closer to the city. After the crash of the IT global business, the expansion plans for the construction of a large campus on the site were put on the back burner, but the development centers were mostly moved out to this single consolidated space. Though the office near the Airport and the other two city offices are maintained as a back up space, the Development Centers and the Head Quarters are concentrated in the suburban location.

Summarising the phases of relocation of IBM, the firm which was initially testing the waters in the Indian market, came in as a joint venture with an Indian business group and automatically located in space available with their partners. This prime commercial building is at a distance of 2 kms. from the Airport and about 10 kms. from the CBD. As the firm expanded from purely marketing of its software and hardware products to software development the Development Centers were located in prime commercial space in CBD. The next planned move to relocate came with the change of ownership to a 99% owned subsidiary of IBM International and the need to consolidate its offices in a single location was felt. The importance of creating a new image of the firm in India as a software and research center of the IBM Global Services was another reason to consolidate offices (Interview Rajiv Mathur, Manager Administration). Though the firm maintains two other offices in the city, the exclusivity of projects for a single parent firm do not necessitate dispersed Development Centers. The alternate office space is maintained as sales and marketing centers and alternate location in case of disaster. The firm has mostly concentrated on locations near the Airport and now moved to a single user office along the highway but still within the urbanisable boundary of the city. IBM India has grown from 40 employees in 1993 to 3500 employees in 2002 occupying a total built up space of 22,500 sq.m.

The shifting of location of the firm can be distinguished into three phases:

- **Phase 1**: Initial location near the Airport in leased office in a Commercial Complex
- **Phase 2**: Expansion into prime Commercial Complexes in the CBD and Secondary CBD locations
- **Phase 3**: Relocation to a location along highway into a Single User Occupied Building while original office is maintained.

The last Softwar firm being discussed is **I flex**. I flex as an independent firm which broke away from the original firm called Citicorp (Subsidiary of MNC Citi- Group) was set up in Bangalore in 1993. From working exclusively on banking related software for the Citi-Corp, the firm was set up as a joint venture between the parent firm and capital raised by the former employees of Citi-Corp. The ownership of the firm still lies 40% with the Citi group but 1998 marked the final emergence of I flex Ltd. as an independent firm selling their banking related software. The original location was a leased office space in a prime Commercial Complex in the CBD. This office was already available to the firm as a part of Citi-Corp. However, with the expansion needs and the rapid growth of the firm by 1998, additional space for the second Development Center was leased in a Commercial Complex in the Secondary CBD. In 1998, the Head Quarters of the firm was also moved to Mumbai to achieve proximity to the Financial Institutions. In the next planned move of the firm, a site has been purchased in a suburban locality which lies in the East, near the Special Economic Zone. The construction of a 12,500 sq.m. building and campus has already been initiated and the scattered Development Centers as well as the Head Quarters is expected to be moved into the new campus by the end of 2003. In the current pattern, the work in the Development Centers is divided on the basis of consultancy projects and product support and customisation of the banking software that the firm markets. The need for maintaining the separation of projects is critical in view of the competition that exists among the clients. The physically segregated Development Centers are used to secure the projects. Even within the campus being constructed for the firm, blocks of buildings would be so designed that the projects can be physically and electronically segregated. The firm has an employee base of 1000 in Bangalore and occupies a total built space of 5,000 sq.m. currently (excluding the campus).

As with the previous two cases, the locational cycle of I flex leads to ultimate suburbanisation and a consolidation of activities in a single campus. Though Bangalore is not the corporate head quarter of the firm once the campus is constructed then Administrative Head Quarter will move to Bangalore. The phases can be distinguished as:

- **Phase 1**: Initial location in a commercial complex in the CBD
- **Phase 2**: Expansion into an additional office space in the secondary CBD
- **Phase 3**: Consolidation of space in a Campus in a suburban location

5.2 Spatial decisions and location change in ITES firms

Having discussed location decisions of 3 software producing firms, I discuss here the same for two ITES firms. There is a clear distinction of locational requirements for production of Software and Internet enabled Services. ITES firms mainly consider two factors that dictate a trade-off for location:

- Rent plus Transport cost/ employee
- Additional costs for speed and reliability of communication networks

Among the Case Studies, **First Ring** and **Acusis** are both Service Firms which provide IT Enabled Services very much dependent on a high speed internet connectivity. The basic infrastructure for these kinds of firms is now available throughout the city with newly laid out Fibre Optic Network and yet they opt for totally opposite locations for their facilities. First Ring is located in the Technology Park almost 15 kms. from the Airport and Acusis is located near the CBD. Differences of locational choice exist between the firms in similar revenue segments and product profiles.

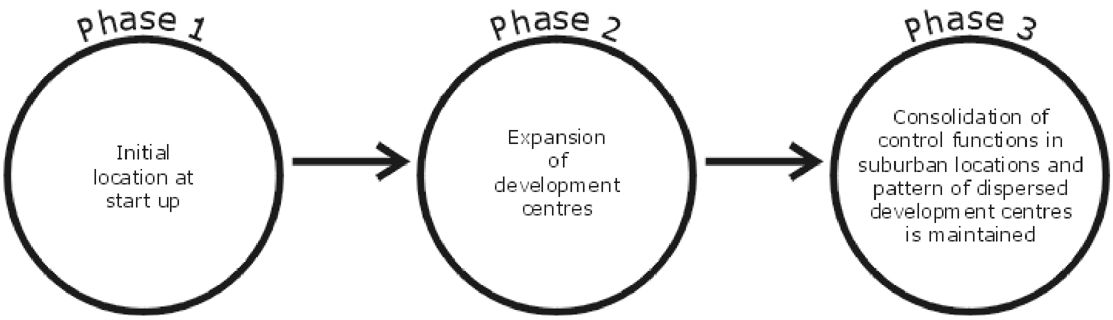
Comparing the locational choices of Acusis and First Ring, the influence of business models on locational choice is illustrated. Acusis which is a Medical Transcription firm relies on high speed communication to get voice data from its clients in the US, which are large hospitals, that has to be transcribed and sent back before the doctors come back to work the next day. The speed of communication and the transcribers is the key to sustaining the business. Similarly, First Ring is also a service firm which offers back office operations such as airline bookings, customer support, call centers etc. which have short turn around times. Both the firms have parent firms which are located in the US through which work is channelled to the main service centers located in India. However, First Ring, prioritising the quality of infrastructure, chose to locate itself in the Technology Park (20 kms. from the city center) and transports its employees working in 12 hour shifts from all over the city to this peripheral location. According to the Personnel Manager of First Ring, the cost of transporting the 900 odd employees is made up by the fact that the communication facilities available in Park are the best in Bangalore and enable high speed business.

On the other hand, Acusis has chosen to locate itself on Lal Bagh Road which is almost in the city center. The firm is based on a model of ‘Home Based Transcription’ (HBT) which enables the employees to get work at home through a high speed communication network and be able to transmit the output to the head office via the same network. The firm aims to employ about the same number of employees as First Ring by end 2003, but they would not be required to travel daily to the office thereby saving huge costs which have been channelled into having a smaller but centrally located office. The Finance Manager of the firm stated that the central location was selected to ensure that in case the employees involved in the HBT needed to contact the office, they could do so without having to travel large distances thereby saving time and money.

The contradiction in the above locational choices lies in the fact that one firm prioritising high quality communication networks opts for a high rent and high transport cost location whereas a similar firm opts to locate in a smaller and cheaper office in the city and employs technological solutions to minimise transport costs.

6 THEORETICAL MODEL OF INTRA - METROPOLITAN LOCATION

Though there are differences among the firms and all of them are not at the same level of business development, a three phase process of location and relocation can be identified. It is represented in the following Graph 2.



Graph 2: Theoretical Model of Location Change in IT Firms

In the ***first*** phase, firms select an initial location in the city. The choice of initial location can be dependent on a number of factors. Among the cases studied initial location is dependent on the **ownership of the firm and its existing size**. Large MNC firms who locate initially to explore the market have an image as well as higher affordability as compared to domestic owned local Start Up firms. Image considerations in the market are not an important consideration for Start Up firms having just entered the market. The second factor which had an influence in the case of IBM as that of **local partnerships and initial contacts**. The location office in this case was dictated by the availability of space with the local partners. Not wanting to make immediate commitments in the city, the existing office space available with their partners was selected for initial location. I flex also occupied space available with its parent firm. The **size of initial capital investment** backing the firm is an obvious determinant of the nature and quantum of space selected for initial location. Established firms such as IBM or those backed by large industrial groups such as Wipro have more flexibility to select prime locations in the CBD than Start-ups such as Infoquark. For ITES firms, initial location is also a decision based on a **tradeoff between quality of infrastructure and the cost of transport** for the large number of employees for round the clock shifts. The small profit margins in this low value added sector are very sensitive to marginal cost increases with factors such as the speed of connectivity and the cost of transporting employees to destinations where the infrastructural quality is high.

In the ***second*** phase, firms expand their Development Centers and start to assume a multiple office patterns in the city. While the original office is retained and most control functions are not moved, the production centers or Development Centers are either expanded or multiplied. In some cases the control functions or the Head Office is also moved to a more prestigious location. This is the phase where a separation of functions within the firm starts to take place. Shift to the second phase takes place when the firms **shifts from onsite production at the clients office to an offshore production**. Offshore production means that project teams would be constantly stationed in the city and more space is required hence the expansion of Development Centers. Once the firm has established its reputation in market and clients can outsource projects completely in offshore destination then the employee strength of firms is increased. The **increase in employee strength** creates normal expansion needs adding to the space requirements. Increase in employee strength in the case of I flex and Wipro was also related to **organisational reorganisation**. As Wipro expanded its internal organisational structure was split into two separate divisions which were handling different markets. This created a need for multiple offices and hence the need for expansion.

Since firms create a specialised niche in the market, they sometimes handle projects of competing clients. For example, I flex which specialises in banking software or Wipro which is specialist in Enterprise Resource Planning (ERP) and E -Commerce, often have projects from firms which are competitors in their own consumer markets. To maintain the levels of project security required to attain client confidence a physical separation of work is required. **Separation of projects from competing clients** thus becomes and additional factor for maintaining physically dispersed Development Centers. This fosters the creation of a network of offices of single firms within the city. The dispersal is maintained either in physical terms or electronically if the Development Centers are consolidated at a later date.

In the ***third*** phase, firms consolidate control functions and some key Development Centers in user specific campuses while a dispersed pattern of Development Centers is maintained. Because only suburbs and peripheral locations offer the possibility of large campuses these are located outside the city with a high quality of firm owned infrastructure. A campus which was initiated by Infosys (second largest IT firm in India) has become a matter of prestige. Facilities such as large conference halls, video conferencing, employee entertainment facilities, firm owned satellite linkups, complete captive power backups, incubators etc. have become symbolic of a firm’s success. Thus **upgraded infrastructure and image** becomes an important factor in this third phase of firm relocation. The motivation behind the suburban and peripheral location for campuses is that large consolidated space is available at an affordable price. The suburbs offer a **good environment** and an option to escape from the over crowded central cities.

Firms such as Wipro and IBM which have reached this stage in their life cycle opt for user specified campuses which they do not necessarily have to own. Like IBM innovative lease agreements are possible with builders. The selection of location for the campus is based on a **relative proximity to other Development Centres**. To maintain the network of offices in the city, firms set up Local Area Networks and centralised servers where project information is saved and accessed. Despite that proximity adds to the convenience of movement between offices for face to face interactions. As reported by the Manager, Administration Facilities of Wipro Technologies, the functions within IT firms are divided into three areas i.e. *technology, communication and enterprise*. Technology areas are the Development Centres where actual production takes place. Communications is the functions which are required to manage interaction between dispersed offices and Enterprise is related to management and administrative functions. The consolidation and dispersal of these three categories of functions differs from firm to firm but in a relative consolidation takes place in Enterprise and key Communication and Technology functions in a campus.

The maintenance of the dispersed pattern in the city even though some functions are centralised is owing to the earlier discussed factor of maintaining project security as well as a second factor of obtaining **maximum taxation benefits**. Under the Software Technology Parks (STP) scheme of the Central Government individual premises are declared as 100% Export Oriented Units making them eligible for Sales Tax concessions. If a multiple office network is maintained projects can be moved around within the intra city network depending on the level of export segment in the output. Not all premises of firms are registered as STPs and hence are not obligated to achieve the stated goals for export. The logic of multiple offices in the city was also explained by a need to **prevent disruption due to disasters**. In view of the September 11 attacks in the U.S., firms have become conscious of the need to have multiple offices which are able to take over operations in case of destruction of any single office. Backups of key information and multiple links in networks are facilitated by the multiplicity of offices. This was a very significant factor in the case of IBM which has adopted this policy in its global offices. Wipro on the other hand adopted measures for 'disaster recovery' being under pressure from its clients.

The three phase process of location change observed among case study firms can be described as a **dual process** where firms have varying tendencies to both disperse from city cores and to centralise in other locations. The formation of secondary business districts within the municipal area as well as a concentration along traffic corridors and nodes in the periphery, though planned, shows the need to disperse in the former and centralise in the latter case. In a future scenario it is expected that as firms attain a certain size they would increasingly disperse from central city locations to campuses, technology parks and other peripheral real estate development.

However, not all firms among the case studies have gone through the three phases described above. Wipro and IBM which have both been in Bangalore for more than 10 years have shown all three stages. I flex is in the second phase and planning to relocate to a campus soon. Infoquark which is the newest Start Up is still only located in its first office. The factor of where the firm is placed in its **life cycle** is an important determinant of its pattern of location in the city. The ultimate peripheralisation and suburbanisation observed in firm location at city level is produced by firms which have had a certain level of growth over time in order for them to plan campuses and user specific, single owner occupied buildings.

7 EXISITING KNOWLEDGE ON LOCATION OF PRODUCER SERVICES: PATTERNS OR DIFFERENCE ?

Discussing implications of the theoretical model suggested above with respect to existing knowledge on location of producer services, parallels can be drawn to the Multinucleation Model put forward by Daniels (1985). The model suggests an evolution of a multinuclear city pattern through a series of location and relocation by firms from the early 1960s to the 80s in urban areas of America. The process of relocation of producer service firms away from the city centre has resulted in a dispersal of back office functions to suburban location with major control functions remaining in the CBD. A further centralisation of firms in suburban locations has lead to the formation of 'suburban downtowns' (Healy and Ilbery, 1990). The 'seed pod model' put forward by Schiller (2001) explains the dynamics of dispersal tendencies from the centre and suggests a cyclical process whereby firms initially locate in prime central locations, expand and then disperse to suburban locations as it becomes too expensive to expand in the CBD. The space vacated by dispersed firms is then taken up by other firms. However, even Schiller points out that certain critical functions such as Finance, Government, Corporate HQs are retained in their original locations. Their reasons range from their ability to pay to the benefits they attain from clustering in the city centre.

Even though a similar pattern of multinucleation, phased shift of location and clustering in peripheral locations can be found among IT firms in Bangalore, a critical difference can be identified. Though firms choose initial locations in the city centre or other locations within the major urban fabric and they follow a path of expansion to finally consolidate in large campuses in the periphery, it is not the management and control functions which are retained in central locations. Unlike other producer services firms, IT firms do not have as many forward linkages to the local urban context and hence do not need to maintain proximity. It is the management and control functions, usually located in the Head Quarter which are consolidated in suburban and peripheral locations. Development Centres which require extensive and affordable space as well as proximity to residential areas in order to enable short commuting distance for the majority of the technical work force are retained in intermediate locations in the municipal area. Higher management staff and senior technical employees have higher mobility and hence can travel larger distances to suburban campuses where strategic control functions and selected Development Centres are consolidated.

The two main aspects of variation from existing theory on urban patterns of office location are: -

- The conversion of residential buildings and land to commercial use for these Development Centres in high income planned residential areas
- The possibility of relocation of strategic control function to suburban locations

In sum, the urban structure created is similar to those discussed in the Multinucleation Model and Seed Pod Models but the distribution of functions among the core city and suburban locations is different.

In contrast with existing theory, strategic functions of IT firms do not require to retain central city locations owing to their export oriented production. Firms which aim to target local markets still retain CBD or intermediate location offices. Other firms after attaining a certain size and having established themselves, seek to consolidate their strategic functions in campuses and single owner occupied buildings. However, even among IT firms, differences exist for IT service firms such as call centers and medical transcription. These firms having predominantly back office operation for a parent firm located in another country have even lesser need to locate in the CBD or even intermediate locations. Their decision for location is based on a trade off between rents and the cost of transporting their larger labour force for round the clock operation. Firms which prioritise larger offices with better communication infrastructure locate themselves in peripheral areas. The limited administrative and strategic functions are still bundled with the service production functions. On the other hand, a completely divergent location choice is made by firms which operate on home based workers and would like to minimise transport cost by locating a smaller but centralised office in the Secondary CBD.

In terms of the spatial form produced and the rent curves, high rise office development in the peripheral IT park has been a State led initiative and more related to establishing a certain image for the city. Private development in the suburban corridors and specialised peripheral centres is still low rise and low density. Land values in the peripheral office developments, though seem to converge with CBD prices. The spatial landscape of Bangalore shows a similar contrast of high rise buildings as compared with the low rise urban fabric. Peripheral high rise development and campuses show another level of contrasts from the surrounding agricultural land and informal urban development as that discussed in the account of American suburban growth but at a much different. Unlike European cities, Bangalore has no strict controls on redevelopment of the colonial CBD and conversion of old structures to high rise office blocks to gain maximum advantage of high land values is common. High rise and high land value in the periphery however, has been artificially created by the higher quality of space and infrastructure investment by public agencies. Planned infrastructure projects such as the Infotech Corridor are likely to increase the pressure on land in the periphery further and create a situation of suburban enclaves of high tech office spaces - a dispersed ‘global business district’.

In terms of determinants of location at each phase, existing theory pays great significance to the role of contact patterns of producer service firms (Daniels, 1979, 1985; Goddard and Morris, 1976; Gad, 1979), their substitutability by developments in telecommunication (Daniels, 1985; Illeris, 1996; Beyers, 2000; Castells, 1989) and to a certain extent on organisational change (Dicken, 1998; Gottmann, 1983; Marshall and Wood, 1995; Illeris, 1996). The latter two streams of theory developed after the 1980s in response to the technological revolution brought about by the internet and personal computers and a consciousness of the ‘Multi National Corporation’ as the centre of globalisation. More recent developments in theory have highlighted ‘alternative’ factors other than communication and contact patterns as determinants of office location (Coffey, 2000; Leslie 1997; Zhou, 1998).

Findings from the study indicate that in service industries such as the IT industry in Bangalore, factors which are internal to the firm influence decisions more than external influences. However, a clearer distinction of factors with respect to existing theory can be made. The following Table divides the factors at each Phase of location in four categories - Communication factors, Organisational factors, Policy factors and Value preferences.

Communication factors relate to the considerations regarding physical transport and the substitutability of contacts with advanced technology. Organisational factors relate to changes and determinants which are related to the way a firm operates. Policy factors are those incentives and spatial policies which the firms avail of and are subject to in the urban context. Value preferences are socio cultural aspects of location such as the aspiration to a certain image associated with office space and preferences for a better urban environment.

	Communication factors	Organisational factors	Policy factors	Value Preferences
Phase I	tradeoff between quality of infrastructure and transport cost for ITES firms	ownership of the firm and its existing size size of initial capital investment local partnerships and initial contacts		
Phase II	separation of projects from competing clients	shifts from onsite to offsite production increase in employee strength organisational change	maximum taxation benefits	
Phase III	relative proximity to other Development Centers	upgraded infrastructure consolidation of control functions	maximum taxation benefits	image prevent disruption due to disasters better urban environment

Table 2 : Theoretical classification of determinants at each Phase of location

Goddard (1975) put forward the idea of dividing contacts into functional interdependencies (contacts between offices), spatial structure (contacts between employees within a firm) and physical movements of individuals and materials. The findings from the cases suggest that in export oriented IT firms contact within the firms (spatial structural contacts) and to certain extent physical movement of individuals (for ITES firms) form important factors in location decisions. In Phase II, Development Centers are dispersed to sever contacts among employees working in conflicting projects to maintain intellectual security whereas in Phase III a proximity of the strategic control functions and Development Centres is designed to maintain ease of physical movement between the offices. A balance between dispersal and proximity is preferred such that a physical separation is maintained but swift transport for necessary face to face contact for internal meetings is possible. However, functional interdependencies do not play an important role as other partner firms and clients are located all over the world. The work which is outsourced in Bangalore is routine operations of a larger multinational firm or specialised service outsourced by manufacturing firms, the need for direct regular contact is minimum. Of the office contacts identified by Thorngren (1973) as programmed (routine), planning (implementation of action) and orientation (strategic decisions to maintain competitiveness), programmed contacts with the parent firm are maintained through advanced telecommunications while less frequent planning and orientation contacts are undertaken by means of video conferencing or actual international travel. While analysing the relocation potential of firms in Stockholm, Thorngren suggested that functions of programmed and partly planning contacts could be decentralised. However, the developments of information and communication technology have enabled the decentralisation of programmed functions not only to suburban locations but even outsourced to global locations. Therefore for these firms which are mainly involved in programmed contacts with the parent firm and clients, intrametropolitan contacts are limited to maintain backward linkages and internal organisational contacts among employees of the same firm.

Reflecting on the role of technology in replacing face to face contacts, empirical studies suggest that with the increasing complexity in production networks which have tendency to be globally dispersed the significance of face to face contacts for strategic decisions is only increasing (Storper and Venables, 2002). Beyers (2000) finds that though means of communication and information exchange have multiplied, these only supplement the core role of direct contact. The findings from the thesis point to a confirmation of this aspect of intra and inter firm communication. Even though firms in Bangalore can disperse Development Centres in various locations in the city as well as globally, strategic management and decision making functions are consolidated and centralised in selected locations. Intra firm contacts with Development Centres are maintained through internet communications and information stored and distributed through centralised servers, yet the Head Quarters of large firms such as Wipro has been centralised further. Since the case study firms have limited forward linkages in the local urban area, contacts external to the firm are maintained through the use of communication technology such as e-mails, telephone, video conferencing and infrequent international travel by project teams and decision makers.

From the Table above it can be seen that organisational factors form an important determinant of location change in the case study firms. Theorists such as Dicken (1998) and Marshall and Woods (1995) have suggested that in the new ‘service economy’, organisations are more flexibly organised as are production processes. Transnational and Multinational firms that form the basic building block of a service economy and of post fordist production operate according to a large number of models (Dicken, 1998). Large IT firms like Wipro, are organised in a way that ‘each unit performs a separate part of the production sequence and units are linked across nations in a chain like sequence’. This is the model which forms the basis of operation at an intra city level as well. The most important factor of location change is the shift from ‘onsite to offsite production’ whereby a firm no longer sends project teams to the clients office but dispersed production centres are established which are responsible for disaggregating the production sequence. This creates the need in Phase II for spatially dispersed Development Centres which are linked to a centralised communication network. Therefore, it is organisational change which is responsible for expansion of the firm in a city and shift toward a ‘multiple office pattern’. Organisational changes such as mergers, acquisitions, break away firms etc. have also been factors behind change of location in the case study firms.

In Phase I and III, it is direct organisational demands that determine location. While in Phase I the affordability for prime space and access to space already available to partners are determined by the nature and ownership of the firm, in Phase III, firms size also determines the level of infrastructure required and the complexity of strategic decisions to be made. The choice for a campus which consolidates all management and strategic functions is made when a firm attains a certain size and requires dependable, secure and high level of infrastructure to manage its complex global business network. Other factors such as ‘image’ and other value preferences also play a part in Phase III.

Recent developments in theory find that as proximity constraints are relaxed dues to a large number of factors, ‘other’ determinants begin to play an important role in office location. These ‘other’ determinants may be quality of life, taxations and regulation, life cycle of firms, initial contacts, image considerations of Metropolitan Philadelphia (Bondenman, 1998); site attributes and establishment attributes in Montreal (Coffey et al., 1996); sub contracting by federal agencies in Washington D.C. (Campbell, 1997); historical forces and existing physical structure in Milan (Airoldi et al, 1997); creative milieus among advertising firms in New York (Leslie, 1997) and ethnic enclaves and connections among chinese producer service firms in Los Angeles (Zhou, 1998). From the findings of this research, there are two kinds of additional factors which play important roles in determining location - policy factors and value preferences. The multiple office pattern opted for by firms of relatively larger size which reach Phase II in the firm life cycle is related to the incentives offered for sales tax exemptions associated with specific registered production units. The incentives are also subject to export targets which the firms have to state and achieve annually. Hence firms maintain multiple offices such that they can allocate projects to units based on their export/ domestic market classification. In addition to this location policies and incentives of the State Government have had an impact on the selection of sites for campuses in the periphery as well as the supply of space by developers. Through planned developments such as the Information Technology Park where location is linked to infrastructure and fiscal incentives, agglomeration at a city level has been influenced.

But apart from that there are some value preferences such as ‘image’ and ‘better urban environment’ which firms make at advanced stages of their life cycle (mainly Phase III). While ‘image’ of the firm is a consideration for subsidiaries of MNCs, even at initial location, it is more related to affordability of prime space while smaller startups which are not backed by large investments or existing businesses are more involved in establishing their reputation in the market. Image becomes an important factor at Phase III when a campus or a single owner occupied office building is opted for. Image building through the campus is an important consideration for firms that have achieved a competitive position in the global market. Other value preferences such as a ‘better urban environment’ in peripheral locations also become important at this phase as the firm can rise above constraints of affordability. A suburban location where the firm can establish an office with secure and dependable infrastructure, recreational facilities, synergistic work environments and an image of success is an option exercised to escape the overcrowding of central city locations.

8 CONCLUSIONS

To summarise the discussion on determinants of location, the difference in nature of work and services produced by IT firms and other producer service firms, there are some basic differences in the factors influencing location. Unlike the findings from existing theory and empirical research, the stress is not on factors of communication and face to face versus indirect contact, but on aspects relating to intra firm communication and organisational factors. Since firms located in Bangalore have very little local market orientation, their inter firm contacts are more focused to their parent or subsidiary firms located elsewhere. The firms have more backward linkages with the city than forward linkages. Their primary interaction with the city is in terms of availability of skilled labour. In such a situation, it is organisational and other factors such as policy and value preferences that determine their location at an intrametropolitan level. In a very simplified version, firms locate in the city, expand and multiply offices, expand further and consolidate selected functions in peripheral locations.

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Macro-spatial aspects of the digital backbones network in Latin America

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1 INTRODUCTION

In just one decade, the infrastructure of digital backbones has extended itself at a global scale as a new channel of distribution of digitalised information (texts, sounds and images), superimposing itself on the traditional distribution channels. ICTs are gradually becoming the contemporary equivalent to the maritime and aerial commercial routes of the industrial age. Despite of the critical importance of the configuration and characteristics of this new infrastructure, urban professionals know little about it. The technical character of the networks, the rapid pace of technological change and the continuously transforming business environment in the telecommunications sector have constrained their understanding of this evolving infrastructure.

The general purpose of this paper is to explore and analyse the main features of the telecommunications infrastructures that provide Internet connection in the Latin American metropolises. Under the assumption that the architecture of the digital backbone networks is re-inforcing pre-existing urban hierarchies and spatial differences, this paper seeks to identify and examine how this is happening and what are the main consequences for the urban development of the large metropolises in Latin America.

2 TELECOMMUNICATIONS IN LATIN AMERICA

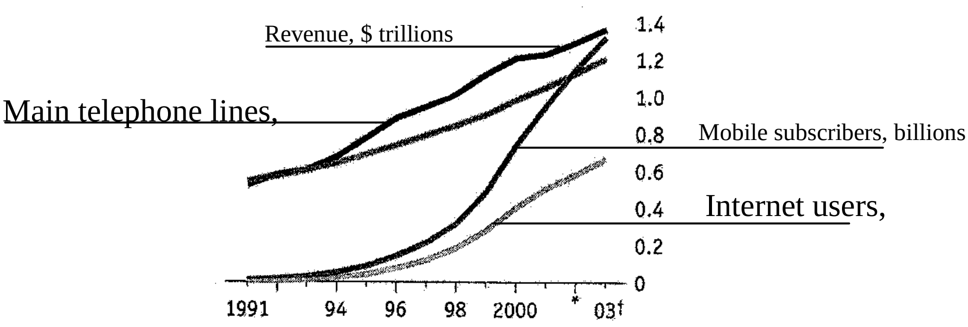
The telecommunications sector has been subject to constant, far-reaching, change since the late 1980s. Thanks to the growing and constant diffusion of ICT networks and devices in homes and businesses, today's world is different from what it was ten years ago. Telecommunications have passed from a relatively unimportant and low-growing sector, to a sector of rapid development and of strategic importance for the economic and social progress of nations. It was transformed from being an industry in itself, to become a vital enabler of all other industrial sectors. The telecommunications sector is currently both the core (major economic activities are mostly information processing and transmitting or depend critically on it) and the infrastructure of the information economy (World Bank, 2000).

During a very short period, the sector was undergone huge transformations that mainly refer to:

enormous technological innovations: Internet and mobile telephony have become pervasive in developed countries and increasingly present in the rest of the world; voice transmission and digital technologies are becoming a single industry; telecommunication networks have been transformed from analogue to digital and from territorially-based local networks to networks with global reach;

changes in the legal aspects: privatisation and deregulation of the telecommunications business; change from a public and regulated utility into a private and highly competitive business run by corporations, mostly of global scale; and uncertainty and instability: from a huge telecommunications hype to the crisis of the sector in a short period due to huge miscalculations, moves and risks taken by the telecommunications firms, that led several large firms into bankruptcy. The main flops refer to network overbuilding, the European 'Third Generation' (3G) spectrum license auctions flop, and the US management scandals and bankruptcies (Shaw, 2002).

Despite the crisis, the telecommunications business is still very profitable. In 1996 the top-ten telecommunications firms earned more than the twenty five largest banks in the world (Alaedini and Marcotulio, 2002). It is estimated that its gross operations margins are of the order of 40% (Nellist and Gilbert, 1999). According to the ITU the revenues of the total industry have reached $1.37 trillion in 2003 (see Graphic 1), while at the same time consumer spending on communications has grown faster than any other household spending (Standage, 2003).



Graph 1: Telecommunications global market 1991-2003 (Source: Standage, 2003, with data from ITU)

In Latin America, the reform and liberalisation of key economic sectors was a central element of the structural adjustment measures imposed during the 1990s. Within them, the reform of the telecommunications companies became a central element of structural change. The Latin American telecommunications reform has tended to follow the ITU formula which has three basic ingredients: (a) privatisation of the sector, (b) free competition and (c) (independent) regulation of the free competition (ITU, 2000). The results are the following:

a) More than two thirds of the public telecommunications companies in Latin America have been partially or totally privatised. This is, after North America, the highest proportion in the world. The privatisation attracted large foreign investors, as local investors had not enough capital to buy the former monopolies. Large European and US American companies became the new

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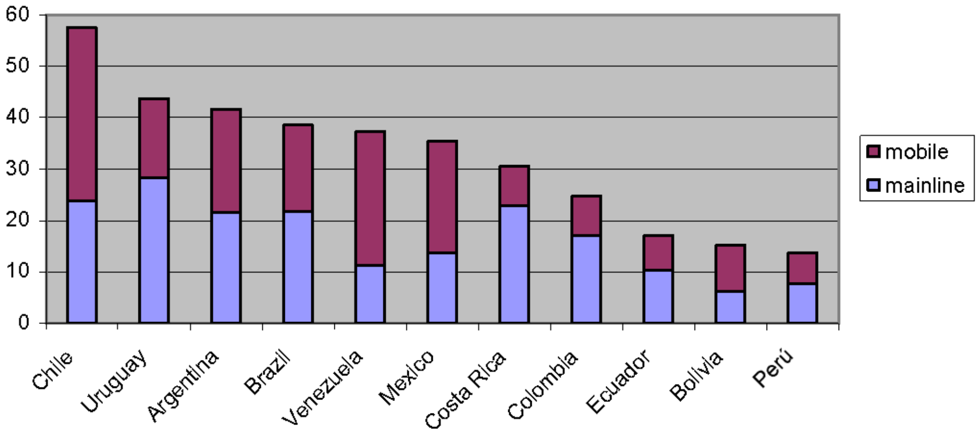
operators[7]. The companies that now dominate the telecommunications market are among the largest companies of the region[8], and sometimes the largest of the country, as in Mexico, Venezuela, Chile and Peru (Hilbert, 2001). One of the most dominant among them is Telefonica, which acquired the networks in Chile, Peru, Argentina, and Brazil (São Paulo). European companies focused on buying the former monopolies, while the US American companies, risking much less capital, have preferred to address their businesses to the new segments of Internet and mobile telephony.

b) The opening of markets for competition was, however, not immediate. Most countries granted the new companies a period of exclusivity that varied between four and ten years from the moment of the turning over of the carrier (ITU, 2000). With rising tariffs, the consumers often complain that the public monopoly have become a private monopoly. Even if now most countries allow competition in basic services, the level of competition has remained low. On the other hand, the region enjoys a high degree of competition in mobile and Internet services, segments which do not demand such high investments.

c) Most Latin American countries created regulatory bodies to promote an environment that attracts investment in telecommunications and the spreading of services. But, the institutional profiles of the telecommunications regulatory authorities are as variable as the socio-political and economic environment of the country in which they operate. Brazil and Chile, the countries with the highest teledensity of the region, are also the ones with the most progressive and effective regulators: Anatel and Subtel, the Sub-secretary of Telecommunications of Chile, which is not a special regulatory body but part of the Chilean Ministry of Telecommunications (therefore not an 'independent' regulator). They are both, with Peru, publicised by the ITU as good-practice examples of 'effective regulation' at global level.

Despite the radical reforms and the good practice examples, a closer look at the performance of the telecommunications sectors shows that the reforms have not been enough to benefit the final customers in most countries. A study of Latin American Economic Commission (CEPAL, 2000) points out that even if the sector has modernised itself and its networks, the users have financed the improvements in many cases. On the other hand, even if average teledensity[9] and the quality of the services have increased, the local access prices have generally risen after the privatisation, excluding a great part of the population from the market (ITU, 2000). Graphic 2 shows the levels of fixed and mobile teledensity in Latin American countries in 2001.



Graph 2: Mobile phone subscriber and fixed lines, per 100 inhabitants in Latin American countries in 2001 (Data source: ITU, 2002a)

Investments of telecommunications firms in Latin America have been mainly addressed to two main segments: infrastructure and contents.

Large international operators and independent consortia invested large capitals to provide Latin America with an appropriate infrastructure and to connect it with the US American backbones with a submarine fibre optic network. Nine large projects were executed to provide the region with 170 thousand kilometres of submarine cables, which amounted to US$ 20 billions (Fernandez-Maldonado, 2000). The total submarine cable capacity of South America increased from 13 Gbps in 1999 to close to 400 Gbps in 2001, an increase of 3000% in only two years (Shaw, 2001).

At the same time, there was an aggressive expansion of the telecommunications sector towards content industries (mass media and entertainment industries), considered strategic under the motto: "Content is king". A wave of mergers, mega-fusions, and the buying of the most innovating firms by the giants of the sector followed. The rhythm of mergers and acquisitions was so fast that it was almost impossible to follow all the events in the turbulent telecommunication market. But the global economic downturn and the fall of the NASDAQ in the stock market in April 2000 greatly affected the hegemonic ambitions of the large telecommunications firms. Telecommunications investment has slowed down remarkably since 2002. The business difficulties the Latin American telecommunications sector is experiencing are mainly related to the economic crisis affecting several countries of the region.

7 The Mexican Telmex is the only large telecommunication company in the region in which national capital is in control of the firm.

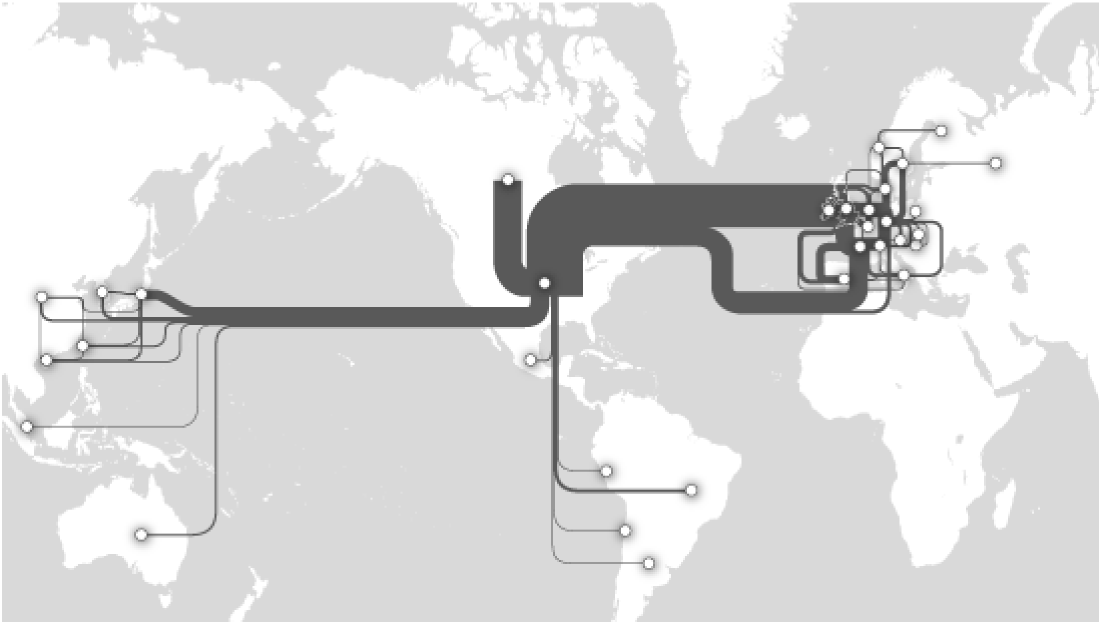
8 In 1998, 29 of the 100 largest companies in the region were in the telecommunications sector (Callaos, 1999).

9 Teledensity is the number of telephone lines (or subscribers) per 100 inhabitants.

3 LATIN AMERICA'S INTERNET BACKBONE NETWORK

Because of the Internet's historical origins, its nodality is still concentrated in the U.S. For at least a decade, American companies have aggressively dominated the global telecommunications industry, constructing networks primarily designed to meet the connectivity needs of U.S. businesses (Townsend, 2001a). Much of the development of the Internet has been concentrated within developed countries and major urban agglomerations.

Since the main nodes are located in the U.S., and a good portion of international Internet traffic transits via the backbones that traverse U.S. territory (see Graphic 3). While every region and nearly every country has a direct Internet connection to the U.S., direct connections between other countries have been less common. Furthermore, direct connections between different major regions are weak. The U.S. still serves as a central switching facility for inter-regional data traffic, being used as a transit point for data packets travelling from one major region to another.



Graph 3. Map of major international Internet routes, 2004 (Data source: TeleGeography Research Group – PriMetrica, Inc. © 2004).

Since 1999, this US-centric structure has begun to diminish (TeleGeography, 2000a), along with the huge deployment of trans-oceanic, satellite and terrestrial fibre optic networks, and the emergence of new Internet exchange points (NAPs) in the rest of the world. In Europe, intra-regional traffic is now mostly locally switched, and does not need to go to the U.S. and back. In 2000 some African countries begun to connect themselves with France, rather than the U.S, showing the importance of cultural and trade links for the Internet connectivity [10] (Bartlett, 2001). At the same time, there has been a shifting away from single dominant regional hubs in the U.S., Europe and Asia towards a more diffuse network (Townsend, 2001b). This trend is the result of the massive deployment of digital backbones that have been made in recent years.

Latin America is still dependent on U.S. connections for Internet traffic. The U.S. dependency is not only linked to the configuration of the networks, but also linked to content dependency as U.S.-based companies are the producers of the content of the most visited sites. Although the major Spanish language content producing countries are Spain and Argentina, still many Latin American portals and e-commerce sites house their data servers in the U.S, although this is slowly changing. Until late 1999, most countries still relied on lower-capacity satellite links for their connections to the US backbones (TeleGeography, 2000a). But, thanks to the culmination of several projects of submarine cables in the region, international Internet connectivity to Latin American countries grew 479.2 % in terms in deployed bandwidth between July 2000 and July 2001, from 2.7 Gbps to 16.1 Gbps (Bartlett, 2001, with data from TeleGeography). In 2003, the total regional bandwidth was more than 25 Gbps[11] (TeleGeography, 2003a).

The two largest submarine networks that were implemented in the 1999-2001 period, were E-mergia, owned by Telefónica and the Latin American Crossing, or Global Crossing, respectively (see graphic 4). Surprisingly, both submarine backbones display almost the same layout, being the only differences the connecting points at the Caribbean region. The cities located at the coast have been, obviously, the most favoured by the presence of the new backbones. Colombian cities, for example, are not connected by the Global Crossing trace, but three Mexican cities (Mexico City, Guadalajara and Monterrey) are connected. The increased bandwidth has greatly improved the performance of the networks in all Latin America. The backbones are currently lightly loaded, but there is still congestion occurring at the last mile.

[10] However, the TeleGeography 2001 study concluded that 80 % of international capacity in Asia, Africa and Latin America is still using U.S. backbones.

[11] The final capacity of these two rings is in Terabytes per second (one Terabyte equals thousand Gigabytes), so there is a huge installed capacity.

Graph 4. The E-mergia network (www.e-mergia.com) and Latin American Global Crossing (www.globalcrossing.com/xml/network/net_map.xml)

As Internet expands it becomes clear that large telecommunications carriers are competing to provide infrastructure and services on an end-to-end basis within private networks (OECD, 2002). In this new scheme, MCI, France Telecom and Telefónica are the dominant regional networks in Latin America. Other companies that have developed their own backbones and links to the U.S. during the past few years are AT&T, Latin America, Bell South and IBM. These trends confirm that the operation of the digital Internet backbones in Latin America is a matter of a few large telecommunication companies, of US or European origin. In this context, Telefónica appears as one of the most important players, with incumbent networks in several of the largest cities and operating networks at all levels of the Internet infrastructure. In this new infrastructural system that is constantly expanding, the metropolises represent then the locations where most of the components of the new system are located. Castells (2001) states it in few words: "*The Internet is a network of metropolitan nodes*."

4 THE METROPOLISES AS NODES IN THE DIGITAL BACKBONES NETWORKS

There are different ways to analyse the position of the cities regarding the Internet infrastructure. The simplest is just to measure connectivity (bandwidth) to international backbones. One of the most comprehensive is that advanced by the MOSAIC group (Wolcott, et al., 2001), which evaluates nations according to three main variables: (a) the (national and international) capacities of the backbones, (b) the number of Internet exchange points, and (c) the local connectivity: the type of access networks to end users.

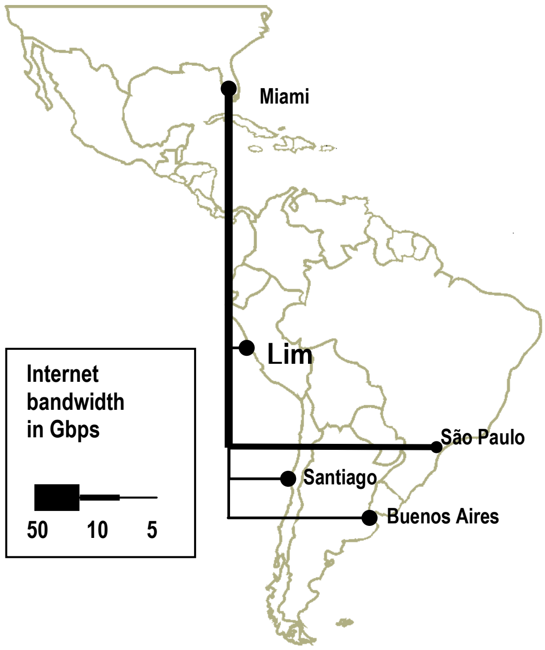
4.1 Backbone capacity

Connectivity indicators for metropolitan areas show that Latin America's Internet geography has a strong relation with the traditional hierarchy of its system of cities. However, as the networks are in constant evolution, the ranking of these node cities, those with the highest Internet connectivity, changes from year to year although it always remains among the same largest metropolises. Graphic 5 shows the main Latin American metropolises in the global Internet infrastructure, those with more than 5 Gbps of capacity in 2003: São Paulo, Santiago, Buenos Aires and Lima. Not surprisingly, these four cities constitute the most important nodes in the fibre-optic rings that circle the region.

If one pays attention to the evolution of the connectivity since 1999, one can see the huge growth in connectivity in the year 2001. The evolution of the position of cities in terms of bandwidth connectivity in the 1999-2003 period, shown in Table 1, illustrates how dramatically the bandwidth picture and the position in the ranking has changed between these years. The cities that benefited most from the increase of connectivity are clearly those that have a coastal location. The 2003 ranking shows that three of the four main cities have high urban primacy. Due to these new powerful connections, Mexican cities have decreased their position in the ranking.

Ranking	1999 (in Mbps)	2000 (in Mbps)	2001 (in Mbps)	2002	2003
1	São Paulo (284,2)	Mexico City (749)	São Paulo (4984)	São Paulo	São Paulo
2	Buenos Aires (146)	São Paulo (566,6)	Buenos Aires (4017)	Buenos Aires	Santiago
3	Mexico City (136)		Mexico City (2182)		Buenos Aires
4	Rio de Janeiro (123)		Santiago (1770)		Lima
5	Caracas (96,8)		Monterrey (1077)		
6	Monterrey (79)		Rio de Janeiro (1029)		
7	Santiago (47,3)		Caracas (433)		
8	Lima (38)		Lima (412)		
9	Bogotá (12)		Bogotá (312)		

Table 1. Top Latin America Internet hub cities in the 1999-2003 period (Data sources: TeleGeography 2000b; TeleGeography, 2001; ITU, 2002b; TeleGeography 2003a; TeleGeography 2003b; respectively)



Graph 5. Latin American metropolises in the global Internet in 2003 (Data source: TeleGeography, 2003b)

When one sees how the metropolises are connected, the U.S. centeredness appears clearly again. Table 2, showing the major Internet traffic routes, illustrates this. It is not São Paulo, but Miami the largest Latin American hub, with 7825 Mbps bandwidth to Latin America in 2001 (Shaw, 2001). New York, with 2003 Mbps, Dallas, with 1546 Mbps, and Los Angeles, with 975 Mbps, have also a position within the 2001 ranking of cities, although they are obviously not located in Latin American territory. Miami's link with Latin America improved greatly since the opening of the NAP of the Americas in its territory in the year 2000. Before that date, New York was the main Latin American hub (TeleGeography, 2000a). This geography reminds us that the Internet geography is still very dependent on the US networks.

Origin	Destination	Bandwidth (in Mbps) in 2000
São Paulo	Miami	3384
Buenos Aires	Miami	1455
Mexico City	Dallas	1340
Buenos Aires	Santiago de Chile	824
Buenos Aires	New York	698
Buenos Aires	São Paulo	666
Monterrey	Los Angeles	656
Santiago de Chile	Miami	503
São Paulo	New York	475
Rio de Janeiro	New York	378

Table 2. Major Internet traffic routes in 2001 (Source: Shaw, 2001)

However, thanks to the improvements in the networks, Internet connectivity between Latin American countries grew at the impressive rate of 2500 % during the 1999-2001 period (ITU, 2002b). This implies that a more diffused Internet infrastructure is also developing inside the Latin American region. In the new Internet geography that would be emerging, São Paulo would be becoming a major hub for international traffic exchange in the Latin American region (ITU, 2002b). The connectivity analyses of the Latin American cities reveal the importance of the size of the cities, their geographic location, their urban primacy and their relative importance in the global telecommunications market. This ratifies the trends to concentration already observed in other world regions.

4.2 Network Access Points

The architecture of the Internet backbone is made of many smaller networks, joined at key locations called, Network Access Points (NAPs), also known as Internet eXchange points (IXPs) or Metropolitan Area Exchanges (MAEs). They are physical installations created by third parties to facilitate interconnection between independent ISPs that aim to be a neutral meeting ground for ISP traffic exchange (TeleGeography, 2000a). Exchange points constitute an asset for the cities that count with them, because as points of local exchange, Internet traffic can be directed to a multiplicity of routes. Without a NAP, carriers have to route local and intra-regional traffic first to the international backbones and then back to the region or city, which is more expensive and inefficient. The importance of an exchange point depends of the number of ISPs involved and the peering between members (Drewe, 1999).

In 2002 there were 155 NAPs in the whole world, from which 51 in U.S. and Canada, 57 in Europe, 36 in Asia and Pacific, 10 in Latin America and 2 in Africa (TeleGeography, 2002a). Latin America had 13 Network Access Points (NAPs) in 2002, located in the largest metropolises: Buenos Aires, Mexico City, Santiago, Bogota and Lima. São Paulo concentrates four of them, from which three began to operate in 2001. There is also one in Panama City, Porto Alegre, Monterrey and Guadalajara.

4.3 Local connectivity

Local connectivity depends on the access networks (the so-called ‘local loop’) that get to the end users. The analyses of last mile connectivity are highly relevant for urban planners, since they are “the material basis for the ‘death of distance’” (Graham, 2001:405). To have a good picture of the local connectivity attention must be paid to three main elements: (a) the basic networks, (b) high-speed (broadband) networks and (c) Internet data centres.

a) Data flows can travel through four main types of lines:

copper lines (used for the last mile),

coaxial cables,

powerful fibre optics (generally used in the backbones), and

wireless (microwave radio or satellite)

With the advent of digital networking, the architecture of the telecommunications networks at local level began to modify itself. To change from transporting voice flows to digital flows, they transformed themselves from hierarchical bundles of copper and coaxial cable into complex and inter-locking rings of optical fibre (TeleGeography, 2002b). The new telecommunications networks are now hybrids of different kinds of wires. Optic fibre is reserved for the backbone network since it is too costly to deploy it up to the last mile.

Globally, the traditional telephone line is by far the most common way to get connected to the Internet. In Latin America, most Internet access, both business and residential, is via dial-up too, so flows basically run locally over the telephone wires. But, since the telephone network was designed to carry voice flows, when it has to carry packet-switched flows, it becomes a low-speed network. For this reason, the local loop is generally a bottleneck, since the total end-to-end capacity of the network is obviously equal to the capacity on the ‘weakest link’. It is possible to make it a high-speed network, by changing the transmission circuits and switches: the digitisation of the networks. In all the Latin American metropolises the fixed-line networks have been steadily expanded along with the digitisation of the networks, in a process that generally followed the privatisation processes. Most large cities have now a level of total digitisation or are close to reach it. As the incumbent carriers have the legal duty to provide connection to any metropolitan company or household (TeleGeography, 2001), telephone networks reach all the neighbourhoods of the city.

b) In developed countries bandwidth is slowly becoming cheaper and broadband networks are becoming popular, although the diffusion varies according to the particularities of the locations. The most used technologies are co-axial cables networks (the so-called cable modem), and DSL (dedicated copper lines). The operators are then the cable TV networks owners or the telephone companies. Other broadband technologies are more expensive and/or technically difficult to install. This includes the wireless networks, fibre-to-the-house (FTTH), and WiFi (Wireless Fidelity). WiFi is a very auspicious developmentthat is still in early phase, but operational in the main hot spots of the large cities. Broadband technologies have been used in Latin America since 1998, but their initial growth was slow due to high costs and technical problems. According to the 2002 ITU database the ranking of countries according to the availability of broadband is topped by Chile, followed by El Salvador, Argentina, Venezuela, Mexico, Brazil, Costa Rica, Guatemala and Peru (World Economic Forum, 2003:301).

Broadband growth has been spectacular in the countries with more affluent customers: Brazil, Mexico, Argentina and Chile. For example in Chile, high-speed connections grew at a 162% rate between March 2001 and March 2002, accounting for 217 thousand connections, from which 49.7% were cable modem and 38.7% DSL (Subtel, 2003). Analysts forecast a total of 1.2 million DSL users in Latin America at the end of 2003 (61% of them in Brazil) and 720 thousand cable modem users (30% of the in Mexico) (NUA Internet surveys, 2003). However, forecasts are generally tricky. The high price of these services (not less than $40 per month) makes it unaffordable for most people, so the ceiling of the market might be reached before analysts’ expectations.

Even if the metropolises are the locations that enjoy a greater variety of overlapping high-speed digital networks, not all areas are equally connected to high-speed networks, only the business, media and elite districts, in a process that Graham (2001) denounces as the filtering of local connectivity. One the one hand, there exist firms that offer optic fibre to final users to those companies for which a good global connection is fundamental for the conduction of their operations. Despite that residential consumers are not such an important market, optic fibre networks have been reported in the exclusive enclosed neighbourhoods and condominiums that have emerged in some of the large metropolises.

The most wired spaces are evidently the business districts of the globally oriented cities, where multiple carriers compete to offer their services. According to the last strategy of data flows in private networks, these firms networks produce a typical example of ‘glocal’ infrastructural by-passing[12], avoiding contact with the local networks, sending and receiving the digital flows almost directly to and from the outside world. In other words, a process of global connections and local disconnections (Graham, 2001), which is also increasingly observed at differing social levels through the emergence of gated neighbourhoods in the Latin American cities.

c) Collocation and Internet data centres (IDCs), also called carrier hotels, server farms, web hotels, or telecom hotels, are also important digital facilities. They are a new urban facility that emerged as a result of the need of inter-connection in locations other than NAPs. It houses switches, routers and servers, providing floor space, power and network connectivity to institutional servers and suppliers of content. Clients can be large carriers, medium-sized ISPs or small dotcom companies, which rent space according to their needs. Data centres develop two main types of businesses: shared or dedicated hosting (renting of the technology: hardware, software and technical assistance so that the companies can have their servers in the centre) and housing or collocation (renting of the physical space, plus security and cooling systems) (Jurado, 2001). For technical reasons they need

[12] Local by-pass refers to the deployment of a parallel infrastructure network that connects valued users and places while it bypasses non-valued users and places within a city. Glocal bypass does the same but connecting local users and places with global circuits (Graham and Marvin, 2001).

to be located near abundant bandwidth, so its preferred location is in metropolitan nodes, near the connection to the high-speed backbone cables, close to the highest (business) demand, and with easy access to physical transportation (Graham, 2001).

These facilities grew explosively in cities of the U.S. and Europe until mid-2001. The end of the dotcom boom and the telecom crisis has made its growth less dynamic since then. But, the growth of these data centres has had clear spatial consequences for the cities involved. Large telecom carriers and specialised companies have recently built several data centres in the large metropolises of the region. These new facilities have improved the possibilities for good routing within the networks. Until a few years ago, the largest dotcom firms that provided content to the Latin American cyberspace were hosted in U.S. locations, since high-quality web-hosting did not yet exist in the region. But the connections had poor performance. The new submarine cables that began to operate in the region during 2000 and 2001 have made high bandwidth available and motivated new companies and existing carriers to construct web-hosting facilities. A report by the Phillips Group found 43 operational data centres and collocation facilities only in Brazil, Argentina and Chile in 2001, of which 28 were carrier-based (owned or linked to large regional carriers) (The Phillips Group, 2001).

5 CONCLUDING REMARKS

At macro scale, the current Internet topology in the region has a well defined structure that provides clear advantages to the large metropolises of the region, their main nodes. The key-components of the infrastructure international backbones, the NAPs, data centres and a variety of broadband technologies to transmit the information flows are almost exclusively located in these metropolises. As the metropolises largely concentrate the Internet connectivity, the other cities tend to link directly with them, producing an architecture of 'hubs and spokes' around the largest agglomerations, which generally have national reach. This suggests that the current Internet backbones' topology would be reinforcing the traditional primacy of the large cities.

On the other hand, in those countries with a less centralised urban system (Brazil, Mexico, Colombia, and Bolivia) a lesser degree of concentration in a singular point is observed. The networks tend to follow the pattern of their corresponding urban system, being monocentric networks in the case of countries of high primacy, and more diffused in the case of countries with a more balanced urban system. In these cases, the concentration is observed in few points. Mexico's proximity to the US networks has favoured its early connection to the Internet backbones, and facilitated a more diffused distribution of direct links to them.

Due to their huge capacity, the optic fibre rings that surround the Latin American region play a fundamental role in the regional Internet infrastructure. In this emerging geography, coastal locations acquire a double importance as nodes. Because of the expensive costs of deploying fibre-optics lines, port cities are favoured spots for the location of the main components of the Internet infrastructure. The most important connecting points in both networks – Miami, Rio de Janeiro, São Paulo, Buenos Aires, Santiago and Lima – have become the more consolidated nodes. The main node of activity in the Latin American Internet infrastructure is undoubtedly Miami, which through the years has acquired a privileged position as the gate to the U.S. businesses, tourism and immigration flows for Latin Americans. This regional familiarity with Miami has been translated into its new role as main gate to the U.S. backbones for Latin American traffic.

It is considered unlikely that the domination of Miami as Latin American hub will change in the near future, given that the macro-architecture of the Internet networks generally reflects the cultural and trade links among countries and regions and between them. The analyses of traffic routes between Latin American cities have confirmed this for the Latin American backbones. Those cities located closer to the U.S., and which, traditionally, have stronger commercial and cultural ties with the U.S., show less intra-regional traffic than the cities located in the Southern Cone (Mercosur countries), which have stronger economic links with each other, besides their traditional links with European countries. This suggests that the São Paulo-Buenos Aires axis might develop as an important regional hub in the long term. Initial trends in that sense have been observed, but it remains still uncertain to which extent will they consolidate.

Despite the fact that the spatial distribution of the Internet infrastructure does not differ radically from the commercial sea routes used for exports and import of products, a big difference does exist. The traditional advantage of Atlantic coast locations, more closely located to the great world markets disappears in the case of digital traffic flows. In this new network geography, distance becomes irrelevant, although location remains important.

The increase of the telecommunications demand in the secondary cities of the region will lead eventually to a more diffuse configuration of the regional network as more locations get connected with each other. However, due to the particularities of the nature of the networks the present structure will not change dramatically. Once the main spatial structure of a network has been deployed within a specific geographical space, no matter of its size, further changes and upgrades in the system will hardly affect its main overall shape - location of nodes, trunk connections and traffic flows (Goussal and Udrízar, 2000). Indeed, great portions of the global Internet infrastructure have been already completed and there exists a great installed capacity in the main lines of regional backbone networks. A more diffused network morphology may develop in the future. But, if intra-regional links will consolidate or not depends upon the local demand and on the political willingness of the governments involved.

At the local level, the overall situation of the ICT infrastructure in the lareg metropolises is satisfactory, since there is basic coverage in all neighbourhoods, which allows households and businesses to have access to telephone and Internet services. But if in the technical aspects, Internet access is widely available, effective access is a matter of economic affordability and in this regard, the privatisation of the networks has not represented an improvement from the previous situation for those households with low incomes, which in Latin America represent great portion of the urban residents. On the other hand, high-speed networks provide access in home and work to the economic elite. Poor residents do not have access at work since they work in low-skilled and informal jobs, and they have very limited possibilities for home access due to the high costs involved in domestic connections. The commercial-financial centres are highly privileged in terms of connectivity, with several layers of fibre optic layers, depending on the position of the city in the world economy. The deployment of premium networks in business and residential areas represent typical examples of local and glocal infrastructural by-passing.

These issues highlight the important role played by large telecommunications firms in the new geography of nodes that has emerged in the last years. Outside the full awareness of urban professionals, large telecommunications firms have become important agents of urban change during the last decade. The decisions about the location of the nodes and the number and direction of the links are, for the most part, in the hands of these private firms and are decided according to agglomeration economies and other 'imperatives' of the business world (Malecki, 2002), and with disregard to regional, national or local priorities. Equally important are the telecommunications policies, which are determined at national level. Townsend (2004) argues that the national telecommunications policies, become de facto urban policies, since those decisions taken on telecommunications issues (as the licensing of spectrum, regulation of new technologies) generate profound effects on urban economic development.

Evidently, the position of a city within the global backbones is of great importance for the attraction of foreign firms and foreign investments, as well as for the smooth link of the urban economies with the global economy. This leads to two other important issues: competition and dependence among cities. It is clear that the networks deepen these two processes. On the one side, the visible trends to concentration demand the cities a competitive attitude of urban marketing, which has little significance for the solution of the urgent problems that affect urban residents in Latin America.

On the other side, multiple links and relationships constitute a great advantage in a context of rapid technological advances and economic instability, which demand a fast reaction and adaptation to new situations. Additionally, the evolution of the regional backbone towards a more decentralised configuration through the emergence and deepening of links among the cities of the region holds many promises. In the context of regional integration, the Internet backbone network can play a great integrating role connecting locations according to their cultural and economic interests.

But despite the advantages that the Latin American metropolises have regarding the technical infrastructure of the Internet, the social contradictions of the metropolises are also reproduced in the field of telecommunications. To tackle this unfavourable situation, different programmes for universal access have been launched in the region, sometimes under an umbrella programme, sometimes as fragmented small scope policies addressed to different target groups (school students, low-income groups, isolated communities. Public funded national programmes have been implemented in Brazil, Chile, Peru, Ecuador, Colombia Venezuela, Argentina, Uruguay and more recently Mexico, with mixed results.[13]

At local level, the best example is the one of the government of the State of São Paulo, which has carried out an effective programme to provide Internet access in poor areas through Infocentros, the so-called *Acessa São Paulo*. There were 72 state Infocentros in São Paulo's peripheral neighbourhoods (plus 105 municipal Infocentros) and 69 in other municipalities of the state in May 2004, giving online courses to 20 thousand people (see http://www.acessasaopaulo.sp.gov.br/).

The bottom line is that the large metropolises which are the main nodes in the new Internet infrastructure, have abundant and cheap international backbone capacity that is underused. As such they constitute the best places for the location of the most advanced firms in the new economic logic, and in general for the integration of their local economy into the global. This constitutes a strategic advantage for the metropolises at macro level, but the situation is not the same at urban level, where only premium locations enjoy these infrastructural advantages. Progressive and innovative urban and telecommunications policies are urgently needed to extend this fundamental asset to the less favoured locations of the metropolises.

[13] The national connectivity programmes that stand out because of their effectivity are the ones of Chile, Brazil, Colombia and Venezuela.

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Open source software - Is it real treatment for public sector's software needs?

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Keywords: *open source, government, strategy consideration, privacy, security, transparency, open standard*

"There are two sides to every question."
Protagoras, Greek philosopher (485 BC - 421 BC)

ABSTRACT

Open source software history takes as long as computer program history. Programmers at the beginning of computing used to programming for free software model and history now just reached back to (the root) community model. One can say: "There is no new under the Sun." But the raised question is about the suitability and usability of these software products for public sector. There are advantages as well as disadvantages… "The coins always have more than one side." There are many initiatives for using OSS in governmental work, but the real success has not come out yet. The research tries to set-up a theory and quantifies the advantages of OSS against the proprietary software (based on social, technical and economic approaches) thereby contribute to the academia and practice. The difficulty of the research is its complexity. None of above mentioned factors can be examined alone. There is close correlation between these factors. At this stage in this research have the main goals to focus on political and economical influences of OSS and to make a theoretical model for an economically reasonable decision for public sector. This paper examines the reasons why was raised the question about using free software in public sector and try to answer the question why are suitable if suitable these software for public sector.

1 BACKGROUND OF PUBLIC SECTOR'S SOFTWARE NEEDS

Industrial nations are undergoing dramatic economic and social transformation. This transformation is characterized by the rapid growing amount of information, wide-ranging implications of Information Communication Technology (ICT) and their impact on the whole economy and the growth of global competition. The societies are in transition to the "Knowledge Society". ICTs changed the World and the societies. ICTs can provide higher life standard for people. Opposite the higher standard there is the digital divide. The 'digital divide' is an umbrella term. Commonly understand the gap between ICT 'haves' and 'have-nots'. Generally, it has two main approaches. One focuses mainly on actual connectivity – infrastructure and access. Worldwide, the gap between those who have access to the Internet and those who do not is enormous. According to the Neilsen/Netratings study as of the first quarter of 2001, only 6% of the World's population had access to the Internet. Of that 6%, 41% comprised of people living in the United States (US) and Canada. 2 Another approach beyond connectivity is the ICT literacy and skills linked to access that does not mean only access to infrastructure, but it has financial, cognitive institutional and political and social cohesion aspects. In reality, many divides exist: both the internal country divides, as well as divides across countries. Today, governments, business, international and nongovernmental organizations have numerous initiatives to eliminate the ICT-related inequities, not just the result of economic differences in access to technologies, but also in cultural capacity and political will to apply these technologies for development impact. The economy can not eliminate the gap alone, so "intervention" of governments is needed. Around the world number of programs exist to manage this problem. National intellectual capital and innovation are based on human resources that is why so important to strengthen the equality by the governments. Government has special obligations as to protect the integrity, confidentiality and accessibility of public information, to protect the privacy of its citizens, to educate the "next generation", to creation job and careful management of budget. Government's functions and operations can only handle by using software applications. The software that is used by governments and controls, handles, transmits the citizens' personal data have to be transparent to protect citizens rights to privacy.

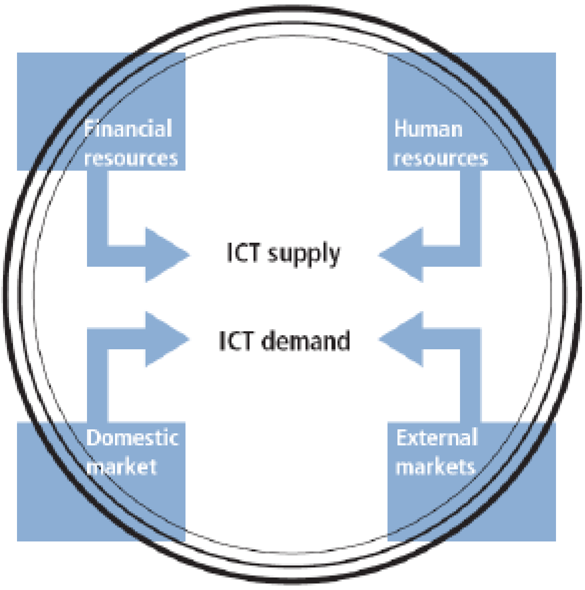
The reason why this paper examines the governemnts role is the size of Public Authorities that are quite different around in the each country from a small villages to a big city. Similar patterns, but different needs. The size determines the role and needs of different PA's. They also have common difficulties and dilemmas (e.g. they have to change data with other authorities and the central government) and different local "problem". The solutions differ for each PA's depend on their demand. Insted of making solution of islands it's time to thinking holistic. Top-down planning for bottom-up problem that means the government has to make a common guidlene and a common interface. The solutions to new challenges require new approaches just as knowledge mapping and knowledge management within the governmental work.

1.1 Roles of the Governments

The Digital Economy transforms governments and also the role of the governments mainly in those areas where the economy is most affected by changes of ICTs, and where the markets would not meet the requirements of social and economical stability. Governments play important roles in creating the proper environment for ICT development, and also have a significant leading role as users of these technologies by creating new modes of behavior in the public at large.

The 3 major levels at which governmental functions can significantly be affected (and generally improved) by ICT:

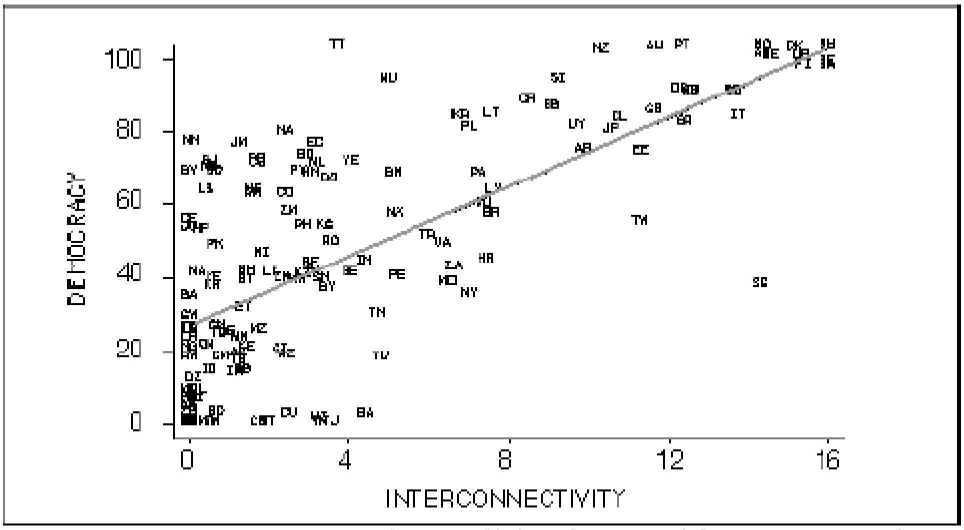
- e-Government (Policy coordination, Policy implementation, Public service delivery);
- e-Administration (Policy development, Organizational activities, Knowledge management);
- e-Governance (Democratic processes, Open government, Transparent decision-making). [2], [5]



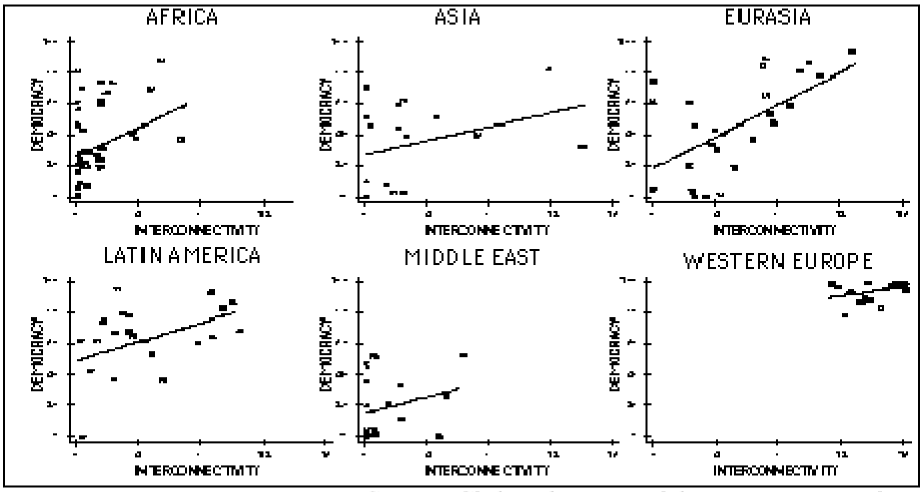
Graph 1. The modern paradigm of Indirect Government influence in ICT,
Source: Bruno Lanvin: Leaders and Facilitators

1.2 Policy implication for democracy

These days when the countries are globally networked, but the democracy not equal whole of the World remarkable the study by Christopher R. Kedzie from 1995. He examines the interrelation between democracy and interconnectivity. He found that interconnectivity consistently emerged as a powerful predictor of democracy. His second perception: "None of the traditional variables which measure and guide foreign assistance policies with respect to promoting democracy seem to cause the desired effect." Figure 1 and Figure 2 show the results of his empirical work. 3 Nowadays China offers the best example of a country whose economic success appears in part to be the result of the government's ability to compartmentalize the types of information that receive wider currency—increasingly promoting more open access to economic information while keeping tight control on what is deemed "political". And China is one of the most active advocate of Linux, as well as it has own Linux distribution named Red Flag.



Graph 2. Relationship between democracy and interconnectivity
Source: Christopher R. Kedzie: Democracy and Network Interconnectivity3



Graph 3. Regional Regressions
Source: Christopher R. Kedzie: Democracy and Network Interconnectivity3

2 OPEN SOURCE SOFTWARE

"Not enough knowledge exists, however, in the critical area of policy formation: the impact of policy choices on open source, and the effect of open source on available policy options and government actions is not well known. The support action builds on the FLOSS project to fill in important gaps in the understanding of open source with a focus on specific gaps in the policy application domain." European Union funded research the FLOSS-POLS will work on three specific tracks: evaluating government policy on open source, understanding gender issues in open source, modeling open source as a system for collaborative problem-solving.

Nowadays the information environment is extraordinary complex and fragile. Modern society is increasingly vulnerable by technologically economically infrastructure telecommunications, energy (see: NY blowout), and transportation. The infrastructure and information systems can be attacked, destroyed, disrupted, and corrupted by single individuals or small groups. It is not absolutely necessary to destroy the infrastructure, or one of its elements physically, it can be disrupted by electronically and almost anonymously. The software became as much important as the hardware, meantime hardly anyone watches the programmers…. And in case when the program is proprietary nobody can take a look inside the program and its mechanism. (Or somebody can do this even it would be illegal…)

Free and open source software gives the user the freedom to use, copy, distribute, examine, change and improve the software. Richard Stallman says that "The fundamental difference between the two movements is in their values, their ways of looking at the world". The term "Free Software" stresses freedom from control by another. Another Free Software advocate Eben Moglen said: "Who controls the software, controls life." This means the organisations and governements also controlled by software provider… The quiestion rasised and emerged by expert is justifiable: Is it right after 9/11 that dramatically and radically changed the world and the relations between IT and governments and also the relations between governments and citizens? The security turns into the most important factor for governments and for the citizens. Opposite the security the privacy and trust became most important things for the citizens and this caused that conflicts appeared between governments and the citizens. Government and political leaders must find out the balance the needs to security and the rights for privacy.

2.1 Keywords: transparency and interoperability

Michel Sapin, the Minister of Public Services in France stated: Next generation e-Government has two requirements: interoperability and transparency. These are the two strengths of open source software."

The only solution in this case is the transparency, not only in governmental working process but also within the software that is used by governments and controls, handles, transmits the citizens' personal date. Microsoft the world's leading proprietary software developer and vendor had been adopted yet the open source method for example Windows Update for updates and patches. Microsoft "Government Security Program" (GSP) is just a similar model when the governments that joined the agreement can take a look-in to the source code of selected Microsoft products. Transparency means that anybody can see and can examine the source code. Probably in first insatance it seems the end-user cannot gain direct benefit from it if he or she is not a computer expert. The experts and the 'community' examines the programs, so the end user can trust this kind software products due to not only the producer and the software vendor see the operating the software.

Interoperability is also the key issue about software that are using in public sector. The interoperability of information systems is necessary in order to facilitate cooperation between (government) organizations and to coordinate business processes within and between organizations. Later all consumers lose their freedom of choice and are herded into using the same product for the sake of interoperability. EU has 25 member states, with different public administrations depend on each countries. These administrations and governments have to interact wit each other, so the different proprietary software products some case suitable to change data wit each other. This causes higher transactional cost and much more amount invested. The open source products care about the standards both of de facto and open standards that assure the interchange data between them. Open Standards are in the field of ICT for the benefit of the interoperability of information systems. Standards may be open or closed. An open standard has been published and adopted on the basis of an open decision-making procedure.

2.2 Aspects of OSS

Open source software has many aspects and related issues to governmental tasks, goals and responsibilities that influence the usability in different fields. Political aspects contain freedom and equality, digital endurance, digital heritage and stimulation of innovation. There is not need to reinvent the wheel. Economical Aspects have the cost reduction and the market health. As it was mentioned earlier governments sometimes have to make intervention into the market on behalf of common good. Social Aspects mean the role of OSS to make equality and eliminate the digital divide. Managerial and/or Technical Aspects mean the quality of the products: stability and reliability. Legal Aspects mean licensing model and liability.

"The copyright law, by default, do not allow for redistribution (nor even use) of software. The only way that redistribution can be done is by granting specific permission in a license." The license is the contract between the User and the Licensor. Open Source licenses are more permitted than Free Software licenses. OSS licenses have two types, non-permissive and permissive. The Free Software licenses do not allow "closing" the source code while the permissive licenses permit the creation of proprietary development. "There are dozens of OSS/FS licenses, but nearly all OSS/FS software uses one of the four major licenses: the GNU General Public License (GPL), the GNU Lesser (or Library) General Public License (LGPL), the MIT (aka X11) license, and the BSD-new license. Indeed the Open Source Initiative refers to these four licenses as the classic open source licenses. The GPL and LGPL are termed "copylefting" licenses, that is, why these licenses are designed to prevent the code from becoming proprietary." GPL was on probe in Germany and found it is legal in Euorpe.

2.3 Why should be considered to use OSS?

The main issue is the dependency, which means that the public sector highly depend on software suppliers. There is no choice for software vendor. How can avoid becoming dependent on a single or a few suppliers? The answer is open source software. There are more than one suppliers, or software vendors. Dependency is in close correlation with security and the Security is linked to Privacy. A point of view: "Who controls software controls the life [and organization]." One can ask: "Is it allowable that any public authorities i.e. government can depend on and controlled by any software vendors?" In case of desktop operating system on Microsoft? Microsoft is working hard to increase customer dependency. The software that is used by governments and controls, handles, transmits the citizens' personal data have to be transparent to protect citizens rights to privacy. Open Source do this, because the source code anytime can be checked, and audited. Hardly anyone watches the programmers…. so nobody knows what the programs do if the source code is closed. This is an enormous security risk for governments. In case of e-voting "The Council of Europe Committee of Ministers agreed the first international legal text on e-voting in elections and referendums. The legal and technical guidelines of the Council of Europe indicate how to build, run and supervise e-voting systems to ensure that results are as reliable as those delivered by traditional paper-based methods. The Council's recommendation emphasizes the need for new voting methods to meet the principles of universal and equal suffrage, free and secret ballots and for the systems to be secure, transparent and accountable." Open source is feasible for this recommendation due to it is secure, transparent and accountable.[9]

Data dungeon can be only avoided by using open standards. The government is responsible for storing a large amount of data in name of the public (i.e. birth certificates, tax records, social insurance records). Data dungeon means if the data store in closed format by proprietary software the information will be hard available and restore for many decades to come. Since Open Source Software and Open Standards give the source, the way in which information is stored is publicly known or at least traceable.[11]

Only Total Cost of Ownership (TCO) shows the real cost of the software. The purchased software will usually remain the property of the supplier; the consumer pays for the right to use the software. TCO extremely sensitive to the set of assumptions people make. All costs have to divide into two large groups, direct and indirect costs. The measurement is hard, because the indirect cost can hardly be budgeted. However it requires more serious examination this research issue.

The countable technical parameters are Reliability, Performance and Scalability of the systems. These parameters can be comparable due to the same technical analyses.

2.4 E-government solution based on OSS

Number and type of open source policies and legislations are considered by national, regional, or local governments around the world. It looks at whether the policy or legislation mandated the use of OSS, expressed a preference for OSS, encouraged its use or commissioned research into OSS. While purchase of OSS could indicate a policy decision that has not been publicly articulated, it could also be simple a decision made on the basis of price or product.

3 CONCLUSION

ICTs have changed the economy and the societies around the world. These changes influence the everyday life in that way ICTs can provide higher standard of life for people. The governments faced new challenges so they had to establish National Information Strategy to make capital out of new opportunities. To use and interact with ICTs a software is needed. No software is perfect. Both proprietary and OSS software are made by people. The most relevant differences are between them, that OSS is developed and assured by group of users and the source code is available for public. This makes this software so desirable for governments and government agencies. The source code is verifiable and modifiable so it is secure. Recent years the governments' tasks expand to build Information Society and e-government services. The secure and trustworthy services must be based on reliable software systems. Since the proprietary software can not be verified according to unavailable closed source code by security, these conditions can be accomplished only by OSS software. In the public sector many software handle and forward the citizens' personal data because in this case 100% security is needed to prevent citizens' privacy. The trends show that many governments choose the Open Source Software due to different strategy consideration. OSS can be considered both a great opportunity and an important resource. OSS has already started to modify the rules in the information technology industry, which will produce enormous changes in further Open source software - Is it real treatment for public sector's software needs? years. Lack of computer literacy is cause delay to spread the open source software due to the employees and policy makers don't want to make another choice. The latest and important issue how the software patent will effect on Open Source Software and all in all on software industry, and how will influence the governments' software procurement and using?

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eEarth: Bridging the divided national geo-databases via multilingual web application.

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ABSTRACT

Access to geo-data repositories in Europe is effectively limited by national boundaries. The EC-funded project electronic Access to the Earth Through Boreholes (eEarth) is developing advanced software tools for multilingual access to the European national geo-databases. The new web services will include: a central web portal to the national geo-database applications, multilingual user interfaces to the national databases, "on-the-fly" translation facilities for standardised geo-scientific terms, GIS functions, access to geo-data via mobile devices, on-line data ordering and payment (http://eearth.nitg.tno.nl/).

1 INTRODUCTION

The national geo-scientific databases are the key elements of the national policies on the sustainable and environmental use of the subsurface. Geo-information is of particular importance for urban planning, where the engineering geological conditions are complicated by abundant subsurface infrastructure. European governments delegate the task of maintaining geo-scientific repositories to their national or regional geological surveys. The National Data Repositories (NDR) receive geo-data from a variety of sources: oil and gas operators, drilling firms, engineering and environmental companies etc and then are responsible for disseminating this data to national users. Publicly accessible databanks allow consultants and contractors to save on the considerable costs that can be incurred for storing and maintaining data and provides them with a rich source of information, an important consideration when assessing a new area.

International data exchange, however, is still poorly developed largely due to the following obstacles:

- The majority of geo-data web services, often financed by national governments, are aimed at national customers and therefore access to these services from abroad has not been a prime consideration in most cases. However, the intensive political integration within Europe together with globalization of the geo-data market raises questions regarding this "national" concept.
- Many web sites and database applications, allowing access to the borehole data catalogues, are available only in the host nation's language. Occasionally an English version is available in addition to the local language version. Thus many foreign clients find it difficult to gather even basic information about borehole data availability.
- The national legislations for geo-data dissemination do not regulate the data transition across borders, even within the EU.
- Different countries have been developing their own terminology for lithology and stratigraphy thereby making cross-border geo-data comparison and interpretation difficult.

In order to improve cross-border geo-data exchange, a consortium comprising eight European geological surveys, institutes and commercial companies have initiated the eEarth project. The project includes the following organizations:

- The Netherlands Institute of Applied Geoscience (TNO-NITG, NL)
- British Geological Survey (BGS, UK)
- German Geological Survey (Bundesanstalt für Geowissenschaften und Rohstoffe, BGR)
- Lithuanian Geological Survey (LTG, LT)
- Polish Geological Institute (PGI, PL)
- Geofond (CZ)
- Geodan Mobile Solutions (NL)
- Golder Associates (IT)
- The project objectives and structure.

The principal objectives of the eEarth project are:

- To increase availability, use and distribution of the European digital subsurface data by providing cross-boundary access to the digital geo-data collections in different EU languages
- To develop the international multilingual commercial services, including WEB GIS facilities, based on public geo-data stored in the national geo-scientific databases.
- To develop recommendations for new European standards for well data description, which can be used for other applications in future.

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The project has three phases:

- Inventory / definition phase (month 1-9)
- Implementation and testing (month 10-15)
- Dissemination and Demonstration (month 16-18)

Phase 1 includes four main tasks:

- inventory of the national and international legislations for supplying state-owned geo-information through a public service.
- inventory of the software applications currently used for storage of geo-data from boreholes in the European countries.
- inventory of national geo-data formats and standards in order to establish a minimum common format for geo-data exchange.
- Design of the web-based multilingual services.

Phase 2 comprises three tasks:

- Implementation of the new multilingual data-access services at three national databases
- Demonstration of a mobile application for multilingual accessing a national database
- Demonstration of open source software solutions for developing web-based geo-database applications

Phase 3 principally concerns marketing of the portal and dissemination of project achievements.

2 THE PROJECT RESULTS

Results obtained during the first phase of the project, are presented below.

2.1 National and EU regulations on geo-data dissemination

In order to ensure that the eEarth cross border services comply with the legislation of the participating countries, an extensive study of the national and EU legal regulations on geo-data dissemination was completed. The research shows that no legal obstacles to cross-border dissemination of geo-scientific data exists in the participating countries, although sometimes the formal procedure for obtaining access to data is quite complicated.

The national regulations concerning geo-data dissemination have many common features. This creates a good basis for harmonisation of national legislation in the future. Notable differences centre on the granting of special access to groups of privileged users

Analysis of the EU legal initiatives confirms that the technical concept of the eEarth system is in line with overall EC policy regarding dissemination of environmental data and provision of access to public data holdings, using electronic means of data distribution.

2.2 Inventory of best practices in national borehole data management

The main task of this part of the project was to summarise the experience and approaches currently existing in the European Geological Surveys regarding description, collection, storage, retrieval, evaluation and distribution of borehole geo-data. This inventory allows identification of the most efficient and modern methods of storing and dissemination of borehole data.

In total we analysed nine national geo-databases of six European countries and the databases of eleven German federal states (Bundesländer). They typically contain 65-80% from the total amount of boreholes drilled in the countries. The sources of information are mainly the archives of the geological surveys and data obtained from drilling companies.

The borehole databases differ significantly in terms of hardware, operating systems, database software and data structure. The majority of the partners use UNIX (Solaris) and Windows operating systems in combination with an ORACLE database management system.

Coding standards are very diverse. Digital input of data is mainly handled by digital forms developed in-house, whereas commercial input systems, like ORACLE or Access forms, are rarely used.

Most database applications have GIS-functions enabling display of location maps. Shape files are normally used as the sources of geographic information. Profile construction, cross-sections and 3D-modelling functions are still under development by most of the eEarth partners.

The procedures for accessing geo-data are technically rather different. The majority of the national borehole databases (5 of 9) can be accessed externally. The web services normally include the display of location maps and metadata overview lists.

Electronic on-line data ordering and supply procedures are well developed in only a few countries, in others – data delivery by post is still the main option. Service costs and payment methods vary significantly, e.g. both prepaid charging methods and payment pro rata are used by the eEarth community.

From a technical point of view all the national borehole data management systems are quite advanced, however the partners continuously work on improvement of their display, evaluation and dissemination functions.

2.3 Development of the XML-standard for cross-border exchange of borehole data

Because geological practice has always been organised on a national basis, up till now there has been little incentive for the international exchange and harmonisation of geo-data. In order to design a common exchange format for this purpose, the data structures of the national geo-databases of six participating countries (United Kingdom, the Netherlands, Germany, the Czech Republic, Poland and Lithuania) have been analysed.

The new geo-data exchange format has been written in XML (eXtensible Mark-up Language). This language is both useful and popular in all kinds of Internet applications, where exchange of data takes place. Current practices in the oil- and gas community (WITSML) as well as in the mining world (XMML) have shown that XML is a powerful tool in connecting different data collections across disparate platforms. However implementation of XML for data exchange is only successful when all users agree on every detail of the format.

The selection of fields has been made against the background of four national exchange formats that have proven to be valid in geo-engineering and geo-environmental applications. As a result forty fields have so far been included, based on the following criteria:

- presence of these fields in the majority of the national database models;
- for metadata - the usefulness of a field as a search parameter for data set selection;
- for borehole interval data - frequency of use by users (relevance to national geo-markets).

2.4 The eEarth system technical design

The eEarth services will allow translations of the standardised geo-scientific terms on the fly, as necessary for metadata and for interval coded data. The demonstration version will include the English, German, Dutch and Polish, Czech and Lithuanian languages. The service will translate:

- The user interface texts.
- The codes and keywords of the borehole metadata.
- The standardized codes of the interval lithology

The architecture of the eEarth system is shown in Figure 1. The conceptual design comprises the requirements collected by the partners from their national and international users. The consortium concluded that a distributed system with individual components of the same look and feel would be the best option. It fits to the requirements and will minimize risk and effort. Below the main components of the system are described.

2.4.1 The eEarth Web portal

A central web portal will be the start point to eEarth services. The portal will be multilingual, encompassing the partners' European languages. This could easily be extended to incorporate additional languages in the future.

The eEarth web portal is proposed to be a relatively simple start page with only two necessary functions:

a) select a language (for further communication and the translation of borehole data)
b) select a country (which borehole data is needed)

The start page would provide links to a national survey's own database applications, where visitors could browse for the information required. From a technical point of view this means that the eEarth multilingual services will become a part of the national systems. The distributed system will:

- allow adjustment of the implementation of the software environment at the partner's organisation
- negate the risk should any element of the central portal be unavailable for whatever reason;
- eliminate the need to standardize coordinate systems and GIS software across the participating organizations, thereby reducing training, data conversion and maintenance overheads in subsequent years;
- allow implementation of the individual national payment schemes currently applied in the countries;
- minimise the interdependency of the partners, including the Web application support, after the end of the project.

2.4.2 Search and delivery of borehole information

When a user accesses a national eEarth web page he will be able to search for data in the national database via either a web-form or a web-based GIS interface. In both cases the data search is based on criteria defined by the user.

To enable the integration of GIS functions two scenarios for the web map server implementation are foreseen: 1) based on open source applications (i.e. UMN MapServer), and 2) based on a commercial software (i.e. ArcIMS by ESRI). Under both implementation scenarios, the GIS page will include a standard set of GIS functions, allowing geographic selection of boreholes from the national databases. A user will be able to select a single borehole via info-click or a number of boreholes by defining a selection area (rectangle) on the map. Subsequently borehole metadata can be displayed for the selected set.

Based on the metadata list, a user will be able to order descriptions of borehole layers along the borehole profile (interval data), when available. In some of the national database applications the interval data can be immediately displayed, in others the data is delivered either by post or e-mail.

Since the interval data is normally not delivered free of charge, access to them is restricted to registered users only. Therefore several special system modules will handle data ordering, user registration, and delivery (Fig. 1).

Electronic commerce functionality, allowing payment with a credit card, is only available at one partner organisation so far At the other national web database applications a user will use traditional methods of payment, such as money transfer via bank, etc.

2.4.3 Translation service

The translation service will provide on-the-fly translation of the user interfaces, borehole metadata and interval data (lithology, etc). The borehole data translation service is a quite complicated tool, which needs to translate coded geological data according to standardized geo-science dictionaries or thesauri. The main challenge results from the fact the translated meanings of many terms only partly overlap with their original definitions. In other words, “similar” terms can have quite different interpretations in different languages.

In order to provide multilingual services, a 6-lingual thesaurus stored in a database and software tools for data translation have been developed. The concept of a “distributed thesaurus”, accepted by the consortium, presumes that one of the partners (i.e. Geofond) will maintain the central ‘master’ multilingual thesaurus (MMT) stored in its database. At the same time each partner geological organisation (PGO) will have individual (distributed) multilingual thesauruses (DMT) stored in translation tables within their national databases. Input and editing of individual terms in the MMT will be made by the partners by means of a special web application. Update of the translation tables in the national databases will be done via an export XML file that is generated by the MMT application.

The advantages of this concept are: 1) each PGO can implement the eEarth services using its own technology; 2) if the structure of the MMT changes, this does not directly affect the distributed thesauruses (DMTs) at the other PGOs.

2.4.4 Mobile service

The project will provide an engineer, operating in the field, with access to a national geo-database by means of a mobile handset (PDA). A “mobile” user will be able to visualize his location and order geo-data from the boreholes located in the area interest. The borehole will be selected by means of a GIS application developed particularly for a mobile handset.

The mobile services require special additions to the system design:

a) to serve mobile systems (special output and controls of the eEarth web pages) and

b) to accept locations of mobile systems (as an input to the borehole selection function).

Both additions are included into the design of the system, where (b) is supported by a position server at the national level only. It is assumed that mobile devices are able to send coordinates of their location in exact form so that the country selection of the start page can be omitted.

3 CONCLUSIONS

The concept of the eEarth system is in line with overall EC policy regarding dissemination of environmental data and the provision of access to public data holdings, using electronic means of data distribution. No legal obstacles to cross-border dissemination of geoscience data have been found on the national levels so far.

The new XML standard, developed by the project for exchange of borehole meta and interval data, will contribute to further harmonisation of geo-data in Europe. Data standardisation is a precondition for combining the national geo-data in a single pan European repository, which may be considered as an option for further unification of the geo-information in EU.

The national geo-databases contain 65-80% of the borehole data in the participating countries. Multilingual access to the national repositories via the Internet will significantly increase their added value, particularly for cross border projects. Access to the geo-information through mobile equipment will stimulate the use of the data by geotechnical and environmental specialists operating in the field.

Although many partners offer comparable services, the national borehole databases differ significantly in terms of data structure, database software, hardware, and operating system. Considering the implementation and maintenance issues the eEarth system has opted for a distributed structure. The eEarth conceptual design includes three main components:

1. A central multilingual web portal containing language selection and links to the national database applications
2. Master Multilingual Thesaurus (MMT) of geological terms maintained at one organisation and used by all the others for updating the dictionaries in their national geo-databases.

4 DISTRIBUTED NATIONAL MULTILINGUAL WEB APPLICATIONS, INDEPENDENT FROM EACH OTHER BUT HAVING SIMILAR INTERFACES AND FUNCTIONS.

This design allows a new partner easily join the multilingual services via the eEarth Web and access the MMT in order to include a new language. The national surveys that join the portal at a later stage will be required to purchase the associated training and support, thereby generating additional income for the project.

In order to insure high quality of this new type of the European geo-data service a comprehensive evaluation of functionality should be undertaken at all stages during development. This would include not just the member surveys, but also commercial partners involved with the project.

5 ACKNOWLEDGMENTS

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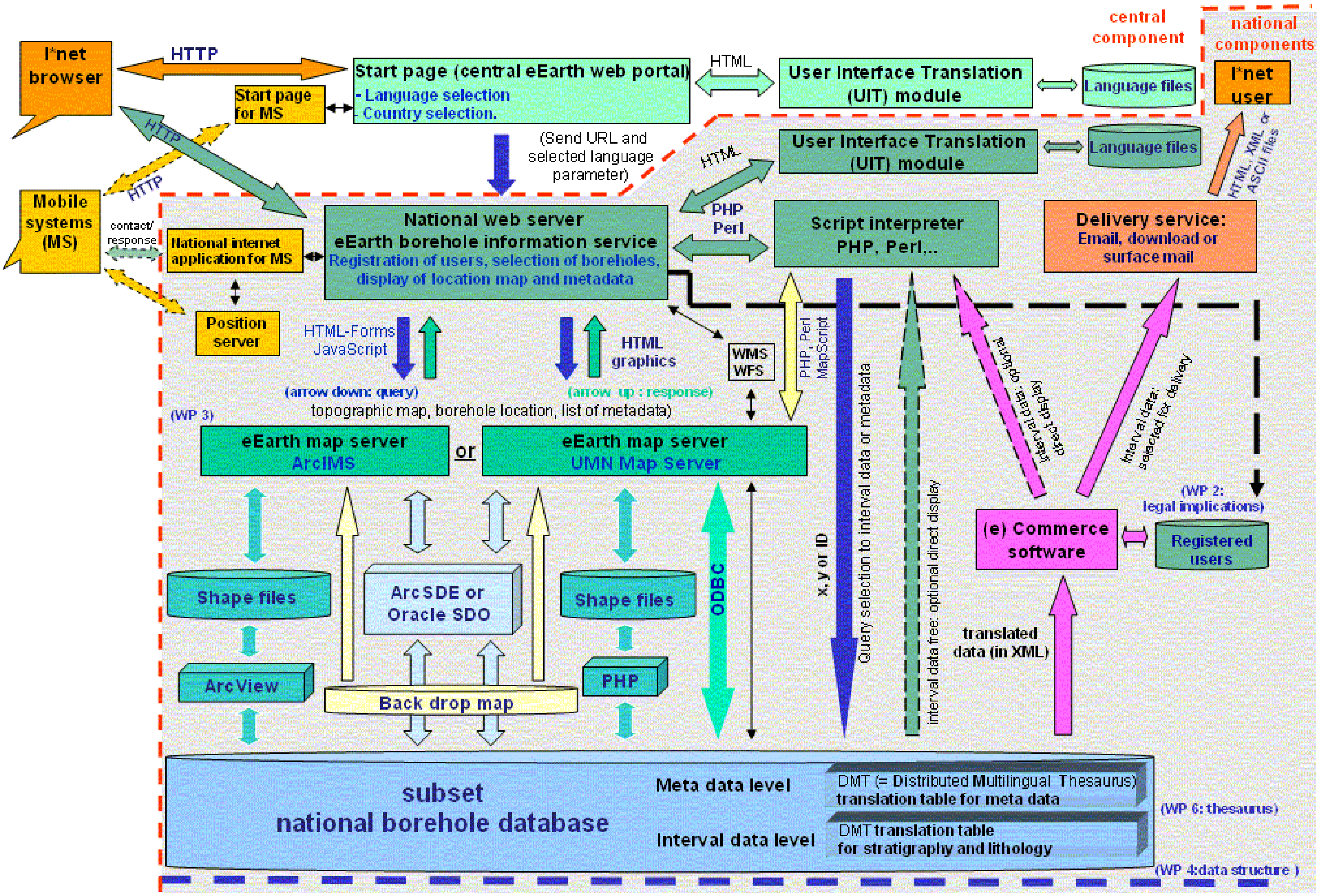

Figure 1: General diagram of the eEarth service implementation.

Music on line or music in the City ? A stake for the Future City .

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Music has shaped the urban landscape for centuries . According to the ideas exposed by Sombart in his book on luxury and capitalism, in the 17 th and 18 th centuries, among luxurious places which appeared (coffee houses, theatres, stores) , there were concert halls and ballrooms . In Paris, these artists, the composers, were very well paid, more than writers . Music appeared in the Court then it was aped by aristocrats and financiers in the City . In the era of bourgeoisie, Opera houses and concert halls are fashionable places . There is even an imitation for the working class (bandstands, ballrooms) . We find in Adorno ' s books examples of what could be an history of Music in the City :

- The decline of Opera . Between the two world wars the talking movies trigger a decline of Opera . They are aimed at realism, and they display many details, while sound is added . Less people go to the Opera House, more people go to the cinemas . However Opera continues, but new operas are not created, only the old repertoire is played . For some reasons, there is an audience . Vocations of Opera singers are rare, and their formation requires very much time and is difficult, therefore they are very well paid . Today to show an Opera is very costly . It occurs during festivals, or in some big cities (Paris, London, Vienna) .
- Existence of centres . As it was heralded by Simmel, money pervading Society is favourable to Art . However artists are selected . The more capable musicians (conductors, orchestra musicians) are attracted by big cities (Paris, London, Vienna …) . Only in these « international centres » , one can listen to music which is played in an excellent way . In smaller cities, there is no possibility, or there are mediocre orchestras . The explanation is people able to buy expensive tickets, to listen to music, in big cities .
- The end of chamber music, which was played and listened in private places, is evoked later in this article .

In the past, the role of Music in the City, has changed . Today, the question is posed because a new media (music on line) appears . Even, the survival of Music in the City, is a question . One can imagine Music in the electronic spaces, only (composed by computers, stored on servers, diffused through Internet) and anywhere (listened thanks to micro-computers and walkmen) . Perhaps, in all the public spaces, a background music which is not really « listened » . However this catastrophic scenario is improbable .

To treat this topics, we shall use two approaches :

- A classification of the « ways and places » , concerning listening to music .
- An investigation of the reasons why technology pervades music . Obviously, the more technology pervades music, the more music leaves the physical places in the City .

1 HOW AND WHERE TO LISTEN TO MUSIC ? A CLASSIFICATION .

We consider six kinds of listening to music :

1.1 Collective / aesthetic .

It is the case of festivals .

1.2 Collective / social rite .

In some cities, listeners frequently go to the same concert halls . Often, they listen to music played by the same orchestra . There is a program of each musical season that they accept (or approve) . They are requiring listeners . Perhaps, in big cities which are not international centres (world cities) some « municipal spirit » has a role, as listeners give support to local musicians, to be able to listen to music which is played in an excellent way, in their city .

1.3 Collective / consumption .

Music is listened by crowds, in places of the city . The urban landscape is treated as a decor. Technology (lighting, sono) is used . These parades are organized by scenographers . There are commercial purposes . Medias are involved . According to the ideas exposed in the Vauchey ' s works, these « listeners » are alone, even in a crowd . We shall describe this kind of listening more accurately, using notions from Adorno, as « entertainment music » or « musical fetishism » .

1.4 Domestic .

It is worth to resume the history of the relations private space / public space, which have changed because of the impact of technology, also . We have recourse to the theories of the French sociologist Flichy .

At the end of the 19 th century, in the industrialized countries (first, in the United States) the private housing, for families, appears . People go outside, mainly to work . It is the end of the time spent in the streets, the coffee houses etc … The mutation was eased by the piano, phonograph, radio etc … The piano has been a success, at the end of the 19 th century, especially in the United States . Thanks to improved manufacturing, the price was divided two or three times . People buy scores (successful songs) . They are played in the presence of the family . Later, the phonograph (a furniture) and the album of photographs will have the same role . Finally the radio set appears . In the fifties and sixties there is an upheaval because of transistor . The teenagers become autonomous (pocket money, love life, politics) . They listen to rock music in their bedroom, thanks to a transistor or a record player . It is the beginning of the « side by side » family . At the time of the TV set, it is going back to the collective life . In general, there is only one TV set in a home . The walkman (used in the home) strenghtens the teenager ' s autonomy . Today technology seems to strenghten this autonomy . The teenagers can download music on line and listen to it thanks to their micro-computer . They can even download movies and look at them on the screen of their micro-computer . A single ADSL access allows a family to use a TV set, several micro-computers connected to Internet, simultaneously . Each individual in the family can obtain what he wants,

music, movies, TV programs etc … on Internet (provided that the cost is accepted) . Perhaps, the collective life could be strenghtened by the « home cinema » . In a comfortable place in the house, there is a large screen on which movies are displayed . It is high definition images . The movies are downloaded at a low cost a few days after they are displayed in the cinemas . Of course, there is a single place in the house which is equipped with « home cinema » . Therefore to look at a film is an opportunity to be gathered .
There are explanations on the decline of music played and listened in private, in the Adorno ' s books, too . It is about chamber music . Chamber music (trio, quartet, lieder) appears in the 17 th and 18 th centuries . Aristocrats, who were amateurs but able to perform music very well, played it . This music allowed a good listening . Music was composed by the more talentuous composers for them . In the era of bourgeoisie, it continues . It declines at the beginning of the 20 th century. The opposition chamber music / symphonic music is an explanation of the aesthetic evolution of music from the 18 th century to the 20 th century . This music is played in a private space, and means friendship, reconciliation, . However the contradiction, which is present in Society, of the necessary authority and the wished spontaneity, can have a role . One of the musicians conduct the other (as the conductor conducts the orchestra) , therefore the group of musicians is sometimes temporary .
There are several reasons why the chamber music has disappeared :

- the rich professionals who played it in the past, work more today (for instance, doctors) .

- today flats and houses are constituted of small rooms, with low ceilings (bad acoustics) and narrow walls (neighbors are bothered) . Music listened thanks to record players is more suitable (the loudness of the sound can be tuned) .

- the record and radio allow to listen to music which is performed very well .

- there are also commercial reasons . Technology (recording, listening) allows to highlight the « sound » , and amateurs are unable to carry out this performance .

The fact that modern music cannot be performed by amateurs is a consequence . Since chamber music has disappeared, chamber music is no longer composed by composers .

From the Adorno ' s point of view, it is not worth to be nostalgic . It should be as to regret the crafstman ' s works, in the era of industrial works . Of course, record player and radio allow to listen to music which is very well performed, anywhere, at a low cost . Today, it is also allowed by music on line .

1.5 Individual / consumption .

Here music on line is adequate . This listening can be described as a listening to « entertainment music » , according to the Adorno ' s ideas . The musical quality is mediocre . It has declined very much since the time of Offenbach ' s operettas . It is something like musical quality at the middle of the 19 th century . To compose it, by contrast with « serious music » , the resources of the division of labour are not used . It is an other story, if we consider technology (this topics is treated later in the article) . For commercial reasons, the products are standardized, classified by kinds (rock, sentimental songs …) . The listeners ' tastes are pseudo-individual . Fashions are imposed through medias . Technology allows « effects » and the consequence is that the musical quality, the images, the « content » (symbols, messages) are mediocre . The audio-visual show creates an « atmosphere » , thanks to technology (sono, lighting, synthetic images) . It strenghtens the suggestive power of music (loud sound, repetition) . The goal is to condition the listeners . It could be compared to alcohol .

1.6 Individual / aesthetic .

According to Walter Benjamin, consumers have sometimes a collector ' s mentality . They believe they are endowed with an experience . They should be able to use « traces » , to understand facts . It should allow to achieve knowledge . Models are the « flaneur » , the hunter, the aged student etc … In the era described by Benjamin (the end of the 19 th century) , it concerned literature . Today, it concerns TV programs or movies, too . Briefly said, the reader (or the watcher) can imagine that he has something to find, and he uses his experience, benefitting from « traces » to succeed in his search . The collector ' mentality is a way to « pseudo-activity » (this term is used by Adorno) or secondary roles . David Riesman, in his book « The lonely crowd » has described how young people who want to be autonomous thanks to their hobby, fail to be really autonomous . He cites the example of young people making cars by their own means, who finally are hired by car makers . An amateur can achieve some knowledge on a particular kind of music (he is able to speak of it and even to play it) , but he believes he innovates, and it is illusory . He is not able to change the tastes . If he has a role, it is under the control of commercial purposes (he speaks during a radio or TV program, or his opinion is taken into account by professionals etc …) .

A consumer could use Internet, search engines etc … to find and download music, in an illusory attempt to achieve knowledge on music . He should be what is called « culture consumer » by Adorno . At the opposite, professionals of several kinds (musicians, musicologists, students in cultural matters …) could have recourse to music on line, not to create a knowledge, but as a useful tool . Of course, advantages are a vast repertoire at disposal, a low cost, practical aspects (rapidity, no physical move needed …) .

2 WHY IS TECHNOLOGY PERVADING MUSIC ?

Obviously, technology pervades music . Moreover, it is costly . It is easy to cite examples displaying that . Some electric guitars are very expensive . Often, in big cities, Opera Houses need to be subsidized (and technology is a part of the total cost, as it is very much used in scenography) . In Paris, a place for all kinds of shows, which is very well equipped (flexibility, lighting, sono, decors) is known as costly .

There are several reasons why technology pervades music :

- It is to hamper music performed by amateurs . When technology is used to produce music (recording) and to diffuse it, an excellent quality of the performance of musicians is provided, and amateurs are discouraged . The good quality of the recorded sound, matters, also . This phenomenon concerns other kinds of consumption products . Either technology, either the know-how, or the both, are used to discourage self-consumption . It is worth to make a rapid comparison of three kinds of cultural products, gastronomy, clothes and music . In the restaurants, only know-how is used . A recent trend is to highlight this know-how, thanks to explanations given to the customers, on the inputs of food, the place where they are produced, how to use them etc … Concerning clothes, it is mainly know-how which is used . The consumers follow a fashion changing frequently, without any delay . It is almost the end of the patrons allowing to make a clothe at home (or it is purely a hobby, or the clothe will be a gift) . However the technology is used : manufacturing technologies in the industrialized countries, transport technology allowing production at a low cost in emerging countries, characteristics of the product (stuck seams, particular materials …) . If « smart clothes » (allowing to connect to networks, to display changing images and texts etc …) are a success, manufacturing and repairing these clothes will be the task of technicians, only … Concerning music, the two means are used (technology and know-how) .

- The repertoire of music which is distributed to a large public, is not so vast . For commercial reasons, « genres » which concern the way in which music is performed, are created . Technology is used to achieve this goal . The way in which a musician performs music, is highlighted thanks to the recording technology .

- The repeated and loud sound allows to trigger the listener ' s tireness, needed to condition his reactions . Here the explanation is psychological . Culture is acquired (even if there is a basis of instincts which persists, according to Konrad Lorenz) . Therefore we find an explanation using the notion of « secondary signalling system » coming from the proponents of the conditioned reflex as Pavlov . In it are stored « active images » associated with pleasure or sore . It is inevitable, as it is the consequence of Education . The access to these images, triggering emotions, is easier when the human being is tired . It is proved thanks to experiments as hypnosis or use of narcotics .
- According to Adorno, a recipe of « musical fetishism » is to isolate an aspect of music and to highlight it (a nice voice, the sound of a particular instrument) . Here, recording technology is useful .
- There is the equivalent of « kitsch » art in music . The kitsch art is naive, aimed at triggering sentimental reactions, emotions . In general, these objects are manufactured products, and cheap . It corresponds to the « idealization of the world » according to Benjamin . When the private spaces and the public spaces were separated, in Paris, at the end of the 19 th century, the intimate space became the reflection of the world, in an idealist way . Flats and houses are full of curios and souvenirs, which are kitsch art . According to Adorno, today good composers compose a music of mediocre quality to earn money . Adorno calls this music « utilitarian music » . It is often music for operas, ballets, movies . This music is part of a show . The techniques of scenography (sound, lighting, decors etc …) are used . The consequence is that good composers abandon the avant-garde music and compose utilitarian music, to earn money . The public service of radio seems necessary to give support to avant-garde music . The young composers need to be known, and the audience is small, concerning avant-garde music . In the usual conditions (diffusion of music depending on commercial purposes) , their music would not be diffused and listened .
- Technology is used in the avant-garde music . A characteristic of Modern Art is the domination of abstract structures and forms on any content . It does not like realism or sense . This artificial character is allowed by technology . Technology allows to explore a potential . Also, it is attracting the proponents of technology, even if today the young generations do not know tradition and do not resist novelty .

The more technology pervades music, the less music is listened in the City . No many people want to meet in a concert hall, to listen to music, which is performed according to aesthetic standards, by a good orchestra, using good instruments . Their interest is to escape the « effects » which are inevitable in many recordings (CDs, DVDs) . They give support to some musicians, and obtain to listen to the music they like . The musicians use their know-how .

Other places in the City are used, to play music . In big cities, Opera continues . In the case of ballets, shows etc … it is « entertainment music » or « consumed music » . Obviously, the performance in a physical space is indispensable . There are also urban scenographies . Sometimes many young people meet to listen to music, and it is so noisy (it is a proof that the recipe of loud sound is used) that the meeting occurs … in the fields . Technology has changed the link between Music and the City . Less people listen to music performed by musicians who are in the same place, and use their know-how (not technology) . In the case of electronic music, the music is not longer played by musicians . Concerning ballets,shows etc … technology is used, but the presence of the audience is indispensable . During urban scenographies, the urban landscape is used as a decor .

3 THE FRANCFORT SCHOOL ' S IDEAS ON MUSIC .

A well known idea from the Francfort School is the transition from Art to cultural consumption . Take the example of thousands of young people meeting to listen to music, in the sixties and seventies . Now they have to pay money . Organizers have suddenly understood that security, comfort etc … matter . Big firms, which want to promote their brand, sponsor these meetings . This money is useful to achieve a financial equilibrium, or to allow a small profit .

Marcuse has described the transition from Art to cultural connsumption : end of transcendence, end of the distant artist, repressive desublimation . In the past, the Artist was in a kind of ideal refuge, having a vision of Society which was a protest against some abuses . At this time Art was for elites and the artist ' s protest was individual and ineffective . It was a mean to make his personal situation bearable . However, this protest existed and had a role in the elites ' culture. At the time of mass consumption, it has disappeared . This has consequences, for instance on the architecture, concerning concert halls and theatres (the scene above the audience is challenged) . Even in the restaurants, the razzmattaz has disappeared, the architecture has changed (less solemn) , the chef is no longer shrouded in mystery, but he gives advices on food to customers. Repressive desublimation means the end of the aesthetic sublimation . Its consequence was an ideal vision of Society and Life, but it was also a source of aesthetic emotions .

In the Adorno ' s works we find interesting ideas on two points : the listener ' s profiles and the present state of music .

According to Adorno, there are six profiles :
- Expert-listener . He is able to assess the musical value of a piece of music, thanks to a real knowledge . Often, he is a professional .
- Good listener . He is able to like good music, and has notions on the history of music, successive styles etc … In the past, he was an aristocrat or a member of bourgeoisie playing chamber music . Now there are less good listeners .
- Culture consumer . His erudition is more apparent than real . He is a kind of snob .
- Emotional listener . Music provides him with emotions . He is not really interested in music . He seeks emotions .

- Resentment listener . He likes a particular kind of music, and chooses a standard in which he believes . For instance, it concerns choir singing, strict standards being chosen . Mimetic and spontaneous aspects of music are avoided . He believes in a community choosing a strict standard and imposing it . Perhaps he is frustated because of his role in Society . He believes in an ideal social place, which is reflected in a particular music, supporting, consolating himself thanks to a permanent delight. There are archaic aspects in music (pre-musical aspects) . Even in the « serious music » there is sometimes an « angels music » .
- Entertainment listener . He listens a music of poor quality (according to aesthetic standards) . His goal is to benefit from pleasant instants, without any effort as a music listener .

It corresponds to our « ways and places » to listen to music :

- Collective / aesthetic . Expert listeners and good listeners, attending festivals .
- Collective / social rite . Good listeners .
- Collective / consumption . Entertainment listeners .
- Individual / consumption . Entertainment listeners .
- Individual / aesthetic . Expert listeners .

According to Adorno, the musical activity is not at a poor standard, but stagnant . He has analysed the decline of the quality of listening to music : decomposition (without taking into account the whole piece of music) , lack of concentration, poor standard from the point of view of musical aesthetics (even the « colourful » sound and the syncopation are concerned) .

We have an example, the songs . The singer is in the role of a person who is young, insolent (often) or self-assured (at least) , lonely, opportunist, a winner and experienced . All these qualities are not compatible, but it does not matter . Are represented the Loneliness, the Lucky Star, the Opportunity, the Victory . It is a few allegories, of a poor aesthetic standard (Walter Benjamin has shown the importance of allegory in modern art) . Here also there is a psychological explanation . According to Konrad Lorenz the instinct of enthousiasm, at the time of youth, has to settle, an object being chosen . A law of « influence » (as tireness which eases influence) is that somebody believes what he wants to believe, more easily . Young people can be attracted by the representation of Loneliness as an ordeal, which is overcome thanks to luck or personal force . Konrad Lorenz has written that, fortunately, music, having not an accurate sense, cannot be an object of « militant enthousiasm » . Of course, but it is not the case of songs, of singers who are filmed, or songs which are listened while images are displayed .

4 CONCLUSION .

Music and the City have been narrowly linked for centuries . Today, obviously, less people listen to music (or play and listen to it), gathering in places, should they be private or public spaces . It is ambiguous . People are used to listen to music which is performed in a better way, thanks to technology . However there are consequences on the musical tastes .

The links between Music and the City were never « simple » , even at the time of the Court . There were quarrels and debates . Later, when the newspapers appeared, critics published articles which were often of an excellent quality . At the end of the 19 th century, not only the « serious music » was at a good aesthetic standard, but also the « frivolous music » was at its peak (the Offenbach ' s operettas) . The musical activity in the City was vivid . What happened ? The change was triggered by technology and mass consumption during the 20 th century . The old mediations have almost disappeared . Instead, there are the « signals from the market » . The problem stems from the fact that cultural products are not goods as the other . They require efficient mediations to allow an evolution of the tastes of the public, young artists who are original and talentuous inventing and diffusing new aethetic forms . Today young composers choosing the avant-garde music earn very little money . According to Adorno musicians (composers and performers) often do not use their full own expertise . There are stars, in music, and often they prefer to highlight an original aspect of their talent, what they carry out very well, even if the standard of the music performed is lower . The tastes of the listeners are at a standard which is not very low, but is mediocre, and is stagnant .

There are still « expert listeners » (or good listeners) who listen to music in concert halls . They can obtain to listen to the music they like, without the inevitable tricks used when music is recorded . An opportunity for « expert listeners » and « good listeners » is the festivals . Those liking a particular kind of music can listen to it, each year, thanks to festivals . It is also the opportunity to enjoy a nice setting, to make a trip as a tourist in the surroundings etc … For big cities which are not world cities, music performed in concert halls and during festivals is an interesting opportunity .

Otherwise are performed in the City operas (only in the big cities) and « musical kitsch » (ballets, shows …) . During urban scenographies (if sound is used) the tastes of the public are tested (but it concerns « entertainment music ») .

Music on line will strenghten the choice of listening to music alone, or at home, but it was initiated before by record players, then CD players and DVD players . Expert listeners or even professionals could benefit from music on line, as it is cheap and practical . One can imagine a radio chain on Internet dedicated to avant-garde music . It would be a support given to young composers choosing it .

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From the vertical city to the virtual-city: the rise of the cyber-city

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ABSTRACT

In this paper, we set out to examine the meaning and significance of the rise of the cyber-city (the city's structures that are part of cyberspace – material and non-material) and its transformational role in the creation of the 'virtual-city'[14].

Constructing high-rise buildings and, hence, creating the vertical city, is a major urban characteristic, due to the developing technologies after industrialisation. Similarly, the 20th century technologies of the Information Age are creating the virtual-city. The ICTs (Information and Communication Technologies) are powerful transforming agents changing vertical cities into virtual-cities, thus redefining our material reality. The transition (partly hidden) from the vertical to the virtual, ceaselessly going on in all aspects of society, is now reaching a critical point calling for a new perspective, crucial in understanding the new social phenomenon of 'virtuality'.

However, in order to gain a better understanding of the virtual-city we need first to examine the rise of the cyber-city due to its key position in the transformation process. The cyber-city (a new socio-spatial formation risen since the 1970's) does not simply act as the intermediary between the physical city and the virtual-city but, most significantly, it enables the existence of the virtual-city itself. That is why we need to know and to understand the cyber-city's complex structures and processes, and their significance in the transformation and (re)production of our social reality.

Keys: Cyber-city, cyberspace, digital city, ICTs, planning, socio-spatial, trialectics, virtual-city, virtuality.

1 INTRODUCTION

Examining the emergence of a city's 'virtual' dimension is not as simple a task as that of studying the production of the vertical city. In relation to the emergence of the virtual-city, simply put, building the vertical city is essentially the construction of high-rise buildings enabled by advancements in scientific knowledge and technological know-how. Technological inventions such as the elevator made vertical movement within skyscrapers a simple affair. Similarly, the production of new and improved materials, such as cement and steel, enabled the construction of flexible, strong, durable and functional high-rise structures.

The physical structures of all cities (indeed the physical city itself) can be described in space by using 3D coordinates (x, y, z). Further, by adding the temporal dimension (t) every structure can be located within the spacetime continuum using a 4D mathematical model. In their turn, 3D & 4D mathematical models enable geographical computer models (e.g. GIS[15]) to represent digitally that which our everyday experience relates to us regarding physical structures and phenomena within space-time.

How do we model, describe, analyse, discuss and experience virtuality and its effects in today's cities? Do we 'place' virtuality within the geographical space or in some other 'non-place' space? What is the role of cyberspace and ICTs in the creation of the cyber-city? What is the relationship between the physical, the cyber and the virtual; what is their meaning and significance?

Before exploring the above let us first examine the meaning of basic terms used here, terms such as vertical city and cyber-city.

2 THE VERTICAL CITY

We have already mentioned that the vertical city is characterised by high-rise buildings achieved through scientific and technological developments essentially after industrialisation. Urbanisation occurred so fast that within several decades most pre-industrial cities grew many times their original size. The production of additional city space, through the enormous expansion of the city's structures on the vertical axis is a response to the enormous and urgent need for more living and office space within the city. One result is that many households, and probably the main bulk of office space, are today placed above the 1st floor. Effectively, cities are now divided into horizontal layers and people are living 'on top of each other'. Due to the high rate of production of vertical space and the huge influx of people into cities, this phenomenon of urbanisation continues uncontrolled.

What is a vertical city made off? In addition to people, and fauna and flora in small quantities, it is the vast number of human made structures (buildings, streets, cars and machines) built on the Earth's crust (using cement, steel, asphalt, bricks, glass, etc.), which produces the city's morphology. It is argued that the structures originally produced to protect and serve its occupants are now serving another purpose: technology. In effect, the human city has been taken away from people, and it has been given to technology.

At the beginning of the 21st century, we are witnessing the inability to properly plan the enormous growth of urbanisation that is still going on all around us. It was almost inconceivable in the 19th century to imagine the existence of cities the size of 20 and 30 million people - the population of a country living and working within few square kilometres. The impact of uncontrolled urbanisation and the sudden increase in verticality produced dramatic economic, environmental and social changes resulting in new socio-politico-

14 The term 'virtual-city' here does not refer to a website's structure or content with information about a city, e.g. the Virtual London (http://www.virtual-london.co.uk/ or http://www.casa.ucl.ac.uk/research/virtuallondon.htm). Instead, the term 'virtual-city' refers to that abstract, 'ethereal' entity which is part of cyberspace and the totality of the non-material structures (informational, intellectual, etc.) that are above, below, outside and inside the 'geographical/physical city'. Hence, a website of the Virtual London is only a small subset of the informational part of the 'virtual- city' of London.

15 Geographical Information Systems (GIS) are computer-based systems that have in their 'core' a mathematically described 'geography' (or geographies) and are used to produce, store and analyse digital spatial models.

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economic relationships. An example is the loss of the sense of belonging to a community or a neighbourhood. Another is that due to failing social services and infrastructures cities are divided into 'rich' and 'disadvantaged' areas (e.g. ghettoes and shanty towns).

The vertical city acquired its own momentum and it is essentially out of people's control. If a city were to be considered as a living entity following its own life-trajectory, then its next manifestation on the evolutionary path is already present: the cyber-city.

3 THE RISE OF THE CYBER-CITY

The cyber-city was born through the creation of cyberspace in the early 1970s, basing its informational structure on the existing telephone network that had already broken down the geographical barriers of silence. Whereas the telephone enabled voice and sound to be transmitted, cyberspace added data and images to voice and sound transmission. Theoretically, at least, any person could communicate with any other person anywhere on Earth. That was heralded as the birth of the Information Society.

3.1 Definition of the cyber-city

In this paper the term **cyber-city** refers to the sum total of the physical city plus that part of cyberspace which is embedded within, or which relates to, that physical city. Similarly, the term **digital-city** is used to denote a digitally produced city (solely made of digital information residing in cyberspace) which has no physical counterparts, such as buildings and streets (e.g. AlphaWorld, http://mapper.activeworlds.com/aw/intro.html). We would have preferred the use of the term 'kybernopolis' (from the Greek, kyberno=cyber and polis=city) instead for that of the digital-city but, in order not to increase the confusion already present (given the plethora of terms in use), in this paper we will stick to the term digital-city. It is incorrect to believe that websites represent a cyber-city or a virtual-city because they can only represent a part and never the whole city. These websites, holding information about cities, are popularly known as cybercities, cyber cities, digital cities, e-towns, e-cities, informational cities, intelligent cities, telecities, virtual cities, virtual environments, virtual worlds, etc.

3.2 The spatiality of a cyber-city

A cyber-city's geographical component is shaped by its physical structures and ICTs. Similar to cyberspace, its information (or 'cyber') part is formless (Figure 1). Even though a cyber-city is affected by the spacetime continuum, as a whole, it has spatiality but not geography. It can be qualified by terms such as global, emergence, flows, interactive, informational, digital, intelligence, etc.

Whereas the vertical city has clearly defined geographical boundaries and each structure can be measured, analysed, discussed and represented in 3D, the cyber-city's major characteristics are fluidity and diffusion. For example, the cyber-city's information stores and information processing belonging to financial institutions (e.g. banking) may not reside within the physical city's geographical boundaries but situated in another city. The importance of that was evidenced during the black-outs of 2003 in N. America and Western Europe, in the cities affected everything that run on electricity sopped working, whereas, part of those cyber-cities were still functioning. This was made possible because part of a cyber-city's data and information resides outside of that particular physical city; it is distributed wherever there is information stored or processed digitally in relation to that cyber-city.

What is the geographical configuration of a cyber-city's ICTs? The ICTs and the electronic web's shape are based on the telephone global network web-like structure. Satellite and wireless communication systems are altering the network-like structure by adding zones and regions of information, thus, enhancing a wider diffusion and distribution of information. Consequently, the city's ICTs enable it to transcend its original localised shape and identity into a cyber-city with global dimensions. Many specialists have been trying to map the city's ICTs and their activities (e.g. data-flows, IP concentrations and data-structures) with interesting and surprising results. A good collection of maps could be found either in the two books written by Dodge, M. and Kitchin, R. (2001a, 2001b) or at their respective websites: http://www.cybergeography.org and http://www.mappingcyberspace.com.

3.3 Cyberspace and ICTs: powerful transforming agents

Before looking at their transforming characteristics, it might be useful first to examine the relation between cyberspace and ICTs. Even though there is no commonly agreed answer to the question 'what is cyberspace?', a widely accepted view is that cyberspace is made of two major components: ICTs (the city outside the wires) and the information stored in or flowing through them (the city inside the wires). Yet a third approach, supported in this paper, is that cyberspace is the total of:

hardware (e.g. cables, satellites)

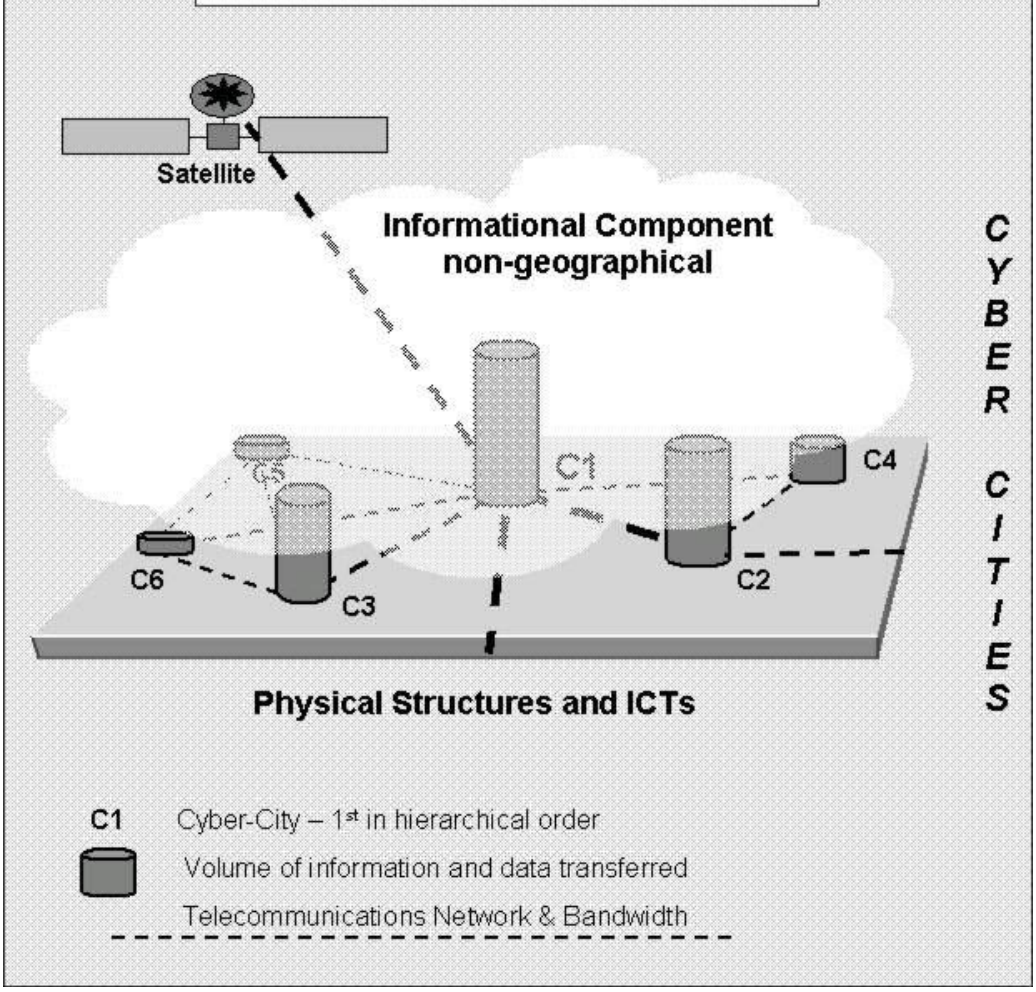
software (e.g. programs and data)

bioware (e.g. people and animals)

It is the cyber-city's informational components (ICTs and cyberspace) that give it its diffused, global dimension and, effectively, they transform physical cities to cyber-cities. The visible components of ICTs (cables, satellites, computers, telephones, aerials, etc.) enable connectivity and access to the networked resources transforming, thus, the local into the networked global. However, it is cyberspace's invisible component – the ethereal part that acts as the 'sea' of information and knowledge – which holds all parts together into a unity: the global informational network. The third, and most important, factor of transformation is humanity because it brings into existence all those phenomena and produces meaning and significance. All three agents are continuously transforming cities by rapidly destructuring and restructuring urban landscapes, thus altering the 'physiognomy' of the post-modern city.

One human activity that has been at the forefront of transformation and obvious to all, poor and rich alike, is today's economy. In order for capitalism to survive, it needs to (re)produce and expand through the creation of new worlds (physical or virtual) with the ensuing production, exploitation and consumption of new products and services. Cyberspace is a capitalist's dream come true because it is a new world without geographical limits, able to contain an infinite number of information-based products and services. It is the crucible in which dreams, pictures, information and knowledge are continuously produced and consumed. To software manufacturers cyberspace is the 'golden goose', because the production costs for either one or millions of copies of a single software program are almost the same. It is argued that digital software is a different type of commodity from physical ones (e.g. cars) because it is essentially information that can be reproduced and accessed (e.g. through the web) accurately and cheaply at almost no additional production costs.

Figure 1 - Cyber-City and Cyberspace



Another major effect ICTs and cyberspace have, based on this new techno-economic activity, is the concentration of power that occurs around centers of management and command, which are mainly situated in big cities. These centers coordinate, invent and manage the networked activities and services of companies. Castells (1996) believes that the convergence of the information technologies creates a new material base that acts as a catalyst in the transformation of the society's structures. He also argues that since the 1970s the nation's economy has changed significantly in two ways: (1) the new information technologies are now embedded within its structures and (2) its activities and effects are global.

3.4 Globalisation and inequality

That which really distinguishes the dramatic change from the vertical city to the cyber-city is that the latter in order to function it operates on digital information and on a global scale. The major characteristics that are central to the cyber-city's operations are decentralised activity and fast access to information (e.g. financial). For example, it is due to cyberspace's ability to transcend all geographical boundaries that the Stock Exchange transactions and communications networks acquired today's global dimension.

However, the cyber-city's promise to decentralisation, democratisation and equality for all through fast access to free information and services not only has not been delivered but it arrives at a time when traditional socio-politico-economic structures appear to be moving towards greater centralisation. A number of authors (Castells, 1996; Zook, 2001) support the view that there are two opposing forces at work. Even though there is a globalising effect due to more information and services made available on the internet, the vast majority of those activities are concentrated in big cities or metropolitan areas. Consequentially, that concentration of techno-economic power exacerbates the already existing inequality between the advantaged and the disadvantaged places.

In addition, those informational related activities occur at specific places within cities, leaving other places unused. As the city's places acquire different value (financial and social), the inequalities increase resulting to informational services undervaluated as spaces are downgraded. Consequently, certain places do not attract investment due to their downgraded infrastructure, which sets in a vicious circle of poverty and neglect. On a larger geographical scale, the same occurs between cities, regions and countries.

Instead of ICTs and cyberspace reducing inequalities, it appears that together with the greater spatial distribution of the production and consumption of cyberspace related services, there is a 'preferential' concentration of those services to specific locations. For example in USA and UK these activities are grouped and concentrated in metropolitan areas, such as California and London, which also receive the lion's share of investments in those countries (Graham and Marvin, 1996; Kellerman, 2000; Zook 2001; Zook, 2002). Soja believes that this dialectical tension between those two opposing forces is the "underlying dynamic of geographically uneven development" and it is "a primary source of the spatial problematic at every geographical scale" (Soja, 1989: 107).

3.5 Whoever controls information, controls the economy

The struggle to control information and its means of production is more than ever evidenced today and it is central to world economy. Because the modes of production and consumption of information have a global dimension it is extremely difficult to isolate those modes and processes within a single city. The basic modes in the cycle of production to consumption of information are: source (e.g. data), production (e.g. software and people), transmission (e.g. HUBs, switches, cables and satellites), distribution (e.g. Internet Service Providers), access (e.g. computers, mobiles and consumer electronic goods), and consumption (e.g. people).

Attempts made to control the information flow at the source and the consumption levels, have largely been unsuccessful mainly due to (a) internet's decentralised structure, and (b) control through the law or force is very difficult to be achieved in democratic societies. Whereas local and central governments control physical consumer goods and services at the points of production and consumption (e.g. through taxes), the same did not succeed so far with data and information. Instead, central government is learning to exercise control on the transmission and distribution points, through the Internet Service Providers (ISPs). That is achievable because physical structures, people and ISPs are located in geographic space and operate under the laws of a country. In addition, multinationals, such as Microsoft, are attempting to control the rest of the processes (e.g. production and consumption).

Recent changes in the legal framework in USA (e.g. Patriot Law) and Europe make it legal for central government and its agencies (e.g. military, NSA and CIA) to gain more control of data flowing through the global informational network. Even though, cyberspace was created by the military in USA during the 'cold war' period (in the late 60's and early 70's) as an attempt to construct the first computer network and control the information flowing through it, users broke free and established the WWW based on a decentralised democratic mode of operation. However, by the end of the 20th century, powerful companies (e.g. Microsoft), organisations (e.g. CIA, NSA) and countries (e.g. USA, France, UK) have regained a measure of control over the information flowing through the Net (e.g. the Echelon listening system). Once more, it is a matter of power enforced by the few onto the many.

3.6 How free is free access on the internet?

Another important issue is that of free access to information residing on the internet. During cyberspace's first two decades information was shared widely and freely between users. However, since the 90's, organisations producing vast amounts of information are either keeping it only for internal use or selling it to users. Only very few publishers allow free access to their e-journals, e-books, etc., and academic institutions allow access to their e-library services (e.g. e-journals and e-papers) only to their internal users. Data has become another expensive commodity, such as gold; data mining is replacing gold mining.

For the majority of the poor people, accessing information on the internet is expensive because it entails use of a personal computer (PC), paying for a connection to the internet and on-line usage charges and, finally, paying for some types of information (e.g. digital maps). There are other factors exacerbating the difficulty to free access of information. A couple of the main ones are:

More information is now costly to be digitally produced (e.g. use of expensive equipment such as satellites).

More people and companies are ready to pay to access data, therefore creating a 'market' for these products.

The implications are that billions of poor people in countries, cities and communities cannot gain access to the information they need because they do not have the money, access to computers or the necessary computer skills. Castells (1996) refers to these people as the 'fourth world'. A newly created disadvantaged group, a global community deprived access to the new commodity: information.

Millions of these underprivileged people live in the cyber-cities of the developed countries. As the emphasis is increasingly placed on digital images, information, and technology, the 'fourth world' is marginalised and effectively excluded from all internet related activities (e.g. jobs and e-learning). Politico-economic decisions are made by other groups of people.

Many hope that the 'fourth world' can be assisted through free access to and training in the use of a PC and free internet access. In addition, local organisations and central governments could provide free access to knowledge and training, and help in the development of free software, such as the Open Source projects. However, at the present, as the city is increasingly becoming more virtual (e.g. virtual communities, virtual museums, virtual teaching, virtual libraries, etc.) the 'fourth world' is 'trapped' into its physical analogue reality, unable to participate in the birth of the virtual global world soon to be ushered in; as many proclaim.

4 THE VIRTUAL-CITY

Some authors regard the virtual-city as a digital space (Shapiro, 1995), others, like Castells (1996), talk about the 'Informational City' and the effects ICTs have on the networked society. Still, others (Heim, 1997; Jakobsson, 1999) view the virtual-city as a Virtual Environment (VE) or a Virtual World (VW). In this paper, the term **virtual-city** means the sum total of all information created, stored and used in cyberspace in the world referring to a real city. Thus, the virtual-city is always a part of the cyber-city.

It is argued that no e-city, e-world, VE or VW can be digitally equivalent of a real city, for two main reasons. First, they are very different types of entity, like an avatar[16] to a living human being. Second, a virtual-city could reproduce or represent only part of a

[16] Avatar is a digital representation in cyberspace of a user. It could be any shape or gender. It could be destroyed and reborn. A user could use more than one avatar (i.e. representations) at the same time in cyberspace depending on the program's restrictions.

real city but never the totality of it. The complex physical interactions (body language, smells, skin sensations, etc.) that are a fundamental part of daily social interactions, are missing from the virtual-city. Even if all people living in a real city were to become users of its corresponding virtual-city, the latter could only complement, imitate or simulate a part of the real city but never stand for it. The 'blood, sweat and tears' involved in building and living in the physical city remain outside of its virtual counterpart.

In addition, it could be argued that the virtual-city is fundamentally different from the physical city because the former does not reside within the city's material structure; it does not occupy a geographical place. Rather, it is distributed and diffused in spacetime continuum, even though it impacts on the physical city and its people. It could also be said that the virtual city is a boundless, non-local, non-geographical, socio-spatio-temporal phenomenon enabling fantasy, imagination, myth, dreams, knowledge, reality, spirituality and materiality to coexist within the continuum of virtuality. All these phenomena manifest through the cyber-city's structures or else they would have been left only potentially possible. As the cyber-city embodies these phenomena into the city's structures at the same time it transforms and abstracts materiality into virtualised environments thus creating the virtual-city. It is as if there are continuous information flows (the city in the wires) from the virtual to the material and vica-versa with the cyber-city being the transformational agent in between; not separating but embracing the two into a synthetic-global-virtual world.

The virtual-city is build by data, information and knowledge. As already mentioned, part of the virtual-city is rooted in the cyber-city. Slowly but steadily the overlapping of the cyber with the virtual are manifesting a different type of 'reality', one that is mainly based on digital bits of data transformed into information and knowledge and not on the tangible and externally lived analogue world. Unlike its user, an avatar within a virtual world does not have to breathe or sleep, similarly the virtual-city never sleeps.

How difficult is it to model the virtual? During the last few decades major developments of existing digital models enable to keep up with the city's physical structures. Even though, some issues of how best to (re)present them remain unresolved, nevertheless, the crux of the problem is clearly how to incorporate and model virtuality in a meaningful way. This may not simply be a matter of improving on past methods and techniques, as when dealing with one of the three dimensions. We argue that the difference between the three known spatial dimensions and the virtual is so fundamental and significant that demands a re-evaluation of the theoretical and philosophical underpinning of practices dealing with virtuality. This is so because the phenomenon of the virtual includes, amongst others, issues such as: (a) it incorporates contradictions and ambiguities of complex and synthetic phenomena, (b) it is not geographical, (c) it requires alternative ways of thinking and approach, and as a result, (d) it demands a break with the past.

If the above is correct, then scientists and spatial specialists in particular will need to find the type of model (or models) able to respond to the challenge. One such 'new' tool is Lefebvre's (1974) trialectic model, whereas the old binary model is redundant:

(a) the Cartesian binary model (e.g. human/machine, right/wrong, 1/0, true/false, past/future, yes/no, white/black, on/off…)

(b) Lefebvre's trialectic model (Figure 2)

The binary model limits the synthetic way of thinking into a two-state logic on/off, yes/no, 1/0, true/false... That restrictive binary logic appears unable to embrace complex analogue issues without first reducing them to simplistic true/false statements. On the contrary, Lefebvre's trialectic model applied on synthetic issues could produce greater knowledge and deeper understanding because it allows contradictions and ambiguities to co-exist and be modelled. As Lefebvre, Soja (1996) and others argue, when the time-space-society trialectic model is applied on socio-spatio-politico-economic issues, it does not exclude dialectic relationships (e.g. socio-spatial, politico-economic). Instead, it incorporates the dialectic within a greater model, that of trialectics. It could be said that trialectics is not a model simply explaining away everything through conflict, opposition or antagonism. Rather, it attempts to examine social issues through cooperation instead of opposition, synergism instead of antagonism, collaboration instead of conflict, and symbiosis instead of separated existence. That which is conceived and that which is perceived cohabite the lived world.

Lefebvre's trialectics do not attempt to compress all logic into a 'black and white' logic; instead, it provides room for all 'shades of grey' in between. Because the virtual raises complex, chaotic and often contradictory issues, it is extremely important to know that trialectics could model them because it is not only tolerant but it is made to deal with complex and contradictory relationships. Therefore, here is a theoretical model tool (amongst others, e.g. the fractal, chaotic and superstring theories) ready to be applied on emerging social phenomena, such as the rise of the cyber- and virtual-city. Specifically, complex social phenomena such as virtual reality, nanotechnology, cyborging[17], bioengineering, artificial intelligence, etc. usually examined in isolation as spatial, historical, technological, cultural, economic or political issues could now be studied by applying trialectics. Similarly, issues of identity, community, security, accessibility and spatiality could be best approached through the trialectic instead of the cartesian model.

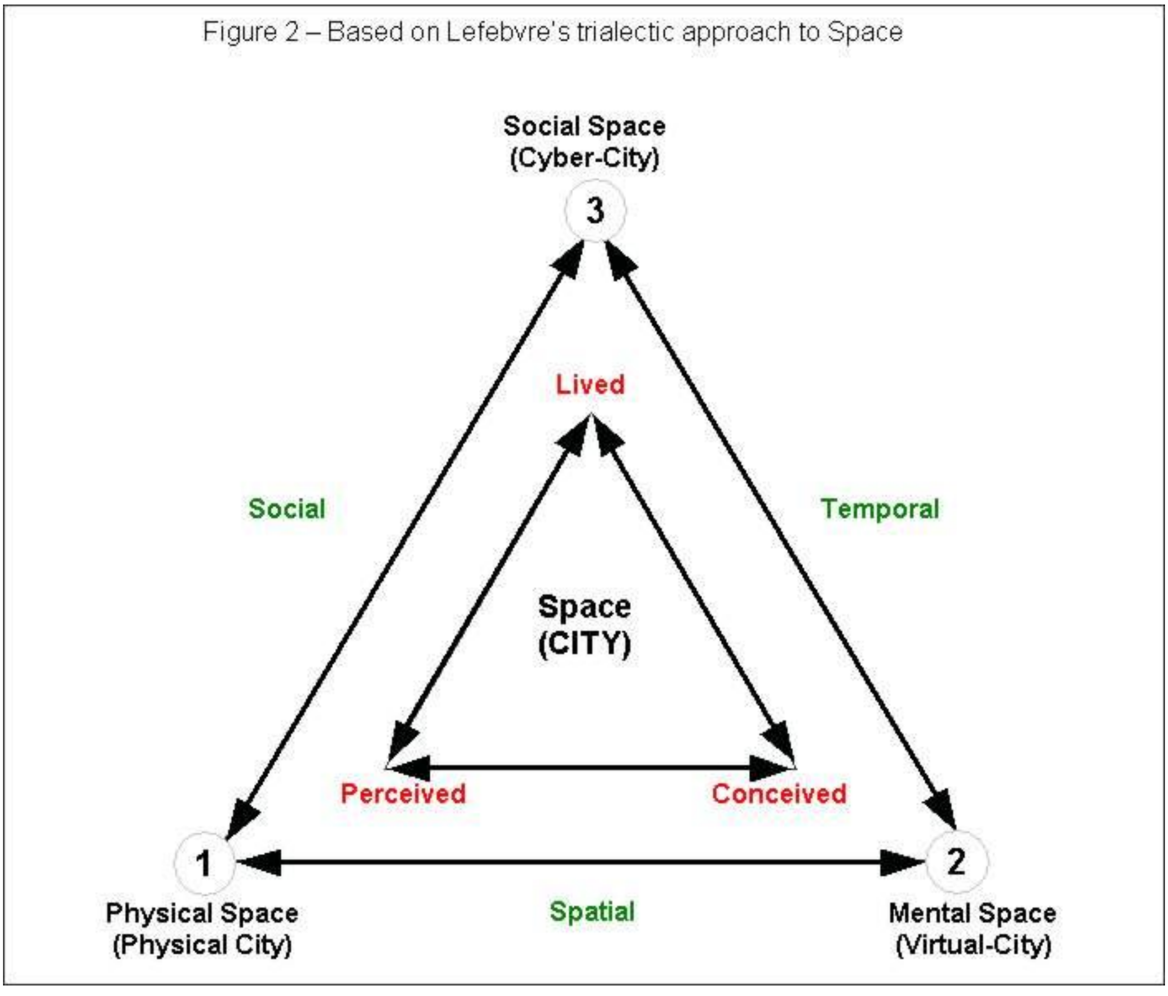
5 THE MEANING AND SIGNIFICANCE OF THE VIRTUAL

Virtuality means different things to different people, including scientists. Why is it significant for spatial and social scientists to study the virtual-city and the virtual? Perhaps one of the most important reason is that by trying to experience and research the virtual it challenges current binary ways of thinking. Another reason is that by trying to intellectualy encounter the virtual, and thus understand the contradictions and ambiguities brought by it, it brings people closer to what 'is out there, just beyond the known horizon' because essentially the virtual appears as continuous formless flows of energies (e.g. information).

It could be argued that the virtual resides outside the x, y, z and it manifests in space-time through projections. Consider, for a moment a 2D entity from Abbot's Flatland (1984) trying to imagine and model a 3D world. Given its lack to perceive and experience a 3D world, it will attempt to think, conceive and describe the 3D world as a set of 2D values within a mode of 2D understanding. Inevitably, there will be many unexplained and unresolved issues (e.g. cosmological) until the whole problematic is raised to and examined (e.g. theoretically, philosophically and mathematically) from a higher dimension. Similarly, problems in a 3D world could be solved when they are raised to a higher dimension. Hence, new models incorporating the virtual as a new dimension (or direction)

[17] The term cyborging means the meeting place of nature and technology in a single 'physical body' (e.g. human or animal); flesh and bones in synergy with hardware and software creating a cyborg.

could go a long way to answer philosophical and intellectual problems and, by doing so, they will establish a theoretical platform upon which specialists could build commonly agreed tools and practices.



If the virtual could be considered as another 'spatial' dimension without place and geography, then what does it stand for? Perhaps the nature, meaning and significance of the virtual could be found by examining current anomalies, paradoxes, contradictions, ambiguities and unexplained areas of knowledge. Like the 2D citizen of Flatland, we can imagine and theorise about higher dimensions but unable to consciously experience them. By taking a step back to the 2D allegory we may find the key to our problem.

One approach will be to examine the **contradictory** effects of the virtual on spatial, social and biological structures. Looking at the virtual as it manifests itself through technology, we could argue that there is a tendency for technology to spread and diffuse (globalisation) whilst, at the same time, it embeds itself within smaller and smaller structures (localisation). For example, within a century the telephone not only found its way into every house (globalisation) but it also moved, in the form of a mobile, onto people's bodies (localisation). Similarly, within few decades computers have spread to the whole world (globalisation) whilst they have been shrugged and miniaturised onto a single wearable chip (localisation). Other technologies, such as bioengineering, information-technologies and nanotechnology, seem to be following similar trajectories. Perhaps, before long, these technologies will be found everywhere whilst, at the same time, they will be embedding cyberspace inside every structure, such as the human body.

Similarly, another approach could be to study **ambiguities**, produced by new phenomena such as cyborging, or the new phenomenon rising through the mutual existence of cyborging and intelligent structures (buildings, cars, machines, etc.), the 'intelligent city'. The latter, closer to spatial planners concerns, is not simply a result of the use of more (or better) artificial intelligent systems but it is essentially emerging because people (with cyberspace embedded in their bodies) are interacting wirelessly with the city's socio-spatial structures exchanging information that is invisible to the normal physical sense organs (e.g. ear and eye). To all intense and purposes, people and their urban structures are embarking on a new symbiosis using as a common base energy, information, intelligence and knowledge. It appears that society is witnessing the emerging of new types of life, intelligence and consciousness.

Merging dualities such as the subject and the object, the global and the local, nature and technology, reality and virtuality into a single structure (e.g. the physical human body and the intelligent city) will certainly produce many social changes. In addition, there is the real danger that people's inability to discriminate between information received directly through the physical senses and that received directly through the embedded cyber-mechanisms will suffer. Under those conditions it could be almost impossible to differentiate between fact and fiction. Living and experiencing multiple environments (virtual and real) at the same time will require a special (or different) 'human being' and a different type of 'society'.

In addition, as artificial intelligence and artificial life systems increase in number and ability during the city's evolution, human beings could realise that they are not the only producers of intelligence and knowledge. That is already happening to a small extend and it might have inaugurated a new era during which artificial intelligence and artificial life systems will, at some future time, demand their 'right' to exist and evolve. If the above is not totally fictitious, then planning for a society living in intelligent-virtual cities where humans and their technological constructs exist in close symbiosis requires fundamental research before is too late.

We could argue that the emergence of the virtual through technology is already evident and by applying suitable models (e.g. trialectics) on the problematic of the relationship of the real to the virtual could help produce a better theoretical basis to assist with planning in the 21st century. In way will be to view virtuality not as an enemy of the real, as done previously, but as an alternative reality. Not something juxtaposed to the real but a phenomenon emerging out of the cyber-reality that unites the two (virtual-real) into a new phenomenon. Familiarity with the world of dreams and cyber-reality could act as a stepping stone towards understanding the virtual-reality. A more practical example is that instead of considering the virtual websites of cities as replicas to those of the physical city, those virtual websites could be seen as part of the cyber-city working in a complementary manner to the physical city. By doing so, the emphasis is transferred from one of oppositions to one of interrelationships between the three versions of the city: physical-cyber-virtual. Social and spatial planners could play a key role in all above issues.

Gaining further knowledge through researching those relationships could lead to greater awareness of the meaning of the 'city' through the formulation of new questions such as: How do we define a diffused global city, or an intelligent city? What types of models are needed to fully study a cyber- or virtual-city? How best could we utilise the physical-, cyber- and virtual-city resources? What type of form, meaning and functionality will a city have by the middle or the end of the 21st century?

Even though, in this paper we are not attempting to fully answer those questions, nevertheless, the position held is that virtuality appears as being a different type of thing, from that of verticality and horizontality. Perhaps, because the latter dimensions are directly bodily experienced as well as mentally, whereas the virtual has a closer relation to dreaming, feeling and intellectuality; a difference between conception and perception. Is it possible that the virtual could be used as an alternative mode of experiencing life? In experiments done with immersed virtual reality worlds, users felt and acted as 'living and experiencing' a different type of 'becoming'. Perhaps if the virtual is not limited through our binary thinking as a simulation of the physical but as something different worth exploring, then it could become an enabling creative tool revealing hidden versions of our reality.

However, because technology is not neutral, the use of virtual technology will be both, constructive and destructive. We share the view that 'technology is neither good nor bad, people who used it are' because it has been created with a purpose in mind. Therefore, the production of these technologies greatly influences their type of use and, consequently, affects how they are perceived. The aforementioned make it clear that phenomenon of virtuality requires urgent and serious research in order to understand its effects on today's society. Therefore, it is imperative to become more aware of the major issues introduced with the rise of the cyber-city and the emergence of the virtual-city and how these redefine our social reality and, consequently, society.

6 REDEFINING SOCIETY

Cyberspace's embedment in socio-spatial structures (e.g. physical, ideological, etc.) has been solidified to such a large degree so that many scientists (Benedikt, 1994; Castells, 1996) support that the two worlds – virtual and physical – are already inseparably interrelated. All modern economies, local and central governments, institutions and businesses cannot properly function without cyberspace. Its absence would cause the collapse of the current culture and all socio-economic structures, as it was temporarily experienced during the 'black-out' that took place in 2003 in Northern America and Europe[18]. Hence, the dependence on information becomes central to society and, as a direct result, the people controlling the modes of production and consumption of information are the ones controlling society. So issues such as democratic participation in reshaping the new society become more relevant than ever.

The change in the mode of production and consumption, e.g. information becoming both a commodity and a currency, transforms and redefines human values and human life. People, by using information and knowledge, (re)shape and transform both their physical and spiritual realities. Forms alter in shape, structure and functionality whilst, at the same time, the cultural expression in society is becoming more visual and increasingly mediated through technology. Specifically, many people are increasingly gaining information through the use of 'windows' (such as TVs, computer monitors, mobiles, etc.) instead of direct contact of their physical senses with physical objects. For example, information on travel destinations, consumer goods and services is experienced through those 'windows' and in most cases people believe to be looking at the 'real physical object', not its digital representation. As more people consider information unmediated through technology (i.e. face to face conversation) and information mediated through technology (i.e. talking on the mobile) one and the same, then that produces a fundamental change in the way we transform and (re)construction our social reality and society.

The cyber-city's most significant contribution is its mediating role: the way people relate to nature via technology. Specifically, the mediation via ICTs occurring at great speeds embraces the whole globe and goes deep into the innermost parts of both the physical and the non-physical structures of society. To the extend that if cyberspace has not already embedded itself within every ideology, belief system, type of thinking or physical structure (biological and non-biological) it will not be long for that to happen. Through those two processes: **mediation** and **embedding**, social reality is continuously restructured thus changing people's ideas, attitudes and behaviours towards themselves, society, technology and nature whilst, at the same time, they are modifying their social reality. In effect, humanity and its techno-scientific products (technologies and ideologies) are engaged in a mutual dance, through which the material is spiritualised through the virtual and the spiritual is materialised through the production of forms.

It could be argued that the virtualisation of the physical city is happening all around us enabled by wireless communications that have now become both the medium and the message. On one hand, the written words joined by the hypertext are transforming the linearity of text into the hyper-linkage of words and phrases, and the interrelatedness of their meanings. By doing so, they are changing both

[18] In the affected from the black-out regions, all the services that were supported for their operation on the use of electric power (e.g. transportation and communication networks) stopped functioning. Hundreds of millions of people in the affected regions witnessed a temporary collapse of the cyberbase culture.

the signifier and the signified through a new contextualisation. On the other hand, thinking through images merges the 'I' with the 'Other' and the self with the many. Finally, it enables both a breakdown and an opportunity to rebuild (hopefully more creatively and wisely) on different sets of values. Similarly, the production of new forms of expression in architecture, art, literature and other cultural, technological, scientific and social activities transforms the physical city into a cyber-city (a hybrid made from cement & steel, and bits & bytes) whilst, at the same time, it merges biology with technology in the production of cyborging.

Today, we are witnessing a stupendous global event: a great, unstoppable, furious, silent, dynamic all embracing transformation acted mainly on the urban global stage. The main actors are human beings and their technologically produced creations. Both the unfolding scenario and the ending of the play are unknown. The virtual dimension of life, as expressed through the virtual-city's information flows, weaves the metaphysical together with the physical into a mythico-technical fabric where both the fantastic and the real are given opportunities to coexist. All these are manifested through that living organism (albeit bio-technological) which we refer to as the cyber-city. The post-human and the post-city are emerging not as merely a fiction or a myth but as the possible next step in humanity's evolution.

7 CONCLUSION

The vertical city with its high-rise buildings has created the cyber-city and the many virtual worlds. Thus, the physical city has been redefined through the emergence of ICTs and cyberspace and it has been transformed into a cyber-city that, in its turn, has given birth to the virtual-city. Without the cyber-city, the virtual-city remains but a dream, a utopia or a dystopia. With the rise of the cyber-city emerged the virtual reality worlds through which many believe they will find their 'Shangri-La', 'Paradise', 'Eden' and 'Shamballa'.

The global character of the cyber-city and the 'ethereal' formation of the virtual-city invite deeper understanding. Hidden within the trialectic relationships between the physical-cyber-virtual could be the key to deal with the city's crises.

People let to believe that everything experienced through the mediating technology is 'real', unavoidably leads to confusion between physical reality and virtual reality. Hence, as virtuality establishes itself in everyday life, it brings closer the imaginary and the fictional to the real, thus challenging us to apply different ways of thinking and models (e.g. trialectics) on real-life situations.

Many argue that if society was more prepared and had planned prior to those dramatic changes then most of today's urban ills would have been cured. Applying that argument on the transformation of today's society (from the physical to the virtual) it could be said that planning for the virtual age should have started few decades ago; at the creation of the cyber-city. However, it is not too late to gain lost ground by concentrating resources on how best to transform humanity from the homo sapiens to the home-virtualis.

For that to be achieved we need to put high on the agenda issues such as humanity, intelligence and consciousness.

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reviewed paper

Participatory Routing of Electric Power Transmission Lines using the EP-AMIS GIS/Multicriteria Evaluation Methodology

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1 INTRODUCTION

The North American electric transmission network was developed under the guidance of the North American Electric Reliability Council (NERC) to enhance the reliability of electricity supply. The network also allows sale and marketing of electric power by one utility to another. Electricity marketing has taken on a much more prominent role with restructuring of the electric utility industry. As a result, long-distance sales of electric power have greatly increased the loading of some transmission lines, and have led to congestion on the transmission network. Recent system failures such as the northeast blackout of 2003 have highlighted the need for increased capacity. While some upgrades of existing infrastructure will be undertaken, some of this capacity must be provided through new transmission lines.

2 TRANSMISSION LINE ROUTING: A SOCIO-TECHNICAL PERSPECTIVE

It is clear that public frustration with, and opposition to, current methods of transmission line placement have impeded grid upgrades and continue to do so. The current crisis situation is rooted in problems that have historically surrounded line placement. Few lines have been constructed in recent years. The rules for the restructured industry provide few financial incentives for building new lines. When a utility does take the financial risk of new line construction, it will often meet with significant public opposition, based on a host of environmental, aesthetic, health, safety, and other, sometimes unanticipated, issues. Such opposition can greatly increase costs and delay lines for years. Plans for several lines, which were easily justified technically and financially, have been finally abandoned due to public opposition. This problem has been brought into sharp focus for the public because of the recent regional power grid failure events. As Mr. Weisgall of MidAmerican Energy Holdings Co recently observed in the *Washington Post*; "Where would 30,000 miles of new transmission lines go? That's the problem. Nobody wants them."

A review of current best practices reveals that advanced spatial analytic methods are not widely used as part of the decision support system to optimize location (State of Alaska BLM 1998). A typical process model is as follows:

i. Utility and other involved parties define need for a new transmission line and approach public authorities.

ii. Public officials announce the intent to build the line and suggest a timeline.

iii. A set of public forums are planned. Many are held under the auspices of NEPA regulations. These include setting a "window" for input. NEPA-mandated concerns are mainly treated as physical environmental matters.

iv. Information gathered from these meetings is transcribed and summarized.

v. GIS is used by the involved parties to locate features and prospective routes.

vi. A series of "preferred options" or numbered line routings are presented to the public on maps or GIS output plots.

vii. Selection is made based on least vocal opposition to the lines shown, or no selection is made based on depth of public opposition.

While the process seeks public involvement with honest intent, key weak points include:

Segmentation of responsibilities. Under the fragmentation of public organizations over the last 30 years, in part as a response to NEPA mandates, different organizational units are in charge of different "pieces of the pie." Sometimes, there is no structured forum at which cross-cutting concerns can be voiced. This is evident in some transmission line cases in the after-the-fact reaction of certain user groups who feel excluded.

A lack of transparency about how the actual routing decisions were made. This lack reduces public support for the chosen option and erodes public confidence in the activities of the responsible parties.

The weighting of factors is not rendered explicitly. This is attributable to the lack of a formalized decision methodology that enables analytical tradeoffs to be made. Further, it is not clear the extent to which the GIS is being integrated into the analytics of the decision making. In many cases GIS is used as a display platform to automate map production of prospective routes rather than as part of an integrated spatial analytic system.

These concerns cannot be separated from the way in which technologies are embedded into this process: for example, if the GIS system used to locate and count decision elements is built and viewed by a small cadre of professionals, it is hard for other participants to use the output as an opportunity to iterate their criteria selection and weightings.

In combination these shortcomings contribute to a decision mode characterized by some public involvement practitioners as DAD or "Decide, Announce and Defend" [1] in which a small set of pre-formed options are defined by experts, out of sight, and then taken to the public. This process circumscribes or undermines discussion of relevant criteria and their weights.

In some cases, the traditional route planning process actually helped mobilize opposition groups by avoiding public involvement until well into the planning process, and then discovering (sometimes at a public meeting) that an important issue for the local community had been missed. Such opposition groups were then able to delay line construction through lawsuits and other tactics. In response, utilities have learned to provide more information about line routes to the public earlier in the planning process. They are using more sophisticated techniques to inform the public of plans, and public input is sometimes accepted on alternate routes.

Even with these techniques, however, primary responsibility for planning the line route still rests with the owner of the transmission lines and is based mainly on traditional technical and construction issues. While this answers many of the requirements, a more effective public involvement process will help resolve many of the potential objections of the public. It is possible and even desirable to have a well-planned approach to public involvement in questions regarding the planning and design of publicly-used infrastructure. Professionals who regularly work with public design issues have documented much of their experience for use in similar problems.

The solutions to these complex issues require a socio-technical perspective; that is, they should rely on technological improvements in conducting capacity to reduce required footprint and system dimensions, but at the same time, the technical system interface with the public and other stakeholders must be improved. Bureaucratic and or/non-transparent impositions of preferred routings on skeptical publics will increase mistrust and will not facilitate a long-term solution. Based on this premise it is imperative that routing methodologies consider and incorporate effective principles of public, multi-stakeholder involvement.

3 SIGNIFICANT ASPECTS OF SUCCESSFUL PUBLIC INVOLVEMENT

A set of fundamental goals defines successful public involvement in complex planning and design questions [2]. These goals reflect the experiences of community planning professionals, facilitators, architects, transportation and land-use planners. They include the following:

The public should be involved instead of marketed to Dynamic two-way communication should be established The process should be inclusive of all stakeholders and create mutual understanding Respectful communication becomes the norm Early and continuous engagement occurs The decision process is defined, structured, and transparent Agency leadership helps make process happen and provides resources to enable the process.

While these are laudable goals in the abstract, they imply a more fundamental shift in the worldview of professional planners and designers [3]. Community design professionals suggest the following principles to help guide public involvement work:

No design is too complex for the public to participate in. Users are neither in complete agreement nor complete disagreement. Participation requires time and effort. The public can be frightening to professionals. More participation is better, and always a struggle. The public can develop useful compromises.

These principles form the basis for the KTC's Structured Public Involvement (SPI) protocols [4]. SPI protocols are designed to ensure that public input into the design and planning process happens before the process is begun: that is, planners and/or designers gain a clear and documented image of public preferences as part of their initial design process. This allows professionals to avoid "guessing" about public preferences and investing much time and effort in plans and designs that are fatally flawed from the point of view of the general public. Publicly unpopular designs can occur because professionals have no useful or practical way to access public preferences. In the worst cases public involvement then becomes a chaotic, disturbing, even counterproductive moment in the planning and design process.

SPI embeds advanced technologies into iterative public involvement processes that maximize the technology's decision-support and public engagement capacities. The team has worked with virtual reality and other visualization technologies as well as decision theoretic methods and GIS in a variety of large-scale multi-stakeholder projects [5,6]. The primary methodology for this project is the team's GIS-based Analytic Minimum Impedance Surface (AMIS) that allows large numbers of diverse participants (public or professionals) to participate in the creation of a routing tool that explicitly includes all of their landscape and environmental feature and preference information in the routing decision process [7].

4 SUMMARY OF ROUTING ISSUES

It is evident that electric transmission line routing problems share many of the characteristics of other public infrastructure location questions, including landfills and other NIMBYs. The problem is always complex: it covers a large area and involves a wide range of stakeholder groups with often competing objectives. Routing demands consideration of a wide range of variables, such as current landuse and settlement patterns, environmental health considerations, locations and habitats of rare species and geomorphological phenomena relevant to construction and maintenance [8]. The problem of integrating these into an analytic system is compounded because some data are point phenomena with specific physical locations, such as structures or localized threatened and endangered species habitat, some are linear data, such as streams and rivers, while others are aggregated and/or interpolated area data, such as National Forest Lands, wetlands, areas with common demographic characteristics, or areas of technical and construction concern [9].

Given this background the aims of the project are to develop and apply a methodology that demonstrates high performance with regard to these four principles:

1. Respect. The process must respect all stakeholders by considering their input and making effective use of this information to influence line placement. It must also be seen to do so fairly by all involved parties.

2. Transparency. It must offer each stakeholder group the opportunity to see and understand the priority system of other stakeholder groups.

3. Efficiency. It should generate useful, easily-understood, transparently-derived and easily iterated preferred transmission line corridor options.

4. Analytic capacity. For user-selected corridors, it must allow detailed corridor inspection, showing meters of coverage of each landscape element and numbers or units of features covered. It must be capable of rapid sensitivity analysis, showing how preferred

corridors across the landscape are affected by varying weightings or tradeoffs of input values. It must show visual configurations of the preferred line placement and how they affect views.

The outcome of a successful protocol will be higher satisfaction with the process and outcomes. A more inclusive, explicitly analytical method that renders transparent the optimization process, using criteria defined and weighted by both relevant expert groups and community input, and which offers iterative feedback opportunities, is the basis for this result. To that end, several evaluation and assessment measures are proposed. These will investigate the degree to which this protocol achieves its aims and to pinpoint areas where it may be improved [10].

5 PRINCIPLES OF THE DECISION LANDSCAPE

The *decision landscape* consists of a surface representing a decision criterion, such as *cost* or *desirability*. It is generated by specifying and quantifying a decision criterion for a wide variety of physical, environmental and socioeconomic attributes and then assigning them a location. Physical attributes include features of the built environment, such as airports, cemeteries and archaeological sites. Environmental attributes include not only the location of endangered species, but also their range and habitat. These also include air and water quality indices and ecosystem evaluations. Socioeconomic attributes are modeled in the form of social and community impacts. The decision landscape is computed and displayed by means of a raster-based GIS.

The decision landscape is a powerful and flexible means of assessing social and environmental factors in a dynamic context. It provides a graphical summary of all development features that facilitates comment and feedback at public meetings and other forums. It offers a powerful analytic tool that can be used in a number of ways to examine any type of development and its impact. Various operations can be performed on this decision landscape: such as point-to-point route “cost” minimization, buffer zone impact minimization, net environmental health hazard mitigation and so on. Because the methodology is quantitative the benefits of specific locational strategies may be analyzed closely and compared with a strong degree of confidence. Moreover, distance-decay spatial effects can be modeled accurately using origin points and mathematical functions.

5.1 AMIS: The Design Process

A State Highway Agency (SHA) requested an analytic methodology for highway corridor comparison. The problems identified and the requirements specified were analogous to those encountered in the electric transmission line problem. A decision criterion termed *impedance* was the core of AMIS [7]. In its simplest interpretation, impedance represented a reluctance to pave. This criterion recognized complexity in decision making. Instead of assuming that for financiers impedance was directly proportional to the cost of routing the Interstate over that feature or attribute, or that for engineers it represented difficulty of construction and so on, it allowed each participant to sum their judgments across diverse, competing criteria. The acronym AMIS was derived from the conjunction of the A - *analytic* hierarchy method - with the MIS - *minimum impedance surface* logic.

AMIS was designed from the ground up to incorporate input from as many sources as possible. In its prototype form, this represented input from a variety of federal (FHWA) and SHA representatives, including Engineers, Planners and Environmental specialists. This process took place over a period of approximately six months, with sets of meetings being held to move through the design stages. Facilitation methodologies were employed at each of these meetings to maximize stakeholder input.

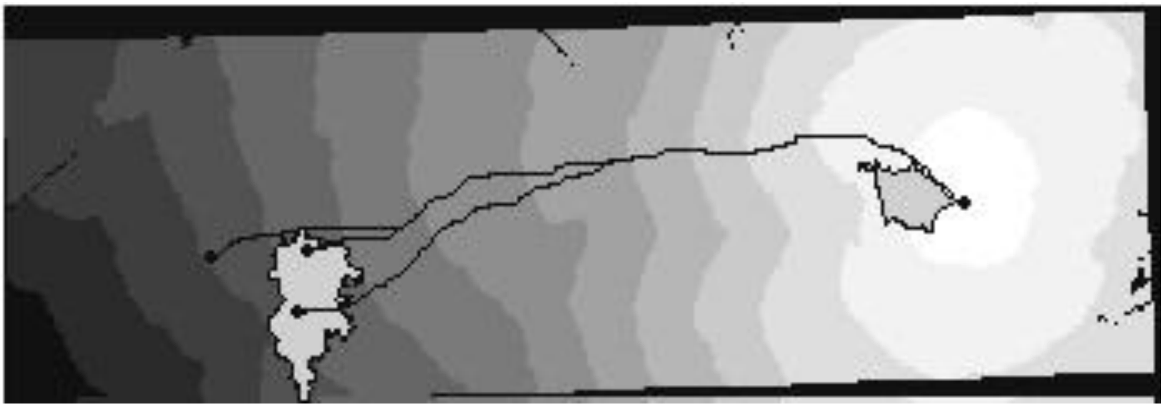
AMIS was built by specifying the multicriteria priority model and weighting its factors and then integrating this data into the GIS to create the impedance surface. The multicriteria model was comprised of a three-layer information hierarchy of surface data elements (originally 69 of these), affinity groupings of the 69 data elements (5 total) and FHWA Purpose & Need categories (8 total). The multicriteria model was designed to determine a final impedance score for each of the elements that could be assigned to a specific feature in Arc/Info.

To gather input data, the research team began with elements identified during preliminary phases. Other elements, identified as conceptually desirable, were added and data coverages were then located for the study area. The GIS data used in the AMIS prototype was taken from the public domain. Nearly 80% of the data could be assembled for analysis of a similar route within two weeks. This offered a much more rapid assessment than conventional contracting processes. The team’s original list was based on knowledge of GIS-suitable data available through organizations such as the USGS and the Area Development Districts. Much of this data was already available for download in database format from the websites of these organizations. Data that would require extensive and costly primary surveying was explicitly avoided. For these reasons the team proposes to use the same grid resolution (30 meters square) for the electric transmission line application.

5.2 Features and Output

In its prototype form AMIS was used to generate an optimum (least-effort/most productive) corridor and to inspect various corridor options for their trade-offs in total scores (Figure 1).

Figure 1: Optimum Corridors Across an AMIS Cumulative Cost/Distance Landscape



AMIS was used to explore the costs of various trade-offs against the rest of the cost surface. For example, the total offsetting costs for accomplishing a particular routing (say, near a tourist attraction) can be estimated through adjusting the attractor value assigned to the feature until the optimum route chooses that path. Alternatively, a set of required coordinates can be specified to AMIS and it will produce the optimum path that includes these specified locations. AMIS can also be used to evaluate the overall score of specified paths and determine the number and nature of features contained within a proposed corridor.

AMIS can be used in a long-range planning sense to explore the early implications of potential corridor locations, or modifications to existing corridors. Highway rehabilitations can be tested mathematically by using AMIS to summarize potential obstacles and issues near a current corridor. A third potential application is infrastructure investment options evaluation. For example, AMIS can be used to quantify more accurately and completely the landscape issues associated with various competing infrastructure investment options. It also allows context-sensitive quantitative comparisons to be made between different environmental policy strategies. The system's sensitivity analysis also satisfies "what if's" in public forums: if criteria modification is proposed, the costs and benefits can be viewed by all participants. This feature of demonstrating clearly to stakeholders how public involvement literally shapes important choices such as corridor alignments and facility locations is a critical advantage of the methodology.

5.3 Highway Project Outcome Summary

When integrated into a wide-ranging multi-stakeholder involvement process the key advantages of the AMIS methodology compared with more traditional, unstructured methods are respect, transparency, flexibility and analytic capacity. In the pilot project, for example, AMIS encouraged the explicit incorporation of specific Purpose and Need categories in the initial stages. This opened a discussion that helped clarify the goals of route planning; a result that was not anticipated by the SHA participants but one that was regarded as fruitful. Moreover, during public consultation cave locations were identified and these were later incorporated. Prior to this phase the SHA did not know of the existence of the caves, their locations, or the strength of public feeling regarding their conservation.

Second, the early integration of stakeholder groups and the formalized approach to group priority-setting reduced the potential for conflict and enhanced the consensual strength of the outcome [11]. Once shown the decision system in operation, participants showed increased enthusiasm and willingness to cooperate ([12,13] for similar results in AHP applications). Enhancing "buy-in" is clearly critical to the utility and its partners.

Third, AMIS offered a customizable framework around which specific projects can be built. Planning priorities can be customized for individual projects, or planning priorities could be mixed over different sections of the same route. So while the process would be the same for different corridors, the values chosen and the comparative priority of goals might not be.

Finally, AMIS data collection permitted the elements and values solicited from stakeholder forums to be compared directly with the values generated by transportation professionals. This allowed participants to evaluate the extent to which professionals were in step with public constituents in determining environmental and other criteria that affected highway placement.

6 SIMILARITIES AND DIFFERENCES BETWEEN THE ROUTING OF POWER TRANSMISSION LINES AND HIGHWAYS

There are parallels between the problem of routing highways and that of routing power transmission lines. In both cases, the infrastructure is generally seen as a detriment to the visual landscape, while still providing certain generalized, non-aesthetic public benefits. Also, the complete impact of the infrastructure is heavily reliant on the ultimate routing alignment, so that a "build-no build" decision is partially dependent on the routing alignment. This means that the process of deciding *whether* to build a new transmission line must involve the public in a careful consideration of *where* it might go.

Certain properties of the transmission line routing problem distinguish it from a highway routing problem, and form important aspects of the research problem. Initially, a complex process decides the need for a new transmission line. In addition to power transportation issues, a number of other issues are considered, including system reliability, security, and ancillary services [14].

At the same time, the transmission lines' benefit to residents is certainly more spatially abstract and less immediately obvious to those in its proximity than is a highway. Because of their immediate physical presence in the landscape, highways have a greater total potential for creating barriers and hazards. Thus, habitat interruption and destruction are more extensive in the right of way for a highway than a power transmission line, and the nature of highway proximity drawbacks (noise, privacy loss, pollutants, and trash) are different than power lines (electromagnetic fields, interrupted views). Conversely, a highway offers the potential for immediate direct benefit to many people located near its right of way (depending on the access properties of the road). The benefits of a highway are also clear to those who will use it. Power transmission lines may not offer the promise of the same direct local benefit. Even if they do, the benefits are more difficult for a layperson to understand, especially if electric service is already reliable and reasonably priced. Transmission lines thus may take on more of the properties of a pure Locally Undesirable Land Use (LULU).

Thus the judgment of the public regarding the intersection of landscape features and transmission lines is likely to be qualitatively and quantitatively different than the highway problem. Because the process is flexible and accommodative, the differences should yield a new and interesting view of how the public views the transmission line routing problem. AMIS anticipates and accommodates this process by encouraging participants to provide the landscape features and the values to be attached to those features for purposes of the routing problem. By soliciting, gathering, and documenting this information, professionals can show how their process of route planning explicitly includes the public's input and wishes. Thus the public, through use of this process, becomes part of the solution process instead of fracturing into contending parties over competing alignments.

While both highway and power transmission line routing strive to discover the shortest practical route, the cost of distance in the highway problem is more or less directly proportional to distance. In the power line routing case, cost is a non-linear function: increasing distance may result in the need to shift the design specifications of the entire line once it exceeds certain critical distance parameters, and the need for a new line may not be an exact specification. For example, two neighboring utilities may agree that a new interconnect is needed to allow the sale of excess capacity from one to the other, and to improve reliability on both systems. There may be a number of points, which can be specified by the utilities, at which the two could be interconnected to achieve the goals. However, complex line routing, with excessive curves or turns in the line, adds to the line length. Increased length will add to the cost of the line simply because of the additional materials and construction needed for the increased length. Sophisticated construction techniques and components needed for complex routes will also increase costs above those of straighter routes.

The route, however, will affect the line's electrical properties as well. The primary electrical characteristics of a line are its thermal and stability limits, and its resistive losses. Thermal and stability limits determine how much power the line can carry. Thermal limits vary with ambient temperature and are a function of the size of conductors used. Stability limits depend on the size and configuration of conductors. Resistive losses are the power lost to heat during transmission, and they also depend on the conductor size. Thus, after a certain increase in length, larger conductors and more complex configurations, which may increase costs, will be needed. At some point the line will no longer be feasible. These issues and costs must be assessed in the routing process and will be considered in the proposed project.

While highway investment decisions are partly fiscal and partly political, the feasibility of an electric transmission line will largely be a financial decision, but it is a complicated process that is evolving as the industry restructures. Monetary values can be placed on future sales, on ancillary services, and on the cost of the line. Reliability and security issues are more difficult to price, but must be considered. Utilities should be able to give some guidelines at the start of the design/routing process for the route to remain within in order to be feasible. Guidelines might include defining a fairly large geographical corridor, and a maximum line length, and possibly other criteria. Such guidelines will put limits on the routing process up front, and constitute legitimate aspects of the overall research question.

Because highways must accommodate moving vehicles, the geometries of the horizontal and vertical curvature, width, and slope of the roadway must meet certain minimum requirements. As the capacity of the roadway increases, it must be straighter, wider, and flatter. However, the overall footprint of a power transmission line may be less closely linked to the capacity requirements of the line, and may allow more flexibility in the horizontal and vertical curvature properties of the final route. This may allow more innovative routing solutions to be devised.

Similarly, the engineering problems of crossing rough landscape may be significantly different, in that bridging problems are quite different between highways and power transmission lines. A highway, except for bridges, is continuously in contact with the land. A transmission line only has towers located periodically along its length, and their location can be designated to accommodate rough landscape.

Finally, because of the difficulty of acquiring right-of-way for publicly-used infrastructure, there may be an argument for shared right-of-way between highways and power transmission lines. The impact of widening existing roadway right-of-way versus acquiring dedicated right-of-way elsewhere may be a important consideration for the routing process.

The impact of these differences may well have significant impacts on how the decision surface is generated and how it is employed to address the power transmission line routing problem. Thus, while the fundamentals of the technical and process questions have been piloted in the AMIS highway pilot, significant questions remain to be answered to bring the engineering requirements and impedance landscape properties together into a satisfactory electric transmission line routing solution. Moreover, the project proposes the integration of advanced electronic polling technology to gather stakeholder input, allowing more participants to give their values per unit of research team time.

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RasterPlan: A TOOL FOR DESIGN OF QUANTITATIVELY DEFINED SCENARIOS

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ABSTRACT:

By developing framework plans on a large scale such as a country or a region, planners use economic prognoses which show future needs for space for new spatial developments expressed in units of surfaces. Planners and designers make drawings and sketches to show where those new areas will be situated, but they do not really measure the surfaces of spaces they created. This often leads to incorrect images which can be wrongly understood by actors in decision making. To avoid this problem the Netherlands Institute for Spatial Research developed a mapmaking software called RasterPlan. The purpose of this tool is to make design decisions quantitatively checkable and transparent. The maps which result from the RasterPlan are precise in geographical positioning and defining the surfaces of designed areas. RasterPlan allows realization of a quantitative program for future spatial needs for various functions such as housing, working, green and water areas, and recreation. In addition to quantitative calculations, qualitative criteria for location choice can be also expressed in a form of suitability maps or buffers. This paper presents an experimental implementation of RasterPlan for the design of a scenario for the future development of the Province North Brabant.

1 INTRODUCTION

Creating maps is an essential activity in spatial planning. Often maps show predicted future developments visualized in the form of sketches or vague drawings. According to Monmonier (1996) as a "scale model" map represents selective, incomplete picture of reality, where symbols used are bigger and thicker than the characteristics they represent.

The power of these images is actually underestimated because they can have large influence on political decisions and public opinion. Vast majority of maps users trust the maps because, "as with many things beyond their full understanding, they readily entrust mapmaking to a priesthood of technically competent designers and drafters working for government agencies and commercial firms….Map users seldom, if ever, question these authorities, and they often fail to appreciate the map's power as a tool of deliberate falsification or subtle propaganda" (Monmonier, 1996).

An example of such a map is the image of areas reserved for urbanization and national landscapes from the Fifth Act of Spatial Planning of the Netherlands. In this image, vertical grey lines show the areas which can be committed to urbanization. As the lines are dark and thick, they give the impression that large amount of the country will be completely built up, which is not what the text of the Act explains. Actually, the grey striped areas are only search zones within which some smaller areas will be developed as urban extensions. So, urbanization zones are only a framework for planning that will be later worked out by provincial or regional planning authorities.

As many participants in a planning process do not read the whole text of the plan, they assume that the images represent real plans, and do not realize that these images are just sketches. A sketch is never meant to be precise therefore when images have to show exact amount of space for future developments, other design techniques should be employed.

With the creation of Geographic Information Systems (GIS) techniques, many designers thought that GIS would be the solution to this problem. But although GIS is a powerful tool for spatial data collection and analyses, it is not frequently utilized in the design process. While the reasons for this are not the subject of this paper, we would like to mention the most important one—conceptually, GIS is a database and not a designing tool. The skills of a GIS specialist are different then those of a designer, and for that reason designers needs extra training to be able to draw in GIS. The strict logic of GIS is not fitting to designers' needs to quickly create sketches when needed. The complicated manner of drawing in GIS disturbs the flow of ideas pushing the design process from conceptual to technical aspects, which all together require more time and efforts than usual design techniques.

In the Netherlands Institute for Spatial Research, we often deal with predictions of future spatial developments expressed in quantitative needs for extension of housing, working, nature, water areas, or infrastructure. Therefore, we needed a simple tool which can be easily and quickly used to design realistic scenarios or alternative plans for future spatial developments. In order to accomplish this, the RasterPlan software was developed and implemented for an experimental design of a plan for the Province of North Brabant. The design of the plan was also conducted with two other methods Land Use Scanner (Ruimtescanner of The National

Institute of Public Health and the Environment - RVIM) and GIS based design method AGORA, developed by designers of our Institute. The three methods were then evaluated and compared. The emphasis of this paper is though on characteristics and potentials of the RasterPlan software.

2 CONTEXT OF THE RASTERPLAN AND ITS RELATION TO OTHER SIMILAR TOOLS

Since the 1960s, there have been concerted efforts to make possible robust representation of spatial problems embodied in functional models of the spatial system. In its most extreme form, this perspective assumes that spatial problems can be represented within functional models, that formal processes enable such problems to be consistently resolved, and their solutions tested using such models (Batty et al., 1998). As a result, a large number of functional models have been developed throughout the world. Those models in many cases use automatic methods, such as cellular automata, logit or agent based algorithms, to allocate the functions. One of the most known Dutch models which uses logit model for allocation is Land Use Scanner, which will be described later in the text.

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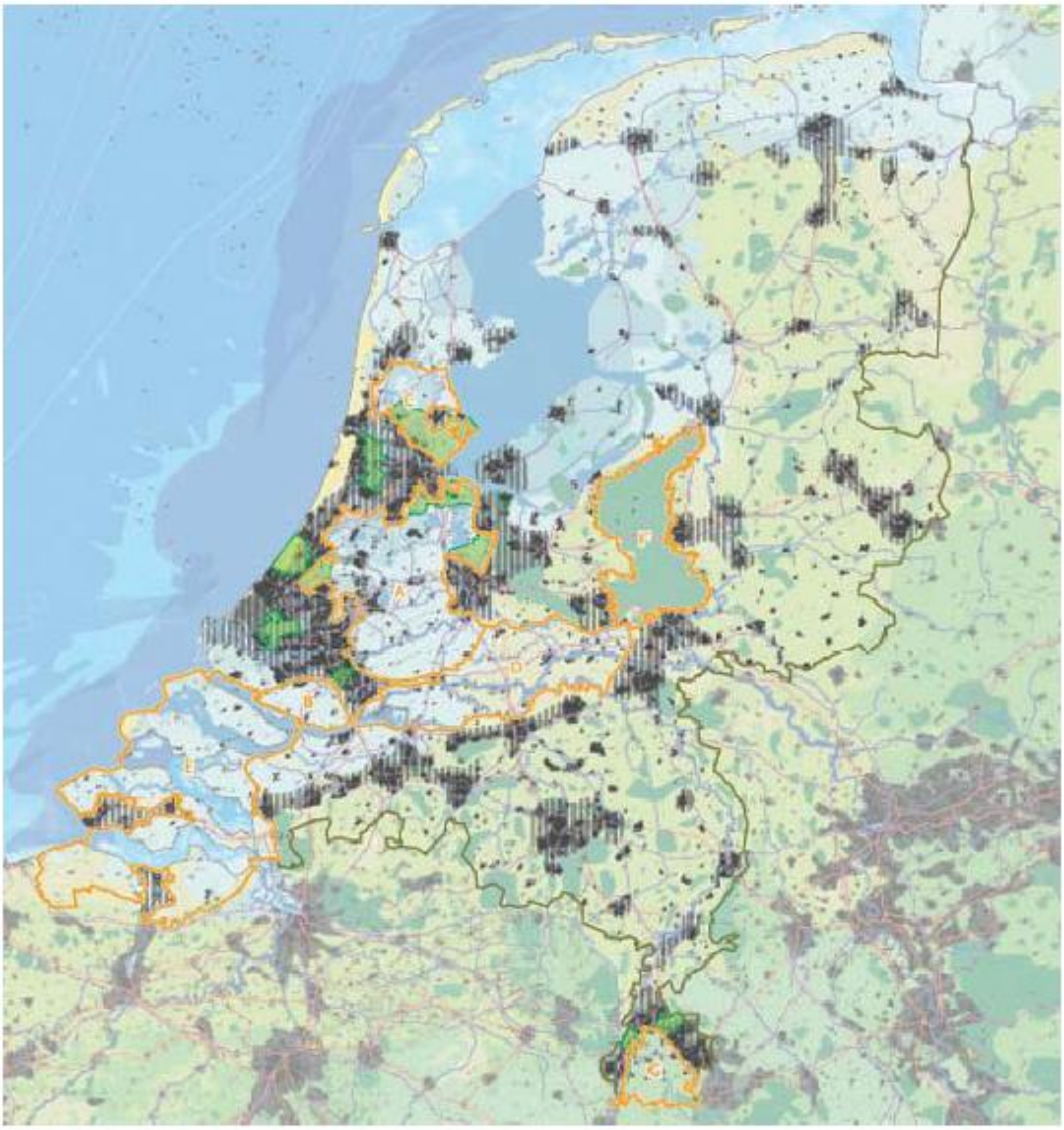

Figure 1. The Map of Urbanization Areas and National Landscapes from the Fifth Act of National Planning

RasterPlan is though not a functional model. It belongs to the other group of tools which will in this text be called Computer Supported Design Methods (CSDM). The basic difference between CSDM and functional models is that CSDM do not use any algorithm for allocation - a designer or a group of designers decide where to allocate which function.

The aim of allocation models is to formalize planning process, which gives an impression that planning is conducted in a quasi-scientific manner. Unlike allocation models, CSDM enable users/actors themselves to design and choose the strategy they want when developing an area. However, this action of design is supported by quantitative and qualitative information. In that sense CSDM differ from other design techniques and are closer to functional models.

There are many CSDM systems developed nowadays; they differ in their goals, and they are applied in different settings. Some of the goals are:

- to make design transparent and controllable,
- to predict or control spatial developments,
- to manage spatial information needed for the design process,
- to develop plan alternatives,
- to evaluate the impacts of plan alternatives,
- to support design decisions,
- to support actors decision making, and
- to promote and stimulate collaborative planning process.

The web site www.PlaceMatters.com gives an overview of currently used systems which are partly allocation models and partly CSDM tools. After a quick scan of CSDM systems and in consultation with world wide planning support systems experts, it is came out that the most elaborate and the most popular ones are Community Viz, Urban Sim, Smart Growth Index (with Paint the Town as its known implementation), and PlaceIt. However, because all of these systems are either model based or GIS based and therefore not completely usable for the purposes of our Institute, we decided to develop our own tool.

3 RASTERPLAN SOFTWARE

RasterPlan is a software which has been developed by the Netherlands Institute for Spatial Research in cooperation with the firm "Digital Architects." Unlike other types of software used for land use planning or allocation, RasterPlan does not rely on any kind of computational model such as cellular automata or similar algorithms. Instead, a designer or a planner decides where and in to which extent to allocate functions.

RasterPlan is programmed in Delphi language as a standalone application. This paper presents the first version of the software which was developed during the past year and has been used in one case study.

Technically, RasterPlan combines some basic GIS operations with simple drawing possibilities similar to those of Photoshop. It consists of three parts:

- a drawing section where raster images can be created,
- a calculations section which calculates land use changes, and
- a section that includes some simple GIS functions such as intersections and buffers.

The interface of RasterPlan looks partly like Photoshop (figure 2) and drawing functions work on similar way.

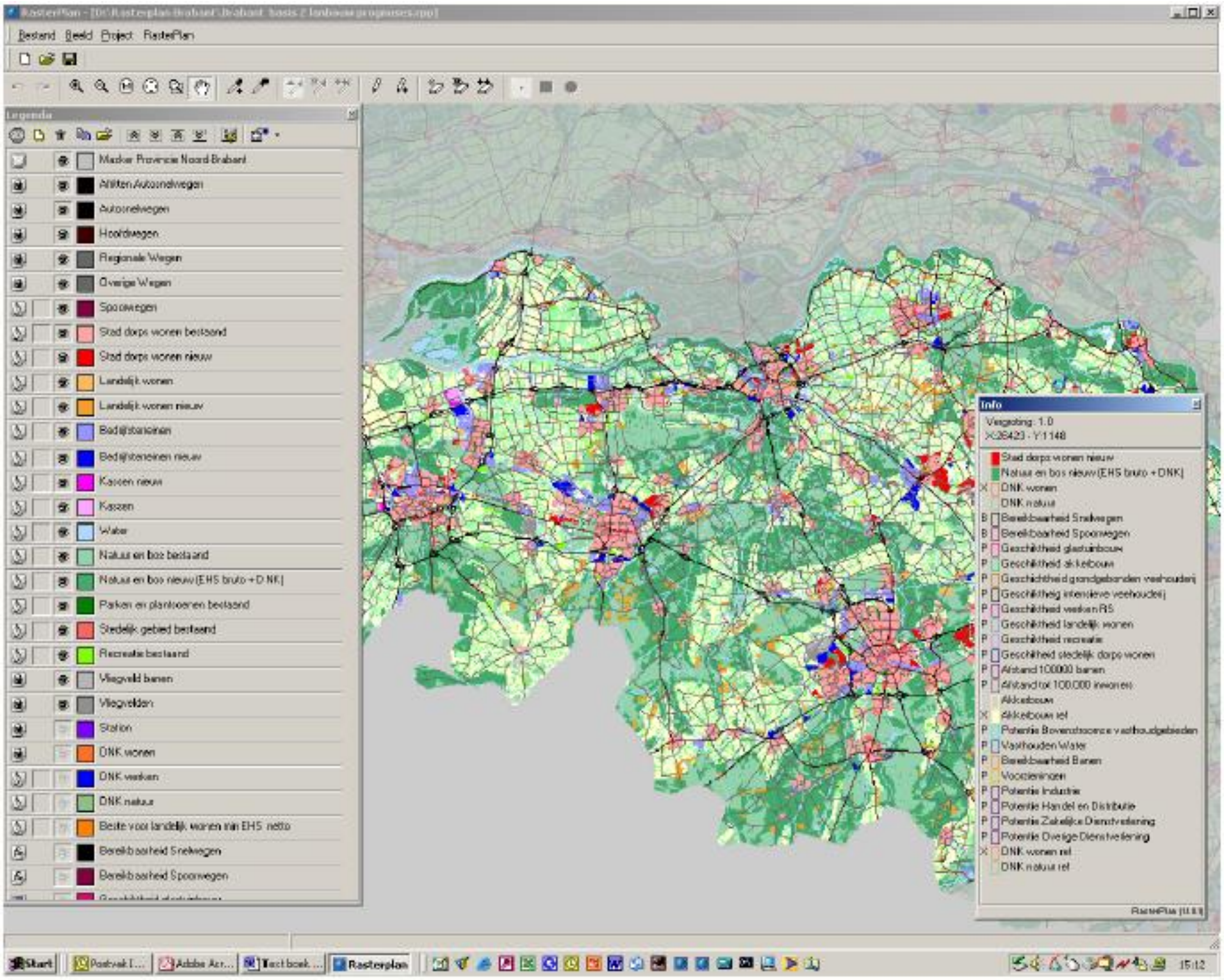

Figure 2. Interface of RasterPlan

As the name says, RasterPlan is a raster based drawing tool. The cell of the raster can be of different size, which is defined at the start up of a project. For the regional or state scale the proper size is 100 by 100 meters, 1ha. Cells of the map are the basis for all the calculations.

RasterPlan uses different kinds of maps and numeric data as input information. This data can originate from GIS and other software applications which can produce bitmap files. The maps are used as overlay information for spatial analyses, but suitability maps from functional models can also be imported and used as a reference for allocation.

RasterPlan combines drawing and calculation functions so that the sketch created can be quantitatively checked. The final product of this process is a map that shows the amounts and spatial distribution of new functions and a table that shows the changes in land use caused by this allocation. Such a map can be exported as bitmaps and used in other applications, while a table can be exported as an excel file.

As RasterPlan involves some features of GIS, it is also possible to perform qualitative analyses important for the choice of location for certain functions. For example, intersections and buffers functions can be used to produce usability maps or to find hotspots. Although technically it is possible to apply it to smaller scales, RasterPlan is designed for making large-scale scenarios, mostly on regional or above regional scale.

3.1 Implementation of RasterPlan on a Case Study of Province of North Brabant

Together with other two techniques – Land Use Scanner and AGORA, Raster Plan was used for the design of spatial development plan for the Province North Brabant. As a starting point for the design all three methods used a scenario study developed by Netherlands Institute for Spatial Research, Free University of Amsterdam (VU), Institute for Agricultural Economics (LEI-DLO), and The National Institute of Public Health and the Environment (RIVM). The scenario study was used to define quantitative and qualitative requirements for the spatial development of the Province.

There were two scenarios designed within the study. The scenario called “Individualistic World” was used for this experimental design. That scenario describes future developments in terms of quantitative program for new areas for housing, work, recreation, and glasshouses, which will replace agricultural land in the province. Next to the quantitative assignment, the scenario describes the main lines of spatial development. So, according to authors of the scenario, it is economic development which is the most important for the future of the Province, and everything that can contribute to economic progress is stimulated. The spatial consequence of such an approach is that more low density housing in attractive natural surroundings is needed. In the scenario the environment is only protected where it has high values, the rest is free for other functions. Agricultural production is represented by large and robust enterprises.

Table 1 shows the quantitative assignment used for the design with RasterPlan, Land Use Scanner and AGORA.

Spatial function	Number of hectares
Housing in urban areas	5780
Housing in rural areas	6898
Working areas	10272
Gashouses	99
Nature	105173
Recreation	3978
Agriculture	-127366

Table 1. Quantitative assignment for the spatial development of the Province of North Brabant

As one of the aims of the research was to compare RasterPlan with Land Use Scanner, for the analyses and location choice a number of usability maps originating form the Land Use Scanner were used as analyses layaers showing where is good and where not to allocate certain functions. Genarally, RasterPlan is not dependent on data or usability maps of Land Use Scanner. It is possible to conduct own analyses by using GIS functions in RasterPlan. It was in this case more for the practical reasons and time limits that we have chosen to import the maps from Land Use Scanner. Additional to those usability maps other information sources were used, for instance the New Map of the Netherlands to allocate new housing and the map of Ecological Infrastructure of the Netherlands to develop new nature areas.

Figure 3 shows the methodology of use of RasterPlan for the design of the experimental plan. Figures 4 and 5 show the existing map and the planned situation of the Province North Brabant which are the result of this process.

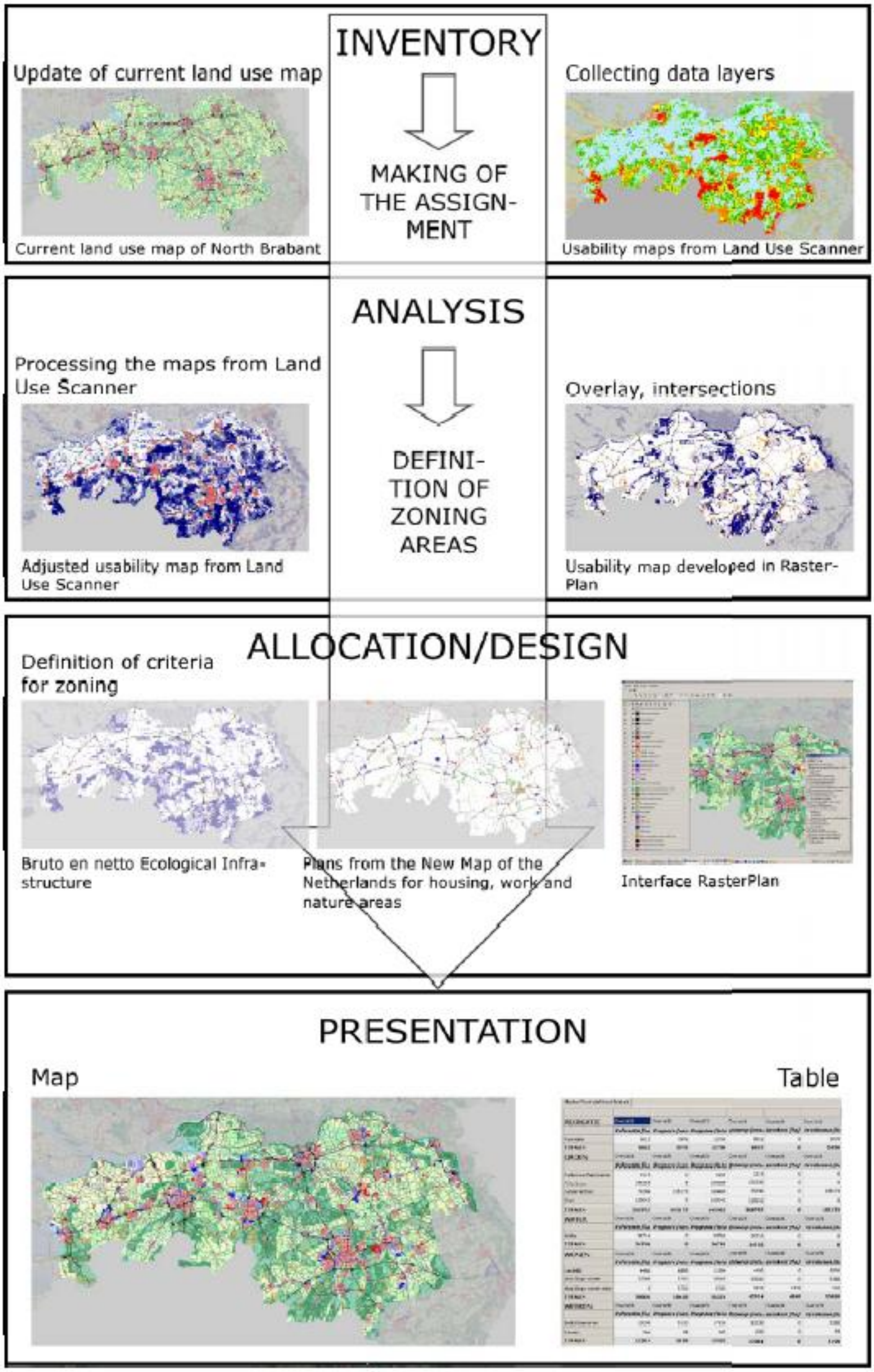

Figure 3. The methodology for the development of the spatial plan for the Province North Brabant.

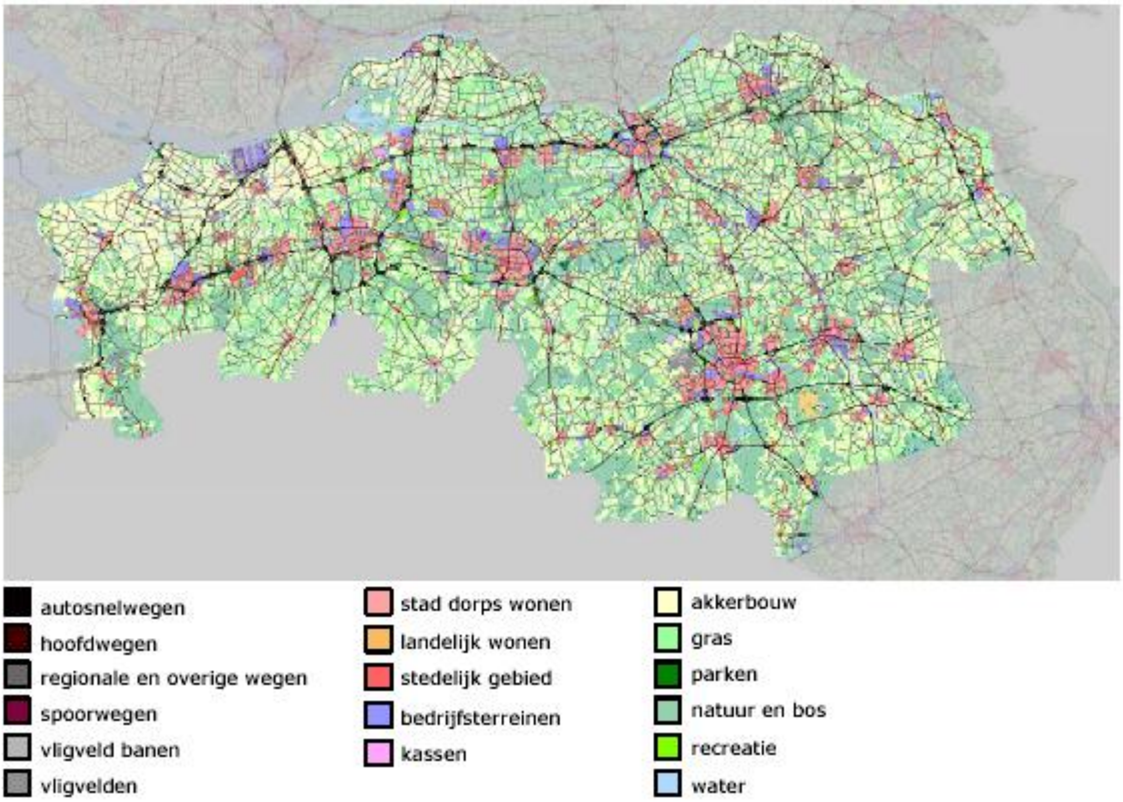

Figure 4. Map of the current land use in the Province of North Brabant made in RasterPlan

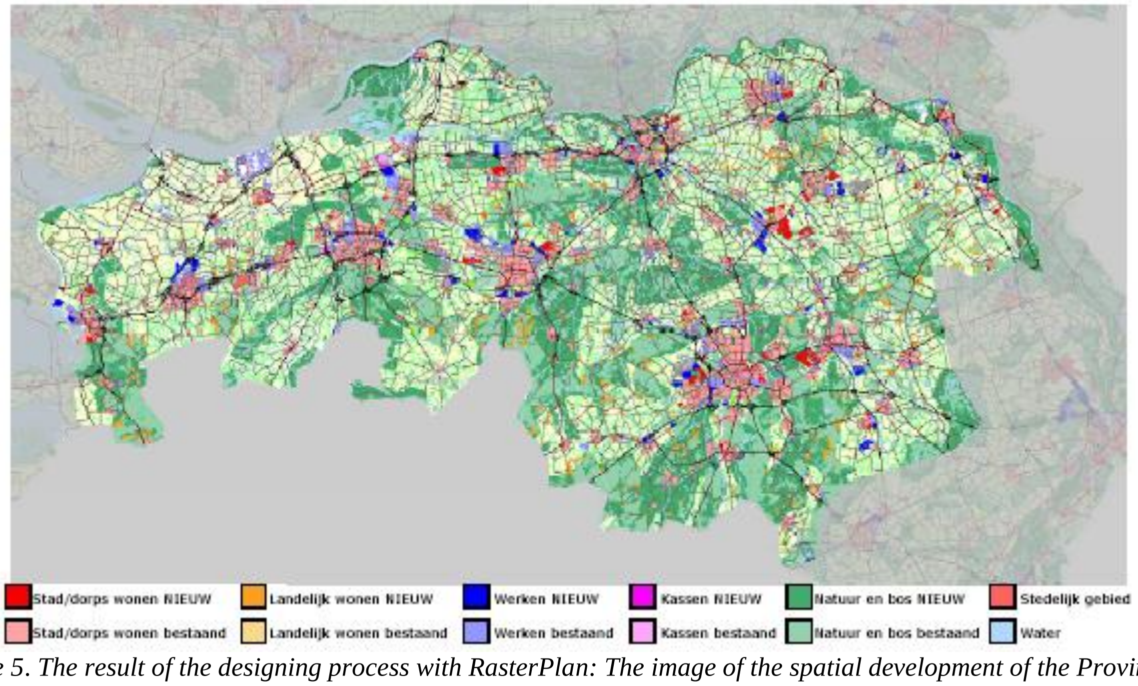

Figure 5. The result of the designing process with RasterPlan: The image of the spatial development of the Province of North Brabant till the year 2030. The grid cell is 100x100m; lighter colors represent current and darker colors future land use. To produce this plan the usability maps from Land Use Scanner were combined with national and local policy plans.

In this plan all the hectares required in the quantitative assignment (table 1) were realized. As a consequence the huge amount of agricultural land was converted to housing and nature areas.

The results of this experimental design are not meant as a definitive plan for the Province because design conducted with RasterPlan was in this case more oriented towards methodological aspects then to the content. Nevertheless, this exercise produced useful insights into a possible spatial development of the province if such a scenario as described above was to come true.

3.2 RasterPlan versus Land Use Scanner and AGORA

In this chapter we will describe other two methods which were also used for the allocation of the land use in the Province North Brabant: a functional model - the Land Use Scanner, and a design method named AGORA. Thereafter RasterPlan will be compared with these two methods.

The two methods were chosen for different reasons. The Land Use Scanner is the most known and used in the planning practice in the Netherlands, and AGORA relies on GIS and hence represents one more attempt to employ GIS in design.

The Land Use Scanner is a known method for land allocation invented by The National Institute of Public Health and the Environment (RIVM). According to its developers, the firm Object Vision, the Land Use Scanner (Ruimtescanner in Dutch) is a GIS based information system, calculating scenarios for future land use. A spatial allocation model, taken into account the current land use, the attractiveness for future land use and regional claims, is used to predict multiple views on future land use. The Land Use Scanner has been used for various spatial planning projects. It was amongst others applied for simulating the consequences of different planning perspectives and assessing the changes in land use caused by a possible new airport location (http://www.objectvision.nl). Figure 6 shows the result of allocation of land use in North Brabant which was conducted by Land Use Scanner.

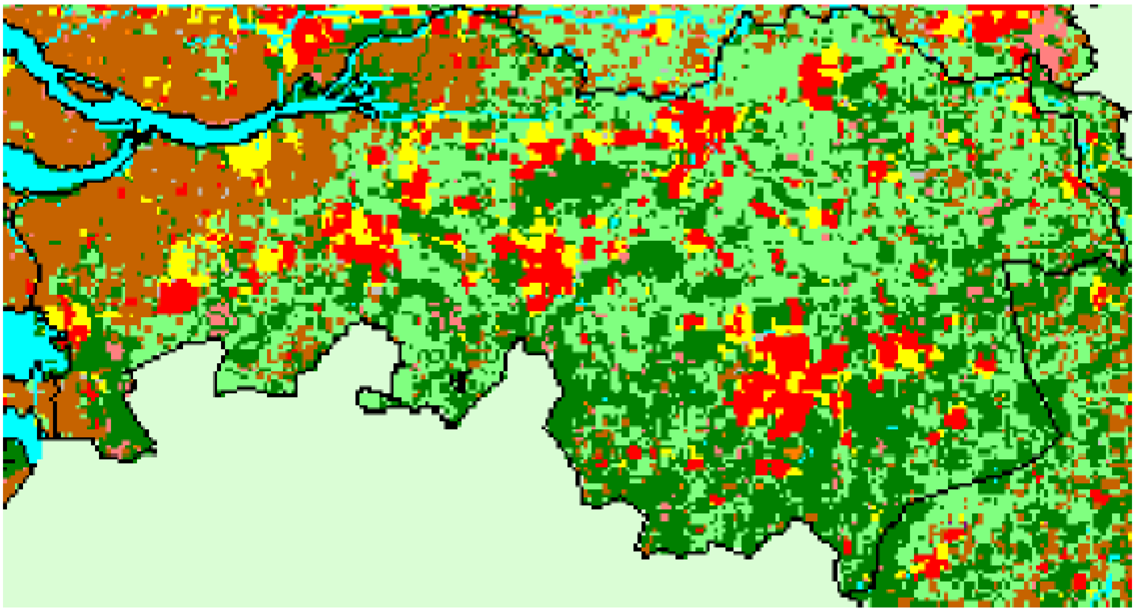

Figure 6. Future development of the Province North Brabant as a result of allocation by Land Use Scanner. Grid cell is 500x500m, only future land use is shown. The same usability maps were used for allocation as in RasterPlan.

AGORA stands for Analytic GIS-supported Spatial Allocation (Analytische GIS-Ondersteunde Ruimtelijke Allocatie). Basically it is a design technique which uses GIS for analyses but also for creating of future scenarios. In this case the ArcMap software was used to produce experimental plan for the Province North Brabant. Figure 7 shows the "plan" developed by two young urban designers by the means of ArcMap.

The table 2 shows similarities and differences between the three methods used. The table focuses on the most important criteria which were used to compare the three methods. There were also other criteria used but because of the lack of space they won't be considered in this article.

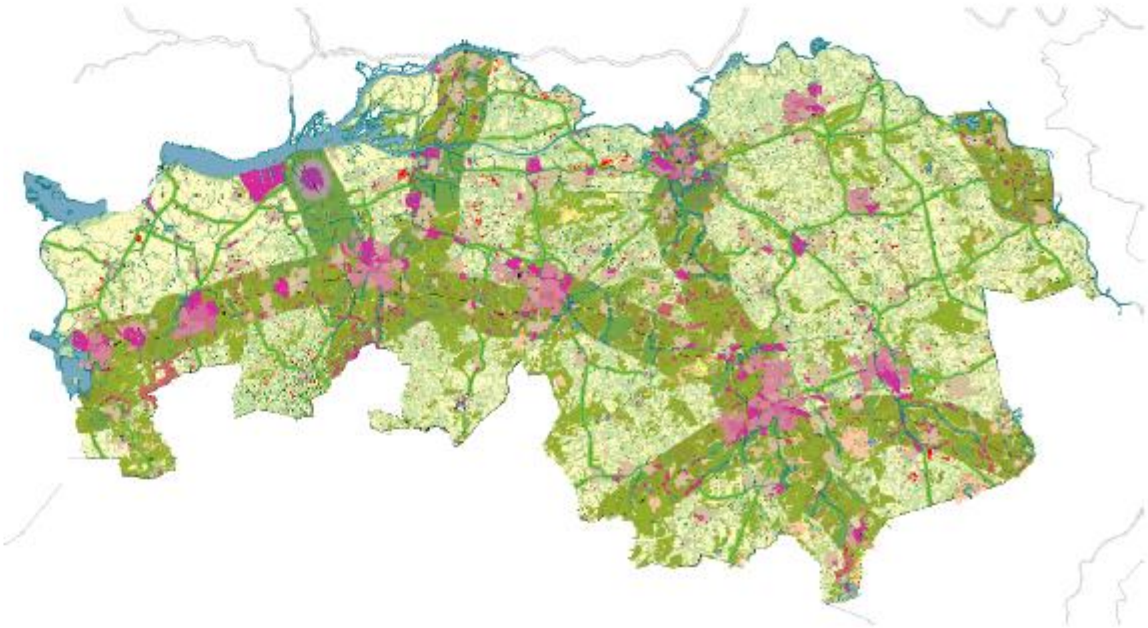

Figure 7. The plan for the Province North Brabant as a product of AGORA method. The vector drawing was produced in ArcView. The allocation is provoking and based on imagination rather than on realistic analyses

Criteria	Land Use Scanner	RasterPlan	AGORA
Grid	500x500m	100x100m	vector
Cell	conains more functions	one function per cell, possible to pile functions	
Legend	limited number of units, defined beforehand	unlimited and flexible number of units	unlimited and flexible number of units
Spatial requirements	defined by prognoses/scenario's	defined by prognoses/scenario's	defined by prognoses/scenario's
Usability maps	produced by model, input criteria defined by user	taken from Land Use Scanner and combined with own analyses	own analyses
Current land use	basis for allocation, but not visible in the final product	basis for design and calculation of land use changes, visible in the final product	basis for design and calculation of land use changes, visible in the final product
Future land use	defined by allocation model	defined by designers in RasterPlan	defined by designers in ArcMap
Product	map and a table of future land use, various evaluation maps	map and a table of future land use	map and a table of future land use

Table 2. Comparison of RasterPlan with Land Use Scanner and AGORA.

The three methods have a lot in common. The following similarities were found:

• The final products of all three methods are not predictions or plans.

• All three methods had as a goal to translate quantitative assignment of the scenario to plausible spatial images, and all three methods succeeded in that.

• The process of making of the maps was comparable because all methods went thorough the usual design steps: definition of spatial requirements, analyses, allocation, presentation and evaluation.

There are also considerable differences between the three methods. Those are:

• Land Use Scanner is an automatic method where creativity can be expressed only in the beginning of the analyses – by definition of usability criteria. By RasterPlan and AGORA creativity of the designer is present through almost whole process and employed in analyses, allocation and presentation phase.

• RasterPlan and AGORA can easily adjust to new and unpredicted situations, to new legend units and different spatial scales. Land Use Scanner is rather rigid in that sense.

• Allocation process of Land Use Scanner is better controllable and reproducible than the design processes in RasterPlan and AGORA.

Generally said Land Use Scanner attempts to simulate the process of change on more realistic manner, AGORA tends to create provoking solutions, while RasterPlan can achieve both.

3.3 Strong and Weak Points of RasterPlan

These initial experiments with RasterPlan highlighted many of its good points, as well as some weak points. Most of the weak points are of technical nature and occured because the software was developed a very short time. So although we knew that it is possible to make everything we missed we had not enough time to do it. As this is the very first prototype, its further developments will easily eliminate these weaknesses.

The strong points of RasterPlan are:

- Design can be quantitatively tested.
- Images, which are the product of design, are realistic.
- Alternative scenarios or hypotheses for spatial development can be easily created and tested in RasterPlan.
- It can be used individually of in workshop settings.
- No knowledge of GIS is needed to operate RasterPlan.
- It is user friendly and easy to learn.

Weak points of RasterPlan are:

- If the grid cell is small and the area large, drawing takes a lot of time. To improve this additional drawing tools (polygon and paint bucket) can be added to the software.
- The resulting images are geo-referenced and precise, comparable with topographic map. If input data are not accurate, mistakes are very easily seen in the final design. Therefore RasterPlan needs good underlying maps of existing land use, and it requires good knowledge about the area in concern.
- RasterPlan is not proper for vague sketch planning.
- Software is in the development stage so it still needs some technical improvements.

4 CONCLUSIONS

RasterPlan is a Computer Supported Design Method which makes the design process transparent and quantitatively checkable. The maps which result from the design process are precise in geographical positioning and in surfaces of designed allocation areas. RasterPlan allows realization of a quantitative program for future spatial needs for various functions on regional or state level, such as housing, working, recreation, green and water areas as well as networks of infrastructure and connections. Next to quantitative calculations, qualitative criteria for allocation can be expressed too. For that purpose RasterPlan uses some basic GIS operation.

RasterPlan is geared towards professional designers and planners; it is user friendly and compatible with GIS systems. It can be used either individually or in group settings. The tool can be actively involved in direct planning process where different actors can express their preferences and immediately bring them on the map.

Finally, RasterPlan is not meant for all design purposes, and has no intention of replacing existing allocation models or sketch techniques. Rather, its purpose is to enrich the assortment of tools which can be used either alone or in combination with other tools, such as Land Use Scanner and AGORA, to enhance the planners performance and products.

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reviewed paper

Emotional Co-respondence Links

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ABSTRACT

This contribution deals with a special design of participation processes for empowerment of participants. Usually this processes last for two or more years. The focus of the design of this processes is based on interdisciplinary research results about knowledge construction and decision making in groups.

As a planner I organize participative planning processes to develop a common goal in space. A participative planning process occurs in a shared constructed reality. Shared reality emerges out of *interaction* and *communication* in groups. My research results point out that concrete experienced emotional co-respondence in a group links participants and leads to grounded knowledge construction and decision making in participative planning processes.

In my planning practice I have organized the mutual experience of *concrete situations* to create co-responding structures between participants. Groups of people affected by a plan are invited to show me their daily environment, the "object" of the plan. We start our contact with walking together. I call this a *moved planning process*.

This paper analyzes the changing structure of the attentive subgroups of participants. Empirical evidence shows that networks between participants are strengthened because of the common experience in concrete situations. The usual structures are broken and new ones rebuilt by experiencing movement; an emotional co-respondence emerges. Walking contributes to the decision process in groups because it links participants in changed structures.

1 INTRODUCTION

Planners create a process of encounter with participants. In this process, information has to be emotionally and cognitively perceived and accepted by the group to arrive at decisions on future plans. Group awareness and group identity enable the participants to construct a shared reality. Shared reality emerges out of *interaction* and *communication* in groups. To point out how participants are linked I want to describe the phases of the moved planning process, the effects of shared experience of movement, and how concrete, experienced emotional co-respondence in a group links participants. This leads to grounded decision making in participative planning processes.

This paper analyzes my practical experience in planning in small rural towns in the light of different theories about interaction, communication, and understanding. It is based on a field experiment which showed how participants experience emotional co-respondence and the effects of this experience. Planning participation here is more than the transfer of information. It deals with knowledge construction and processes of decision making in groups. In other papers, the focus was on the relation between physically motion and emotional correspondence (Rottenbacher 2004), and on knowledge construction and decision making of a group (Rottenbacher 2004a). In this contribution, the focus is on the changing structure of the attentive subgroups. Networks between participants are strengthened because of the common experienced concrete situations. I discovered that walking contributes to the decision process in groups and links participants in changed structures. The research results about communication processes in groups relate to Barabasi´ s book "Linked" (Barabási 2003), in which phenomena of building networks are described. The result of this analysis is to identify the processes which strengthen the structure of the group in enabling an emotional co-respondence.

2 PHASES OF THE MOVED PLANNING PROCESS

To initiate a process of building trust I organize walks to create a shared situation. The aim is to break up the usual structure of participation and decision making in the village. Each meeting during the planning process is structured into a phase of walking and a following phase of sitting together to reflect. The arrangement enables a process of contact within the group. This I call an encounter of a group.

Welcome: Each meeting starts with a welcome, where I explain the aim and the structure of this meeting. People are asked to show me their daily environment. Then we start and go through the space to be planned.

Arrival: Initially the participants arrive in the situation, the location and the other arriving participants. Participants experience movement and space. They get familiar with the situation, find their style of interaction and take over roles as experts of their daily life.

Attending: During walking we identify the important topics and speak about them. We participate in a process and integrate new experiences and information.

Common decisions: During walking we see what has to be done. At the end of the meeting we sit together and collect ideas, recognize the needed activities and decide the next steps until the next meeting.

Sharing of responsibilities: Everybody is assigned a task to complete before the next meeting. The previous experience of a joint activity creates the motivation to contribute. Joint activities help to get into contact and to come to a mutual understanding.

3 SHARED EXPERIENCE OF REALITY

For communication it is necessary to get into *contact* and to come to a *mutual understanding*. Mutual understanding is possible if the participants have *co-responding* perceiving capacities and interpretation patterns (Schmid 2004). In my planning practice I have organized the mutual experience of *concrete situations* to create co-responding structures between participants.

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Our experiences are corporal and sensorial. If we meet in *concrete situations* our bodies tell about our experiences. This is a simultaneous perceiving and expressing. When we talk our bodies communicate information about our state and attitude (Argyle 1975). When we walk we simultaneously perceive, decode, and make decisions about our daily environment and on acting in it. Perceiving and expressing are shared actions, not individual actions. For example if people sit together and speak, they copy postures from each other. We all know how contagious yawning or laughing is. Depending on our empathy we feel the sadness of another close person in the breast or his anger in the stomach (Hakansson 2003).

Joint walking increases an *intercorporal* existence of the group. This intercorporal existence is the basic human experience of relationship. This existence contains all information of experiences and knowledge, and influences our feeling, thinking, and acting patterns (Merleau-Ponty 1966). In this intercorporal existence you can feel, see, and interpret the actions and intentions of other participants (Lewin 1951).

In the mutual experience of concrete situations communication is based on the expectation that all participants share this knowledge about capacities, practices and stances towards objects (Burkart 1998). The symbolic meaning of roles, things, and situations motivate movement and actions, and give a shared orientation. The capacity of people to understand the acting of the other is an evolutionary adaptation. Individual development differentiates from common actions (Geertz 1983). Older experiences are brought in as common sense, and symbols, used like gestures or words, get their meaning from the context implied and understood (Joas 1980).

During walking the meaning of symbols are related to the ever changing shared experiences. The previously constructed reality of individual participants often differs from the encountered reality during the walk. In our shared experience and speaking about it we explain our realities, our understanding of behaviour and symbols.

We progress from collecting data and abstract concepts to a common experienced reality. This ultimately touches upon the feeling of identity of the people affected (Damasio 1999). I am able to show them in which relationship their ideas stand to attitudes of society at large and norms, which are manifest in the use of space, and in the use of land.

4 GROUP INTERACTIONS

needs, wishes, aims, and tasks. In the A group is determined by group characteristics and participant characteristics. Groups consist of individuals. Each Individual is looking for security, communication, acceptance, acknowledgement, and cooperation. The dynamic of a group is more than the sum of the actions of participants (Lewin 1951). There emerges a dynamic, independent of the possibilities of the participants. In the *moved planning process* everyone gets the possibility of personal experiencing, communicating, and acting. Everybody finds space for personal *moved planning process*, I create a mood for mutual esteem to enable joint actions. Everyone is an expert of his or her personal life and must be respected for this and his contribution encouraged.

The first decisions at the first encounter in a participative planning process lead immediately to first realizations. The experience of the outcome of acting together develops a spiral of decisions, each related to realizations, which changes the base of interaction patterns of the group, the trust, and the tolerance in frustrations for further actions.

The main resources of group influence to increase dynamics are the personal attendance, the public obligation, the social contribution, and norms of the group.

4.1 Individuals

The personal acting has a self referential meaning to give continuity and identity to the own being and acting. The “I” is a live system which has emotional, spiritual, and cognitive abilities. It is adapting permanently to the changing environment. For the internal structure of self it is crucial to have self awareness for these changes and anchor it to ones own identity (comp. Damasio 1999, Varela 1997, Roth 2001) . We experience a personal history and we develop through our experiences. We acquire new competences through the contact with others.

From the base of this “I” we are able to get into contact with “You” and with the experiences of the “You” (Buber 1995). Within this context we are able to understand behaviour of the others as an expression of their “I”. At an encounter and during a walk this concrete context is strengthened. People find a common rhythm and breath, and have joint experiences. This immediate behaviour evokes patterns of existence and less patterns of thinking.

“I” experience with my feelings, bodily sensations, with my mood, and passions. “I” perceive and interpret with my mind. It is a continuous process of self fulfilment, perception, acceptance, integration, and takes new things in (Dreitzel 1992).

In the moved planning process “I” experience the changes of my environment, of my interactions, as effects of my acting. My bodily experience, in movement, between being a body and having a body, enables, that “I” express in movement my knowledge about this situation, and that it is possible to be seen and understood by others. In movement “I” experience, and reflect the concrete situation and make decisions on acting in it. In movement the integration of new emotional and cognitive experiences are contributed.

Essentials for the contribution of participative processes are that:

- Participants experience a personal development. Social interactions have an effect on personal development. The effects increase a self-organization of the group (Geser 1983).
- Participants experience repeated processes of socialization. They experience improvement, enlargement, and confirmation of their behavior, attitude, and acting (Dreitzel 1992).
- The behaviour of the participants depends more often on the actual situation than on previously developed thinking and feeling patterns. They speak more about current experiences and less about abstract opinions acquired from outside sources (Dreitzel 1992).

4.2 Subgroups

Independent of participant characteristics the participant take roles depending on group structures, emotions, affections, likes and dislike. During usual participative meetings participants sit around a table and expect motivation and ideas form the planner. They sit beside friends, building subgroups repeating the social structure of the village. The subgroups have about three too five participants. These subgroups remain mostly constant during the meeting. There are few possibilities for dissolving the groups and that the participants experience themselves mutually in a new context.

During the moved planning process we walk through the space to be planned and stop at special situations. This facilitates and sometimes forces the formation of new subgroups. According to emerging topics, participants build new subgroups.

The first encounter happens in the subgroups. There they find a common rhythm of steps and breath and experience concrete situations. In the subgroups, participants encourage others to report about their experience, about function and meaning of a special situation, to take on the role of an expert. In the subgroups they experience an emotional co-respondence of mutual understanding during walking.

They experience each other mutually in common walking and acting;

the shared emotional state increases;

common activities are arranged, first decisions are arrived at.

4.3 Group

Typically about twenty participants form the whole group. These are people responsible for, affected by, and interested in the outcome of the process. At the beginning it is a heterogeneous group. They bring with them different knowledge about the circumstances and do not have a base for interactions in that special group. This may evoke feelings similar to feel like a stranger. At the beginning, beside the official welcome, the participants of the subgroups start with offering contact. They try to find a familiar style of interaction.

An orientation is given by the structure of the encounter, they know, what we will do in the next two hours. During walking the whole group meets at special stations, situations. There everybody stops, tells about meanings of the things visible, and depending on the topics new subgroups continue.

After walking we sit together and reflect what happened. Old and newly built subgroups sit beside each other. Participants tell about their impressions, and their messages remain side by side (Johnson 1987). In the whole group the co-responding bodily states partially synchronize their mental situation. From physical and mental co-respondence participants reach a consensus about first topics because they “name” what they experienced immediately after this co-respondence. From unconscious experienced empathy they reflect and name what happened, what they perceived, and describe their joint expectations. At that point the planned future is anticipated, and grounded decisions are made.

5 EMOTIONAL CO-RESPONDENCE

The term "emotional co-respondence" comes from a therapeutic context. It is mostly used in person centered relations and in forms of gestalt therapy (Schmidt 2004). Emotional co-respondence describes the communication of emotion, questions and answers without words (Fuchs 2003).

5.1 Communication of Emotions

During encounter participants experience different emotions. Related to experiences of gestalt therapy and gestalt theory these special emotions increase accorded to the different phases of contact, which every encounter has. The encounter happens first during walking in the subgroups.

The first emotions participants experience are bodily feelings like attraction, you turn towards one person, or you turn away. You try to compensate feelings being strange or insecure with looking for a familiar situation, you turn towards known participants or towards new one, if they look interesting. There the bodily feeling of curiosity is stronger than circumspection (Dreitzel 1992). We can observe this getting into contact expressed in bodily movements, eye contact and the finding of personal space. These emotions are expressed and understood by the participants.

During contact increases an emotional co-respondence. Participants synchronize steps, and breathe, and reach a co-responding emotional state. In gestalt theory this is described as a change of contact boundaries. Within that phase boundaries are opened. The power for this opening comes from our need, our attraction. There our capacities for awareness, for orientation, and for acting are strengthened. Based on this experience at the contact boundary will and actions are motivated and expressed in movement (Hannaford 1995).

After reflecting in the whole group participants experience once more an emotional co-respondence when they talk about topics, which evoke emotions (Clynes 1989), (Smith 2001). There it is observable that they first get slowly in their motions, then they name their decisions, after they have named the decisions they show quicker movements.

5.2 Base for Interactions

To each personal movement (behaviour) belongs a shared movement (behaviour) (Merleau-Ponty 1966). Joint walking creates experiences together, namely the common rhythm of step, the regular breathing, the physical effort, and the feeling of fatigue. We perceive pictures with our senses and I move people to encourage their trust in their senses while moving the body. I encourage them to trust their own understanding of their needs.

Imagination and understanding emerges from our embodied experiences (Varela 1997). Human bodily movement, manipulation of objects and interaction, integrate recurring patterns and develop new ones. We are able to integrate information and transform it into knowledge in a mutual understanding. Joint activities bring up joint experiences; we manipulate objects and interact in the group. Experiencing actions together leads to a mutual understanding in that special situation.

Participants in groups recognize behaviour, character, state, and attitude of others nonverbally (Fuchs 2003). During a meeting participants find a corresponding style of interaction. They improve this style of interaction and communication until they feel comfortable. Often nonverbal communication in groups is ambiguous and tentative.

This context is the backdrop for concrete understanding between participating persons. This relation becomes apparent in behavioural patterns, through acting, and physical movement. It opens the structures of social interaction and renews a new base of contact. The participants experience themselves mutually within every new meeting and the structure of interaction in the concrete situation is defined anew.

Participants develop new roles and test them in new behaving patterns. This is the pre-condition that they are able to perceive new contents and information, and integrate it into their personal experience, knowledge, and acting. This flexible interaction enables to anticipate and imagine the future

6 NETWORKS

6.1 Regular and Random Networks

Watts and Strogatz (Watts and Strogatz 1998) defined two extremes of small world networks, namely

regular networks, wherein nearby nodes have large number of interconnections, and distant nodes have few; and

random networks, which are uncluttered, and have a short path length. The randomness makes it less likely that nearby nodes will have lots of connections, but introduces more links that connect one part of the network to another.

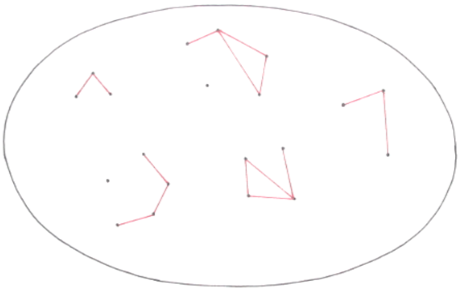
The initial situation in a planning process in a village is closer to a regular network, with strong ties in established groups. During the moved planning process, unexpected links are created. This reduces the path length in the network and allows information – but also emotional co-respondance – to spread more quickly. Nodes have access to more information, and can realize more ideas. Correspondence through shorter path in the network brings synchronization and collaboration in groups. We may relate emotional correspondence to small world networks:

process of interaction in groups **in concrete situations**	**building of networks** **participants are linked**
getting contact	network - structure
trust	↑
emotional correspondence	
mutual understanding	context - meaning + understanding
decision making	content - feeling + naming
realization	↓
	function of participation - meta level

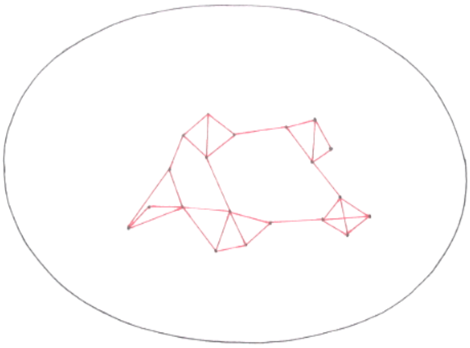
6.2 Networks of Participants

The concrete experienced situations lead to an emotional co-respondence, and the base for interactions is getting better. Trust increases. The common experience of outcome of decisions and realizations lead to a growing tolerance for frustration. Not all wishes of the participants have to be fulfilled right now. The interaction base survives negative experiences and frustrated expectations.

How participants get more and more linked is shown in the next two figures.

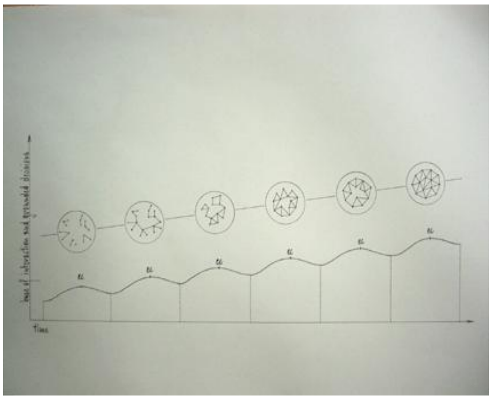


This figure shows the usual structure of the whole group. The subgroups build by the participants relate to the social structure of the village.



After an encounter and after experiencing concrete situations in emotional co-respondence, participants are better linked.

During the moved planning process we have more encounters. The next figure shows the development of the interaction patterns and how participants are more and more linked.



7 ESSENTIALS

Joint walking increases the intercorporal existence of the group. This intercorporal existence is the basic human experience of relationship. It contains all information of experiences and knowledge, and influences our feeling, thinking, and acting patterns. This intercorporal community is important to reach a co-respondence for decision making.

In concrete situations participants experience an emotional co-respondence in the first subgroups. The usual structures of interactions are dissolved and new ones rebuilt. During the moved planning process participants get more and more linked. An essential part of this planning process is to recognize joint tasks and assign duties and responsibilities. The support of self perception, self-confidence, and joint activities leads to grounded decisions.

For a grounded decision it is necessary that participants experience the concrete situation and use less abstract constructions. They experience themselves mutually in acting, movement, decision making, realization step by step, and within the shared experience of outcome. Immediately within the first meeting we realize small steps. Small successes support the process of decisions and acting, and create a shared self consciousness and a shared identity of the group. The shared self consciousness of the group accumulates over multiple interactions, because participants are linked.

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Complexity vs. Security in the Austrian Land Register

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1 LAND REGISTER AND LAND PROPERTY

The design of processes is a difficult task. Inappropriate design can increase processing time dramatically in computer programs and non-computerized administration as shown by Hammer and Champy (Hammer and Champy 1995). Public processes like spatial planning are examples for complex processes. Spatial planning must consider various requests. Errors in the planning processes may result in unsatisfying spatial situations and correcting these situations produces additional costs. The result of the process shall thus be correct, i.e. the risk of producing a faulty result shall be minimized. On the other hand, a process should be as simple as possible since simple processes are faster and cheaper.

It is a general assumption that the reduction of risk increases the complexity of a process which we will substantiate in this paper. As an example we use the transfer of land property in Austria. We use this example because the goal is clear and the number of actors is limited. We will start with the simplest situation where persons are involved who completely trust each other. Then we will gradually remove risks and show how the process becomes more complex.

Like spatial planning land registration is a public process. The process of land registration contains a number of tests to make sure the process is correct. The complexity of the tests varies in different countries but still they have a result which can be verified (Bittner and Frank 2002). The transfer of rights on land is an example for such a process:

In case of registration of title like in Austria transferring rights on land is quite complex (Navratil 1998). The transfer must be registered and requires a document that is checked in different ways. For example, the right must be in accordance with the Austrian laws and the person transferring a right must hold that right and must have the right to share it. No disputes may arise since all checks have been performed.

In case of registration of deeds like in the US the process is much simpler (Onsrud 1989). Documents are checked only if there are different opinions about the current legal status. This simplifies the process of transfer dramatically. In case of dispute, however, the process becomes more complex, since all documents registered for the piece of land are require checking.

The example shows that systems designed for the same purpose (securing rights on land, especially property) may have different design. Bogaerts and Zevenbergen separated seven aspects where the designer can select from different alternatives (Bogaerts and Zevenbergen 2001). Some of these aspects only influence the organization (centralized or decentralized, land registration with separated or integrated cadastre) or the financial system (by government or self-supporting). Other aspects influence the data provided by the system and the risk for the user if he uses this data. Comparing the design of systems in the cadastral domain is difficult as shown in (Frank 2004).

2 COMPLEXITY OF SYSTEMS

Different aspects of processes provide a measure for the complexity of the process. One of these aspects is the number of participants. Processes with a small number of participants are simpler than processes with a large number of participants. The number of steps in the process is another measure. Additional steps complicate the process. This section introduces some definitions on complexity, security and complex systems. We then clarify our definition of the term complex system and its implication on the Austrian land registration system.

Complex systems are lately used as a synonym for *system theory*. System theory has been founded by scientists like Ludwig von Bertalanffy (biologist) or William Ross Ashby (psychiatrist) in the last century (REFERENCES!!!). Its focus is the study of systems. A *system* can be defined as a composition of *components* that interact with each other in order to facilitate the flow of information, matter or energy (http://en.wikipedia.org/wiki/Systems_theory). Research in system theory is interdisciplinary ranging from biology, mathematics, physics, computer science to philosophy, sociology and economics.

System theory studies the interaction between parts. A pile of sand is an example for a complex system. The interactions between the grains of sand cause the special shape of the pile. The interactions can be represented in terms of a formal or mathematical model.

Procedural complexity is defined in computer science. The O –notation can be used to determine the costs of an algorithm. It allows to classify algorithms according to their costs in terms of time and resources (Knuth 1973)

Abbreviation	Complexity = Costs	Intuition: 1000 x input
O(c)	constant	… same work
O(log n)	logaritmic	…10 x work
…	…	…
$O(2^n)$	exponential	… hopeless

Table 1: Measuring the complexity of an algorithm using the O-notation

Several definitions of system complexity have been given in literature. Some authors are very critical about measuring the complexity of a system: Silvert claims that complexity is a property of models and not of systems. The model being an abstract simplification of the world or a snapshot of the world at a certain point of time. Complex things are sometimes described with simple models. The "complexity of an object is in the eye of the observer" and therefore measures for system complexity are either invalid or of very limited applicability unless they take the role of the observer into account (Klir 1993; Silvert 1996).

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It is our belief that complexity comes from the interaction of simple parts. Complex systems are defined as a hierarchy of linked subsystems. The communication between components is of vital importance for the success of a complex system. Many software projects failed because the communication between the components has been ignored when integrating them to a complex system (Brooks 1991).

In order to design a complex system subsystems have to be identified and designed. The present model is in the domain of land registration and therefore relates to geoinformation. A critical review for component based GIS has been given by Timm and Riedemann (Timm, Riedemann et al. 1998). Geoinformation science proposed several mechanims to reduce complexity. Hierarchies in terms of classification, aggregation and generalisation have been investigated (Timpf 1999). Frank proposes a multi-tiered ontology to separate the physical world from observations, cognitive models and agent theory (Frank 2001).

In systems like the Austrian land register, as well as in other economic systems agents have a high priority for protection against risk. Agents will therefore aim for security. We mean security in the sense of the state of being free from danger or injury. Wordnet gives still six other definitions of security (Fellbaum 1998).

In the next section an agent based model of a system for the Austrian Land Register will be introduced. The complexity of the system will be defined by an increase of agents involved in order to prevent risk. Additional measures of complexity are the time taken for a certain transaction in the system and the costs connected to it. Security are all actions taken to prevent risk. Risk being the possibility of economic loss.

3 TRANSFER OF OWNERSHIP – THE SIMPLEST CASE

The Austrian land register is a register of title. Thus the data provided by the land register is assumed error free and up-to-date. Problems may occur, however, if rights need not or cannot be registered. The land register is intended for private rights only (property, right of use, right to draw water). Restrictions emerging from public law are not registered. On the other hand transfers cannot be registered if it is not evident that there is a transfer. In law creates the transfer based on a fact (acquisition of property by using the land more than 30 years in the belief that it is one’s property, inheritance) then the register may be out of date. Another problem is the up-to-date-ness, which depends on the cycle of database-updates. The updates of the Austrian land registration database are done each day at midnight. Thus there may be a registered document that cannot be seen in the land register.

One of the major principles of the land register is the principle of priority (Krejci 1995, p.179; Twaroch 1998). The principle of priority states that the document registered earlier is more important than the document registered later. The position in the list of documents is called rank. Conflicts can be solved easily: The document registered later is invalid.

The transfer of land in Austria consists of two steps. The first step is the creation of a contract documenting the transfer of property. The second step is the registration of this document in the land register. This contract must contain

an identification of the piece of land affected by the contract,

the right transferred (in our case the right of ownership),

the price,

the person transferring the right,

the person receiving the right,

the signatures of all involved persons, and

the date of signature.

The simplest case of property transfer is the following: A person (the seller) wants to sell land to another person (the buyer) for a specified price and the following conditions are met:

The buyer has the necessary money.

The persons trust each other.

Buyer and seller set up a contract containing all necessary information and sign it. They set up an irrevocable declaration that the transfer can be registered, the ‘Aufsandungserklärung’, which is comparable to the quitclaim deed. The quitclaim shall remind the seller that he gives away a right. It is usually a small paragraph which is part of the sale contract. The signatures are done in front of a notary. The notary certifies that the seller signed out of his free will. The seller then receives the payment and the buyer receives the documents, especially the quitclaim. The buyer finally uses the documents to register the transfer at the land register.

This process involves four agents: Buyer, seller, the notary, and the land register. The process consists of the following steps (see also table 1):

Setting up the contract.

Signing in front of the notary.

Exchanging quitclaim, payment.

Registering the transfer at the land register.

The process can be completed in less than one day. Setting up the contract is easy following a model contract. The meeting with the notary can be arranged so that the buyer can register the transfer the same day the documents are signed. Costs arise at two places: The notary receives payment for the certificate and the land register receives payment for the inscription. In addition taxes have to be paid.

Step	Agents	Result
setting up contract for property transfer	buyer, seller	document of sale, which can be registered at the land register to complete the property transfer
signing of the contract and other necessary documents	buyer, seller, notary	signed documents (document of sale, quitclaim), certification of the notary stating that the signatures were done voluntarily
exchange of documents and payment	buyer, seller	seller receives payment, buyer receives documents necessary for registration
registration of property transfer	buyer, land registry	buyer registers the transfer and completes the process of property transfer

Table 2: Steps of the simplest form of property transfer

4 ELIMINATION OF RISK

The simplest case presented in the last section contains two risks:

The seller may not be owner of the land.

The owner may sell the parcel twice.

4.1 Buying from the right Person

A problem for the buyer will occur if the seller is not owner of the land. The risk for the buyer is that he pays receives no right of ownership. The right of property can only be transferred from one person to the other. The process demands that the person transferring property is owner of the land. Thus the buyer has a claim for repayment, which he must enforce.

The land register provides evidence for land property. The easiest solution to solve the problem of the buyer is thus to demand an up-to-date copy of the land register. This copy at least proves that the seller was the owner at the date the copy was created. The copy complicates the process in two ways: It adds a step to the process (the seller has to obtain it) and adds costs.

Step	Agents	Result
obtaining copy of the land register	seller, land register (ev. notary)	proof that the person selling the land owned the land at the time the copy was obtained, reduces risk to buy from wrong person
setting up contract for property transfer	buyer, seller	document of sale, which can be registered at the land register to complete the property transfer
signing of the contract and other necessary documents	buyer, seller, notary	signed documents (document of sale, quitclaim), certification of the notary stating that the signatures were done voluntarily
exchange of documents and payment	buyer, seller	seller receives payment, buyer receives documents necessary for registration
registration of property transfer	buyer, land registry	buyer registers the transfer and completes the process of property transfer

Table 3: Steps for property transfer with protection against purchase from the wrong person

4.2 Precaution against selling twice

4.2.1 Problem description

The remaining risk is that the seller already sold the land and the copy of the land register was obtained prior to that sale. This risk can be reduced by accessing the land register online. The notary, for example, has access to the land register via Internet. This again increases the costs for the notary but still leaves risk because the database of the land register is updated every 24 hours (during the night). Thus the data is a few hours old and it is not possible to get more recent data. A solution for this problem would be that the notary and the land register are in the same office. However, this would restrict the right on free choice of notary.

In the current siruation the data is not completely up-to-date. Even if inspecting the database online it may happen that the seller tries to sell the land to two persons. If he does this at the same day nobody will be able to notice it since registered documents will only be visible the next day.

Selling twice results in two different outcomes:

The buyer who registeres the transfer first receives ownership. He is now the registered owner of the land.

The buyer who tries to register later receives no ownership. The problem of this buyer is that the quitclaim is signed by a person who is not owner of the land. Only the current owner can transfer ownership and therefore the transfer cannot be registered. He does not lose anything but he will have to enforce his claim of repayment.

The problem for the buyers is that only one of them will become owner of the land. The other person will have to sue the seller to get his money back. The decision, which of the buyers will become owner is simple: The person registering his documents earlier is the new owner. The other person would try to register documents signed by a person that is not the owner any more and thus the documents must be rejected. The problem is to eliminate this risk for the buyer.

4.2.2 Austrian solution

The Austrian solution for this problem is the ‚Anmerkung der Rangordnung'. The ‚Anmerkung der Rangordnung' acts as a placeholder in the series of documents. The property owner can apply for a rank certificate (the ‚Rangordnung'), which is proof of priority. The rank certificate has the time stamp of the application and grants a certain position in the list of documents. The rank certificate is only valid for one year and there is only one copy of it. It is also visible in a copy of the land register.

The registration of a document together with the rank certificate causes the document to have the same position in the list of documents (the same priority) as if it has been registered at the time the owner applied for the rank certificate. Since the rank certificate is visible in the copy of the land register the buyer can demand receiving the rank certificate. The registration of the property transfer will then have the rank of the rank certificate. The transfer will be valid even if the land was sold twice and the other transfer was registered earlier. Since this has been done after the application for the rank certificate the buyer who has the rank certificate can remove all transfers registered after the rank certificate.

Figure 1 shows the principle of the rank certificate. Situation a has one valid transfer registered which thus has rank 1. The owner then applies for a rank certificate (situation b). Then the two transfers B and C are registered (situations c and d). Both transfers have a lower priority than the rank certificate. Transfer B is registered together with the rank certificate and thus receives the rank of the certificate itself. It now has priority over Transfer C (situation e). If the transfers are property transfers then the transfer B becomes invalif and can therefore be deleted (situation f).

a	b	c
Transfer A in rank 1	Transfer A in rank 1	Transfer A in rank 1
	Rank Certificate	Rank Certificate
		Transfer B in rank 3

d	e	f
Transfer A in rank 1	Transfer A in rank 1	Transfer A in rank 1
Rank Certificate	Transfer C with RC in rank 2	Transfer C with RC in rank 2
Transfer B in rank 3	Transfer B in rank 3	
Transfer C w. RC		

Figure 1: Principle of a rank certificate

The rank certificate adds another step to the process. The seller must apply for the rank certificate. This can only be done directly at the land register and the seller must pay fees.

Step	**Agents**	**Result**
applying for proof of priority	seller, land register	document granting a specified rank
obtaining copy of the land register	seller, land register	proof that the person selling the land owned the land at the time the copy was obtained, reduces risk to buy from wrong person
setting up contract for property transfer	buyer, seller	document of sale, which can be registered at the land register to complete the property transfer
signing of the contract and other necessary documents	buyer, seller, notary	signed documents (document of sale, quitclaim), certification of the notary stating that the signatures were done voluntarily
exchange of documents and payment	buyer, seller	seller receives payment, buyer receives documents necessary for registration including rank certificate
registration of property transfer	buyer, land registry	buyer registers the transfer (including rank certificate) and completes the process of property transfer

Table 4: Steps for property transfer with protection against purchase from the wrong person and double sale

5 BUYER BUYS WITH MONEY BORROWED

There are two possibilities how credit institutes can be connected to the property transfer. The credit institute may provide the money for the purchase or the land is encumbranced by a mortgage. Mortgages are a guarantee for credits. Mortgages allow the beneficiary to demand foreclosure sale of the land connected to it. The proceeds of the auction will then be used to repay the credit and the former owner of the land receives the remaining money.

5.1 Credit Institute Providing the Money

The credit institute may provide the money necessary if the buyer has not enough money. The credit institute takes a risk if granting a credit. The credit institute loses the money if the borrower cannot pay the money back. Credit institutes developed several strategies to reduce this risk. We only look at mortgages as guarantee for the credit and disregard all other possibilities like insurance or distaining upon the salary. The reason for this restriction is that only mortgages influence the process of property transfer.

The problem is that the credit institute would require the mortgage at the same moment the borrower receives the money to restrict the risk of fraud for the credit institute. At that time, however, in case of property transfer the borrower is not yet owner of the land and cannot grant the mortgage. Each of the three agents provides and receives something:

The credit institute provides money and receives the approval to register a mortgage.

The seller provides the documents necessary for the property transfer and receives the money.

The buyer provides the approval to register the mortgage and receives the documents for the property transfer.

5.2 Credit Institute as Beneficiary of a mortgage

A credit institute may also be involved in the property transfer if there is already a mortgage connected to the land. In this case the buyer will want to get rid of this mortgage. This is easy if the credit has been repaid. The credit institute (the beneficiary of the mortgage) will then permit the deletion of the mortgage and the owner of the land can apply for deletion. The credit institute will ask for the money if the credit has not yet been paid back. This situation is similar to the situation in 5.2. Again each of the agents provides and receives something:

The credit institute receives the money and provides the approval to remove the mortgage.

The seller receives the remaining money and provides the documents necessary for the property transfer.

The buyer provides the money and receives the documents to register the transfer and remove the mortgage.

5.3 Combined Situation and Solution

Figure 2 shows how a combination of these two aspects leads to a situation with circular dependencies. The buyer requires the documents of property transfer (document of sale, rank certificate, and quitclaim) and the permit to delete the existing mortgage. In exchange he offers the money, part of which the seller hands over to the credit institute, which is the beneficiary of the existing mortgage. Since the buyer must borrow the money he asks a credit institute for it and offers a mortgage as guarantee for the credit. Unfortunately he must be owner of the land to permit the registration of the mortgage. Since he needs the money to become owner and must be owner to get the money the situation results in a circular dependency.

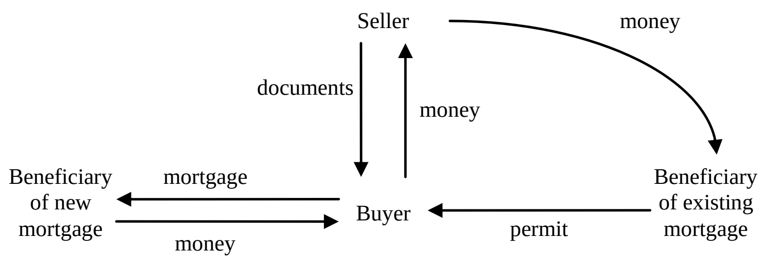

Figure 2: Exchanges for the property transfer

This situation contains risk for each of the agents. One of the actors must provide his part without receiving immediate return. Let's assume that the beneficiary of the new mortgage provides the money without receiving the mortgage immediately. There is the risk that the 'buyer' does not buy the land and permits the inscription of the mortgage. In this case the credit institute will have to perform legal steps to get the money back, which will be expensive in terms of time and money. If, on the other hand, the seller and the beneficiary of the existing mortgage agree to provide their documents it may happen that they do not receive their money. In this case they would have to perform legal steps. The situation thus requires a solution which reduces the risk for all involved actors.

The solution is the introduction of a trusted person. This person collects the money (or the promise to provide the money), the signed sale documents, and the permit to remove the existing mortgage. The person then provides each actor with what he needs:

The buyer receives the documents necessary to register the sale and delete the existing mortgage,

the beneficiary of the existing mortgage receives the outstanding money,

the seller receives the remaining money, and

the beneficiary of the new mortgage receives the document necessary to register the mortgage.

The trusted person is usually the notary since he is already involved in the process and he is a person of public trust. The notary then organizes the whole process and usually does not only collect and distribute money and documents but also registers the changes at the land register. Of cource this service is not free of charge.

Step	Agents	Result

applying for proof of priority	seller, land register	document granting a specified rank
obtaining copy of the land register	seller, land register	proof that the person selling the land owned the land at the time the copy was obtained, reduces risk to buy from wrong person
asking for credit	buyer, new credit institute	promise for credit
ask for deletion of mortgage	seller, old credit institute	permission to delete existing mortgage if credit repaid
setting up contract for property transfer	buyer, seller	document of sale, which can be registered at the land register to complete the property transfer
signing of the contract and other necessary documents	buyer, seller, notary	signed documents (document of sale, quitclaim), certification of the notary stating that the signatures were done voluntarily
exchange of documents and payment	buyer, seller, notary, both credit institutes	seller receives payment, buyer receives documents necessary for registration including rank certificate
registration of property transfer	notary, land registry	buyer registers the transfer (including rank certificate) and completes the process of property transfer

Table 5: Additional steps in order to achieve a model including credit institutes

6 CONCLUSIONS

The example of property transfer showed the connection between risk and complexity of a process. In our approach the only way to deal with complexity is to study a concrete case. We start out with a simple solution for our task, this provides a simple process but leaves risk for all agents. We then study scenarios with different risks, which lead to an increase in the number of process steps, agents, time, and money.

The simplest case contained risks for both, the buyer and the seller. Elimination of the risks complicated the process of property transfer by requiring more steps to be done or more persons involved. Each additional step usually also costs money. Notaries, for example, have fees for specific types on tasks. Also the land register must collect taxes for the registration of specific rights like mortgages and fees for providing information.

We assume that a similar connection between risk and complexity can be seen in other processes. Work performed by Grum and Frank (Grum and Frank 2005) also assumes that the risk of getting lost on a trip increases with the complexity of the route. We will investigate other examples in the future to check our assumption that there is in general a connection between risk and complexity of processes.

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Rational Ignorance of the Citizens in Public Participatory Planning

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ABSTRACT

One of the most important goals of public participatory geographic information systems (PP GIS) is to improve citizen's participation in planning processes. Does this really happen? Unfortunately, very little empirical research exists which would testify or falsify this hypothesis. In the process of trying to involve the citizens in the planning processes, we observe the effect of rational ignorance. Ignorance about an issue is said to be rational when the cost of educating oneself about the issue sufficiently to make an informed decision can outweigh any potential benefit one could reasonably expect to gain from that decision, and so it would be irrational to waste time doing so. For most citizens the personal benefit of getting involved in planning activities and learning how to use a public participatory GIS application is usually low and the cost of participation high. Therefore, they rather decide to ignore the possibility of participation. In this paper, we concentrate on the rational ignorance in spatial participatory planning and the role of PP GIS in this process.

1 INTRODUCTION

Community participation has become an important topic in planning theory and practice. Recent trends signal a paradigm shift towards decentralised, less bureaucratic and more participatory models. Novel participatory forms such as online surveys, online discussion forums, and computer supported decision-making tools offer new opportunities for the citizens´ involvement. Some of these tools make us of geographic information systems (GIS) and concentrate on the implementation of GIS and web-based technologies in public participation situations. Technical solutions for such applications range from web-based multimedia systems to GIS supported communication platforms. Their major goal is to link the technology and the community enabling the process of participation. The practice shows that the traditional methods of participation, such as for example organised meetings, presentation of the new, planned activities on the analogue maps do not result in broader participation of the citizens. Can new possibilities for involvement improve participation? Can they contribute to the empowerment of the citizens? In spite of the new technologies, we still observe the effect of rational ignorance as an integral part of the participatory processes. Rational ignorance appears independently of the implemented participative method, and is a term most often found in political science and economics, particularly in public choice theory (Buchanan and Gordon 1962; Gunning 2002). Public choice theory is concerned with the decisions a rational individual should make in an individual or collective environment and is the basis for social or collective and public choice theories. Social or collective choice is dedicated to the particular problem of choice in a collective environment. It is a branch of economic analysis that studies the behaviour of politicians and individuals. James M. Buchanan who closely worked with several other economists, most notably Gordon Tullock, laid down the theoretical foundations for public choice theory. Their book, the Calculus of Consent (Buchanan and Gordon 1962) pioneered this new application in economics. According to rational choice theory, ignorance about an issue is said to be rational when the cost of educating oneself about the issue sufficiently to make an informed decision can outweigh any potential benefit one could reasonably expect to gain from that decision, and so it would be irrational to waste time doing so. For most citizens the personal benefit of getting involved in planning activities and learning how to use a public participatory GIS application is usually little and the cost of participation is rather high. Besides, citizens feel that they cannot really influence the final planning decisions. In such cases, they decide to ignore the possibility of involvement and participation. Economists say that these poorly informed citizens are rationally ignorant.

In this short paper, we investigate the analogy of voting models and public participation in spatial planning. We present the meaning of participation, mention some applicable participation models, and discuss the role of GIS-based public participatory applications in the process of participation. One of the most important goals of public participatory geographic information systems is to contribute to the improvement of the citizen's participation in the planning processes. Does this happen? The basic dilemma between the individual versus public interest in participation, and the issues of the citizen's motivation cannot be solved only with an appropriate design of the application. Rational choice and game theory provide us with some very useful concepts, such as for example the concept of rational ignorance, which can help us to understand the behaviour of the citizens and their possible and current role in the participatory planning processes. We illustrate the conflict between the individual and common interest on the case of the prisoner's dilemma and conclude the paper with some directions for further research. The concepts discussed in this paper applied to the participatory situations in spatial planning are in the initial stage of development. Special attention has to be devoted to the design of the user interfaces including the idea of intelligent user interfaces, which would be able to register particular characteristics of the participant and accommodate the user interface to his or her capabilities. Additional research has to be devoted also to the methods of motivation of the citizens. An integrated approach for PP GIScience combining technical and social aspects of an online map-based argumentation is urgently needed.

2 PARTICIPATION AND SPATIAL PLANNING

2.1 Meaning of Participation

The word *participation* in general means something positive; it implies that someone is cooperating, ´playing´ along with the group or an individual, working with others in order to achieve a common goal. Participate comes from the Latin noun *particeps* which is a combination of part or *pars* (a piece) and *capere* (to take). The common usage of the phrase ´to take part´ or ´to take part in´ refers to participating in a group discussion (Skrbina 2001). The word *particeps* originally came from a translation of a Greek word *metokhe* (metoxi, metohi), of the meaning ´partaker´, *metechein* is the infinitive type of the verb *meteho*, meaning participate, and *metechon* (or metexon) meaning participant. The noun *particeps* became a verb *participare*, and then changed into *participate,* which we use in English language today. Participation refers to the ontodynamic relationship between two related entities. In this relationship, the "participant", the one that participates, contributes something to the superior entity. She shares her knowledge, her part of the world and reality with the superior entity in order to contribute to some high-level goal. The participation has been for most people in our democratic society limited to voting the representatives in elections and then lobbying them over personally relevant issues. Other methods of participation include opinion surveys, referendum, focus groups, discussions, forums, etc.

2.2 Models of Participation

Current models of participation include voting in elections, some of them focus on ethical issues (Solomon and Hanson 1989) such as democratic ethics, citizen ethics, citizen's rights and duties, mutual respect and help. Some other find their origins in social capital theory considering citizens to be the social capital and stressing the importance of the social learning (Crick 2001). One of the popular theory of participation is voluntary theory of participation represented by the civic voluntarism model (Parry, Moyster et al. 1992). The authors of this model identify resources, such as money, time, education, etc., motivations and mobilization as the three most important classes of participation. They argue that individuals with high socio-economic status and enough time available are likely to participate more than the individuals with less time. Arnstein (1971) provides a model of participation in a form of a ladder including eight stages, starting with manipulation and therapy which she considers as non-participation stage, and continues with informing, consultation, placation, partnership, delegated power and citizen control. The ladder analogy was applied and further developed by several authors. Weidemann and Femers (1993) use it for the classification of the public rights adapting it to their analysis of decisions needed for the purpose of hazardous waste management. According to their analysis, public participation increases with the level of access to the information as well as the rights that citizens have in the decision making process. Some other authors (Smyth 2001; Carver 2001; Steinmann, Krek et al. 2004) apply the analogy of a ladder in GIS-based public participatory approaches.

2.3 Participatory Planning

Planning has traditionally been recognised as a centralised, bureaucratic activity carried out by planning offices, planning authorities and other stakeholders. It was executed top-down and lead by the planning experts. Recent trends signal a paradigm shift towards participatory planning models. Community involvement and participation has become an important theme in planning theory and practice. The efforts towards participatory planning are based on the assumption that people are willing to become actively involved in the spatial decision-making. Public participation itself is in spatial planning processes regulated by law. In the province of Salzburg in Austria, for example, ROG 1998 (Salzburger Raumordnungsgesetz) regulates the process of public participation in spatial planning. The law describes public participation as an integral part of the planning, but it does not specify the way in which this participation should be executed. The planners emphasise utilising participatory methods, not only for the purpose of informing the citizens about the planned activities, but also as a mean to cooperate with the citizens, and as a mean for sharing the knowledge and ideas within the community. The participatory approach in spatial planning requires understanding of the social processes in a community and the behaviour and motivations of the individuals who form the community. It requires also novel, innovative, and attractive models of participation and participatory decision-making tools. These tools include methods for initiating, motivating, and maintaining citizen's involvement and technical tools that can enable, and support new ways of involving the citizens in the participatory spatial planning.

3 THE ROLE OF GIS-BASED PARTICIPATORY TOOLS

Standard, classical methods of public participation in spatial planning include personal discussions, meetings organised in a public place, presentation of the planned activities with the help of analogue maps, etc. In contrast to the traditional methods of participation, novel forms are beginning to evolve due to the new technological possibilities. Recent developments, especially in the field of web-based user-friendly applications and broader use of Internet as a communication tool, encourage the evolvement of the novel ways of the involvement. These new forms include online discussions, web surveys, online forums, virtual workshops and conferences, exchange of e-mails, and online map-based discussions. They can be supported by geographic information systems (GIS) and integrated in a public participatory GIS (PP GIS). In the last few years, a huge amount of scientific literature emerged in the field of PP GIS, discussing technical and social issues of such applications. This research field became very popular within the GIScience community. However, the practical side of this research shows a very different picture. Namely, it is very difficult to find good, operating, practical examples of such PP GIS applications. For the purpose of our study (Steinmann, Krek et al. 2004; Steinmann, Krek et al. 2005), we finally managed to selected twelve online public participatory GIS applications. We focused on their visualisation capabilities, interactivity, usability of the application from the user's point of view, and GIS functionalities included in the applications. Our survey based on the executed interviews showed that the most of the selected applications "only" deliver information to the user and provide some basic possibilities for the one-way communication such as for example writing an e-mail or getting involved in a discussion forum.

The role of GIS-based participatory tools is limited to providing the information to the users and visualisation of the spatial problems combined with some simple tools for communication and participation. Simply making GIS available on the Internet does not constitute an effective participatory decision support solution. An integration of the GIS capabilities and participation functions still offers potentials for further developments and new concepts. The providers could create intelligent interfaces to specific problems that can intelligently react on the user and recognise the socio-cultural and educational background of the user and adapt themselves to their requirements accordingly (Carver 2001). In spite of the huge technological development, support of a GIS and multimedia, integrating games into the visualisation of the spatial problems, we cannot observe increased participation in spatial planning. The GIS-based tools itself cannot encourage higher public participation in spatial planning since GIS and spatial data are expensive and require substantial investment in learning how to use them. Their major role is still limited to enabling time and place independent access to information and one-way participation. The reasons for low participation in spatial planning should be investigated with a great care.

4 INDIVIDUAL VS. PUBLIC INTEREST IN PARTICIPATION

Public participation in spatial planning is a collective action involving planning offices, authorities, and individual citizens. The problem of such collective actions can then be taken in a preliminary way to be a dilemma or conflict between collectively and individually best action, where the action required for achieving the collectively best outcome or goal is or can be often different from the action required for achieving the individually best outcome (Tuomela 1992). An example would be searching for the best location for dangerous, waste material. Trying to find the right location represents a conflict of interest between the citizens, planners, nature preservation authorities, and government. This diabolical phenomena is referred to by a number of names including “Many-Person Dilemma”, “Contributor’s Dilemma”, “The Voter’s Paradox”, or in general “Social Dilemmas”.

4.1 Common Good

The social dilemma results from the situation in which a group of citizens shares a common output and in which each individual must decide whether to contribute to the public participation planning activities or not. A common output can be a location of a new bus station, new traffic regulation in the town, changes in the land use, or an alternative location for the new school. The etymological origin of the word common is the old French *commun* and Latin *communis* meaning the service ´as if serving each other´ (Magness 1999). “The common good” seems to be based upon the differentiation between the things that are good for individuals and the things that are good for everyone as it is the case of the public welfare, national defence, and the light on the public roads and streets. For example, “equality before law” might be considered a component of “the common good” and “winning a business ticket class, or an opera performance” would be an individual or private good. Other examples of a common good include an accessible and affordable public health care system, and effective system of public safety and security, peace among the nations of the world, a just, legal, and political system, unpolluted natural environment, and a flourishing economic system. Another characteristic of a common good is accessibility. A common good is a good to which all members of society have access, and from whose enjoyment no one can be easily excluded. Concrete changes in the environment planned by the planning offices and authorities are a common good and they are shared by the citizens and other visitors. All persons, for example, benefit from the availability and accessibility of a common good. They all enjoy the benefits of clean air, the location of a new bus station, an unpolluted environment, or any of our society's other common goods. Maintaining and establishing a common good requires cooperation of several individuals and stakeholders. However, it might seem that since all citizens benefit from the availability of a common good, all would be willing to contribute to the establishment and maintenance of the common good. Nevertheless, this is not the case. Different people have different values and valuations of what they consider to be important and worth of investing into. Such disagreements are bound to undercut our ability to evoke a widespread commitment to the common good. Such efforts can only lead to adopting and promoting the views of some, while excluding the others.

4.2 Prisoner’s Dilemma

The repeated Prisoner’s Dilemma game captures the essence of the conflict between doing what is good for the individual e.g. self-interest behaviour and what is good for the community e.g. cooperative behaviour (Davis 1983; Friedman 1986; Baird, Gertner et al. 1994). It is a classic problem statement describing a situation where what is rational for an individual is in conflict with what is rational for the group. It is modelled as a game, defined by the players of the game, their possible strategies, and the rules of the game. In general, games are played by the sequence of moves. Individual moves are of interest insofar as they contribute to an overall plan of action e.g. the strategy. What characterizes a strategy is that, at every point of a decision, the strategy dictates precisely what the player does (Friedman 1986). Associated to each possible outcome of the game is a collection of numerical payoffs, one to each player. These payoffs represent the value of the outcome to the different players, and tell us the consequences of actions for a player. Solving a game is the process of identifying which strategies the players are likely to adopt.

The Prisoner's Dilemma goes like this: two criminals are arrested for a crime and placed in separate rooms. The game is simultaneous-move game, which means that the players (the criminals) choose strategies simultaneously without observing the other’s strategy. They have to decide about their own action without knowing the reaction of the other criminal. Each is given the opportunity to confess the crime or remain silent. Each of them is told the following:

- If neither of you confess, then a minor penalty will apply to both of you.
- If you confess and the other prisoner does not, then you will be set free, and he will get a severe punishment.
- If both of you confess, then you will both be charged for the full crime, though some leniency will be shown because of your confession.

This challenge is typically represented in a table (see table 1) and is often called pay-off matrix. A payoff matrix **s**hows the payoffs that each player will receive in the game, and they depend on the combined actions of all players. These payoffs represent the value of the outcome to the different players, and tell us the consequences of the actions for a player. A payoff matrix is used only in the case when there are two players playing a game. The strategies in our case are to be “silent” or to “confess”, and the prisoners can choose one of them. The pay-off matrix shows possible consequences of their selected strategy.

		Prisoner 1

		Stay Silent	Confess
Prisoner 2	Stay Silent	1: Minor penalty 2: Minor penalty	1: Set free 2: Major penalty
	Confess	1: Major penalty 2: Set free	1: Intermediate penalty 2: Intermediate penalty

Table 1: Prisoner's dilemma

The prisoners in this game individually gain more by not cooperating, but if both defect, they both lose more than they would if both cooperated. The problem is that individually, each prisoner reasons that it is more rational to confess regardless of what the other prisoner does. The strategy "to confess" is a dominant strategy, which is the best choice for a player for every possible choice by the other player. A player will choose a strictly dominant strategy whenever possible and will not choose any strategy that is strictly dominated by another. However, from the individual point of view of both of them, it would be the most rational if neither of them confessed. This peculiar parable serves as a model of cooperation between two or more individuals in ordinary life. In many cases, each individual would be personally better off not cooperating on the other. Without the opportunity to coordinate their actions, they are not able to achieve the outcome that is best for the pair of them.

5 RATIONAL CITIZENS

The result of the prisoner's dilemma provides an explanation for the citizens´ behaviour in the case of the public participation in spatial planning. The participation itself incurs cost to the citizens, and usually brings rather low benefit in comparison to the level of the investment. The cost of participation includes the cost of informing oneself about the form of participation, planned activities and learning how to use a public participatory GIS application. When we proceed with some activity that costs us time, money or other resources, we expect to get some return for our efforts. The benefits are difficult to quantify. Depending on the activity, the benefits can be direct or indirect. When we take an action that we directly benefit from, it is easy to assess the benefit to cost equation. When we do something for the collective group, in which the reward derives from being a group member, the situation is much more complicated. It would seem reasonable to wonder how the benefits derived from being a member of the group compare to the cost to the individual contributing. The situation in spatial planning participation is similar to the situation of voting and the seeming irrationality of voting, i.e., that it is irrational for voters to vote and to be informed. A rational actor analysis of politics starts with the decision to participate in the political process. A simple cost-benefit analysis indicates that the probability of one's vote being decisive is so small that the cost of voting exceeds the benefits. It is commonly argued under a rational choice theory going back to Downs (1957) that it is irrational for a citizen to vote and to acquire political information (Jankowski 2004). Besides, the citizens also feel that they cannot really influence the final planning decisions, and make choices together with the government. In such cases, they decide to ignore the possibility of involvement and economists say that these poorly informed citizens are rationally ignorant. Some authors, for example, Buchanan and Tullock (Buchanan and Gordon 1962) claim, there is no difference in individuals´ motives in the various private and public sphere of action. In both cases, people pursue their own interests rather than ideal version of the public interest. According to them, the primary differences are in the rules of the game, and therefore in the individual's incentives and responses.

Amazingly but typically, the return to the individual from being a group member is often less than the cost of the contribution made by the individual. In this apparent paradox, in which the cost of a given action to an individual can be considerable and yet have no significant impact on the benefits accrued to the individual from being a member of a group. Therefore, it turns out that "rationally" best choice of the individual is to "free-ride" e.g. to share in the group rewards of his or her contribution. The individuals become "free-riders" by enjoying the benefits of a common group, without really getting involved in the common activities, for example, in participative spatial planning. The benefits of a common good are available to everyone, including those who choose not to take part in establishing and maintaining it. The new location for a bus station, unpolluted air, a good and accessible health care, etc. are, once established, available to everyone. The issue is about the problem of group shared property where individuals that do not contribute cannot be excluded. The problem might appear if enough individuals become free riders and the common good that depends on their involvement can be destroyed.

6 CONCLUSIONS AND FURTHER RESEARCH

Our democratic society calls for active involvement and participation in all areas of living and working. Participative strategies can be used in very different situations; examples include goal setting situations, voting, or participatory planning. Ludwig and Geller (1997) show the effectiveness of participative strategies on a case of pizza deliverers. They studied injury control among them and found out that members of a group who participated in a goal-setting process not only improved the target behaviour but also showed significant increases in relevant behaviours. The authors of the study assume that the participative intervention facilitates the activation of implicit rules and intristinct motivation, whereas assigned interventions my place implicit goals by external control which is restricted to the targeted behaviour. While planning has traditionaly been a highly centralised and bureaucratic activity carried out by the planning experts, recent trends signal a shift towards inclusive and participatory planning models. Inspite of these efforts, we observe rather low number of citizens taking the opportunity foe an active involvement in the participatory spatial planning. The reasons for that can be best explained with the problematic of the common good and the individual citizens that place their high value on their individual freedom. Our society persue the individualistic personal view and supports the individuals to persue their individual goals and interests without interference with the others. Some researhcers call for for the improved understanding of the "ethics of the common good" addressing also questions related to our attitude towards the individual´s contribution to a common goal. The choice that we face in participatory planning and also as a society in general, can be best described as a choice between a society as a group of individuals who protect and follow their own selfish interests or a society in which people accept modest investments and sacrifices for a common good.

In this paper, we focus on the effect in economic and political science literature known as "rational ignorance". We present a (partial) explanation for the citizens´ behaviour and their ignorance which influences the process of public participation in general, and in particular in spatial planning. The paper tries to give some attention to the topics not so well known in public participatory spatial planning. The question that appears is "Can we do something against rational ignorance of the citizens?" "How can we deal with it?" Rational ignorance is only one possible explanation for the behaviour of the citizens. Other reasons for low participation should additionaly be investigated. Systematic studes of the citizen´s behaviour, values and interests in participation are needed. Motivating the citizens is one of the crucial issues and can substantially influence the results of participatory planning. A change in the culture of planning means also changing from ´public participation´ lead by the planning authorities into ´participatory planning´ in which diverse groups of individuals and stakeholders come together, exchange information, negotiate, and attempt to achieve consensus. Because of the voluntary and informal nature of these processes, new techniques and tools are needed, which would enable sustained motivation and commitment. Individuals, employees, and stakeholders should find appropriate ways and mechanisms for animation and inspiration of a project team, department, corporation and individuals involved in participatory planning. Even though, the methods and models for motivation and mediation exist, they are still not widely used in the process of spatial participatory planning. One of the crucial issues is the investment in learning how to use electronic, map-based based applications and how to design them in such a way as to attract broader general public to participate in planning processes. The issues of usability of such applications gain the importance with the goal making them available to all social groups. Other research issues are; systematic methods for motivation of the citizens, models and indicators for usability of PP GIS applications, research on attention, and more systemathic research on rational ignorance, its reasons, and effects in spatial planning public participation.

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Interactive Landscape Planning – Results of a pilot study in Koenigslutter am Elm, Germany

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1 ABSTRACT

In the Lower Saxony town of Königslutter am Elm, Germany an online landscape planning support system has been implemented in the context of the Development and Implementation Project (E+E Vorhaben) "Interactive Landscape Plan" (*interaktiver Landschaftsplan*) www.koenigslutter.de/landschaftsplan.htm, which was sponsored by the German Ministry for Nature Protection (BFN) and the State of Lower Saxony. From April 2002 until Jan. 2005, an interdisciplinary team from the University of Hanover developed an internet platform in conjunction with the preparation and implementation of the landscape plan. The implementation of the internet platform, which explored new approaches to information, communication and participation in communal landscape planning, is the focus of the following article. The objectives, prerequisites, components, benefits and limitations of this online landscape planning support system are discussed. Of particular interest is the role of landscape visualization in the planning process and communication with citizens.

The online landscape planning system aims to improve the quality and acceptance of the landscape planning proposals by improving citizen participation and understanding. To this goal, the research project attempted to identify the appropriate form of integration of the new media with the existing planning process. The internet platform that has been developed and tested in Königslutter is comprised of open-source components that can be implemented individually, depending on the needs and resources of the community. In this paper the results of the project will be described with an emphasis on two areas of research: the use of media in the participation and visualisation.

2 PURPOSE

Citizen participation in the decision making process about environmental issues is a goal of the Agenda 21 and the Aarhus Convention as well as a political objective that must also be addressed in landscape planning. The potential of the new media to support this goal in landscape planning and to improve citizen understanding and acceptance of environemtal measures was examined in the implementation and development project (E+E-Vorhaben) "Interactive Landscape Plan Koenigslutter"[19] (http://www.koenigslutter.de/landschaftsplan.de). From April 2002 until Jan. 2005 an interdisciplinary team at the University of Hanover composed of landscape planners, computer programmers and social scientists accompanyed the preparation of a landscape plan in Königslutter am Elm, which was carried out by the city of Koenigslutter and an independent planning office.[20] The team was responsible for the conception and implementation of the internet plattform as well as the execution of citzen participation events in Koenigslutter. In additon, the accompanying evaluation research carried out by the Institute for Open Space Development and Planning Sociology assessed the development of the internet plattform and supplied feedback throughout the project.

2.1 Objectives

The objectives of the research project were to develop an online landscape planning system, composed of individual components or tools, which assists citizens, politicians and public authorities to understand, actively participate and exercise their influence in the landscape planning issues. It was also the goal of the online landscape planning system to compliment existing planning participation methods by:

making communication more efficient and flexible,

reducing the need for personal communication,

offering access to additional participation opportunities independent of time and place and

improving the understanding of planning issues through visualization.

Finally the research project attempted to identify the appropriate forms of integration with the existing planning process.
In addition to financal benefits and incentives the city of Königslutter had a variety of objectives and reasons for taking part in the research project. With the use of new media in the implementation of the landscape plan, the city aimed/hoped to:

reach a wider range of citizens, including young peole,

make political and administrative decisions more transparent,

motivate citizens to take part in the planning process,

improving acceptance of nature and landscape related planning measures and

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[19] The project team at the University of Hannover consists of:
ILN: Prof. Dr. Christina von Haaren und Dr. Manfred Redslob (project managers), Arne Neumann, Barty Warren-Kretzschmar, Roland Hachmann, Carolin Galler;
IfAS: Prof. Dr. Erich Wolter (project manager), Karl-Ingo Friese,
IFPS: Prof. Dr. Bettina Oppermann (project manager), Simone Tiedtke

20 City of Koenigslutter am Elm: Susanne Stabrey (project manager), Jutta Meiforth;
Planning office: ***entera***/ Hannover

promote citizen identification with the town and improve its image.

The interactive landscape plan addresses a wide range of users, from the citizen of Koenigslutter with little planning knowlege to the experienced landscape planner. Especially important user groups such as:

farmers, who as important land users are crutial for the implemation of planning measures,

citzen groups who are effected by planning decisions as well as

nature protection organizations, young people and city authorities.

An additional research challenge was to develop an online solution which would meet the needs of the diverse user group and their varied information and participation demands.

2.2 The initial situation for the landscape plan and the E+E-project in Koenigslutter am Elm

Koenigslutter am Elm is a rural, agricultural community in the southeast corner of Lower Saxony, Germany with approx. 17,800 citizens and 17 incorporated town districts. The scenic landscape of hills, forest and river meadows provides important recreational opportunities for local residents and tourists. However, large parts of the community are used for intensive farming due to very fertile loess soil which, in turn, has lead to the loss of structural elements, e.g. hedgerows, in the landscape over the last 100 years (entera 2004).

In recent years, the politicians and city administrators of Koenigslutter have encouraged a service-oriented city administration and strived for better communication with local citizens, e.g. new internet site, more office hours. This open attitude and apparent interest in citizen participation made the city of Koenigslutter a good partner for the research project. However, in the rural community the high-capacity, broad-band internet connection was not yet available. This technical difficulty remained a hinderance to the online-participation throughout the project.

In Lower Saxony, the landscape plan is intended to be an expert assessment of the landscape and nature solely from an environmental perspective. The results and recommendations of the plan are then considered in the community's land use plan and other sector planning, which means public influence in this configuration is somewhat restricted. However the city of Koenigslutter tried to overcome this problem by allowing for more public involvement within the landscape planning process and promoting additional discussion of implementation strategies of landscape plan proposals with citizens and interest groups within a subsequent action plan.

In addition, the state of Lower Saxony offers relatively few subsidies and agri-environment measures and programmes focused on environmental protection, compared to other states in Germany (SRU 2002: 93f.) As a result, the implementation of landscape planning proposals is not financially attractive for the farmers and therefore their willingness to embrace the environmental measures is generally limited.

2.3 Structuring of the participation process

In the Interactive Landscape Plan, citizen participation activities were incorporated throughout the phases of the landscape planning process and reflected the discussion and participation needs which were recognized during the landscape plan. However, four major "participation projects" which focused on specific local environmental issues, formed the core of participation events during the case study.

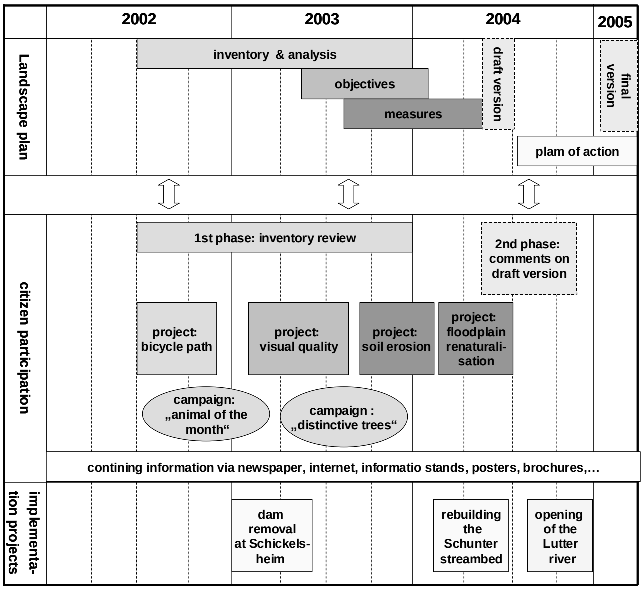

Fig. 1: Structuring of the participation process in Koenigslutter in phases and projects

- **Participation phases (general issues of the plan):** Throughout the planning process the various public authorities (e.g. city administration, nature protection agency on the county level) were encouraged to participate and the citizens could inform themselves about the progress of the landscape plan using the internet platform. Initially a broad public participation approach was taken in the inventory phase. Citizens were encouraged to review the inventory and analyis and to make comments and corrections online. To promote contributions to the inventory and to draw on the knowlegde of "local experts", two different campaigns were carried out, in which citizens were asked to report sightings of various animal species in Koenigslutter on a monthly basis and to send in photos of distinctive trees. In the end phase of the landscape plan, citizens could discuss the completed draft of the landscape plan (design phase). A detailed version and an abridged version of the plan were available on the internet. Using the participation modules citizens could draw and comment on the maps and draft text.

- **Participation projects (site and topic specific)**: The participation projects provided the opportunity to discuss topics that were relevant to both the planners and the public, such as a bicycle path concept, visual quality issues, soil erosion and the renaturalisation of a local floodplain. The projects, which involved a series of events, included town meetings, excursions, seminars and working groups and involved various user groups in different town districts. Visualisation techniques were tested in the context of these events to examine their effectiveness in public participation (see chapter 4.2).

3 THE LANDSCAPE PLANNING SUPPORT SYSTEM

The interactive landscape plan has been developed as a modular system, comprised of a "tool box" of open source components which can be implemented by the community as required (fig. 2). The system provides the user with a variety of functions that are essential for effective online support of citizen based planning (Couclelis, 2004). After the completion of the project the individual tools are available as open source applications and can be used for landscape planning or related planning forms when appropriate.

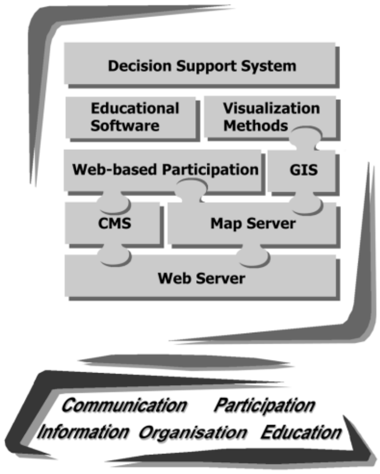

Fig. 2: Components of the Interactive Landscape Plan

3.1 Functions, components and media used

Providing citizens with **information**[21] is still the primary function of the internet platform. Background information about the landscape plan, its methods and planning procedures, the project framework, meeting announcements (launched via a calendar) and minutes, updates on the progress of the landscape plan form the core of information. In Königslutter the complete text and maps of the draft landscape plan in an interactive, a comprehensive version of the draft plan as well as an abridged version prepared for the general public which is structured by chapters of the plan or by city districts, aerial photos and panorama photos help visualize the information online. Detailed information about the topics to be discussed in upcoming town meetings was posted in the internet to help the citizens prepare for the discussions. Beyond simple information retrieval, users can subscribe to an electronic newsletter which delivers information about the most recent planning developments.

The **geographic information system (GIS)** is a core information component of the internet platform for which a digital landscape plan[22] is a prerequisite. The geo-referenced landscape planning data is visualized in the internet as interactive maps with query functions through the use of a **map server**. (In order to promote open source product development, the UMN map server was chosen.) The interactive maps were developed for users with little GIS and computer experience. Therefore, an intuitive and simple interface design, without English computer jargon, was considered essential. Users can interactively view the landscape plan, pan and zoom, and specify the map content, displaying different layers with dynamically generated legends. The ease of using the interactive

[21] defined in this context as one-way-flow of information items from the central "player" e.g. the planner towards the recipients e.g. the public
22 The landscape plan was prepared by entera and the city of Koenigslutter am Elm with ArcGIS 8.1 from ESRI.

maps, fast loading time, naturally increases with improved hardware and faster internet connections. In rural areas, such as Königslutter, where DSL is not always available, users can view the interactive maps but they must still contend with slower performance.

The **educational** potential of the internet for independent learning and the transfer of knowledge can be used to promote a broader understanding of landscape planning issues. Interactive multimedia learning modules provide an excellent means for presenting landscape and nature protection information in a playful and entertaining manner. The Interactive Landscape Plan offers several modules designed for different age groups, which not only inform about Königslutter but also explain ecological topics such as the hedge rows habitats.

Beyond accessing information, citizens must be able to **participate** in the process and **communicate** their ideas and needs. The internet platform in Königslutter offers citizens email contact to the project team, a discussion forum as well as comment forms for the interactive maps and a map annotation module (see map-based participation module). Discussion forums offer citizen groups, such as farmers, the opportunity to network and discuss controversial issues, regardless of time or place. Different visualisation techniques like panorama photos and interactive simulations of planning proposals supported discussions both online and within town meetings along with traditional metaplan-techniques and printed maps. The challenge is to integrate the participation possibilities over the internet and the visualisation techniques with the traditional "live" planning process. For example, effective online discussion groups, which offer the opportunity to follow up on issues raised in community meetings, must appear promptly in the internet and require sufficient publicity. Planning, coordination and flexibility is essential for the effective integration of such "live" and "online" discussions.

The interactive maps are not only an information tool, but also assist communication between users and promote quick and easy feedback using comment forms. In addition, the map server supports a **map-based participation module** that allows citizens to annotate the maps with text and graphics using a Java applet. These comments are then submitted directly to the City Authority for Environment in Königslutter and posted on the map server. The "place based" comments are published, either anonymously or with the author's name, in a layer of the interactive maps. The city can then evaluate the comments, respond directly to the citizen via email and, when necessary, make the appropriate amendments to the GIS data. The map-based participation module improves access to the plan information, promotes transparency of opinions and ensures that the comments are accurately geo-referenced (Hachmann, 2003).

A content management system developed within the project helps the administrators to **organize** and update the complex and constantly changing internet platform without the need of extensive computer programming knowledge. The use of editors for different purposes like text editing and picture upload makes for a corporate layout of the platform (Friese et al. 2003). The system also manages user, group and access rights which is the basis for the map-based participation module.

As part of the concept of integrated use of new and traditional media, the city of Koenigslutter supported all activities with extensive media and personal information including press releases, printed newsletter and sometimes direct information of relevant partners on the local scale. Fig. XYZ summarizes all media used within the project and Fig. 123 illustrates how the two groups of media were be used in combination within one participation project in Königslutter.

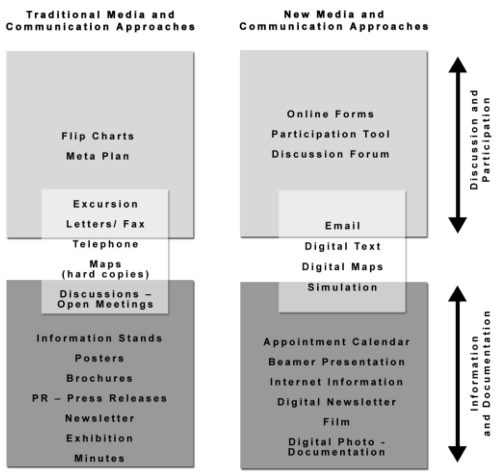

Fig. 3: Kind of media used in the interactive landscape plan

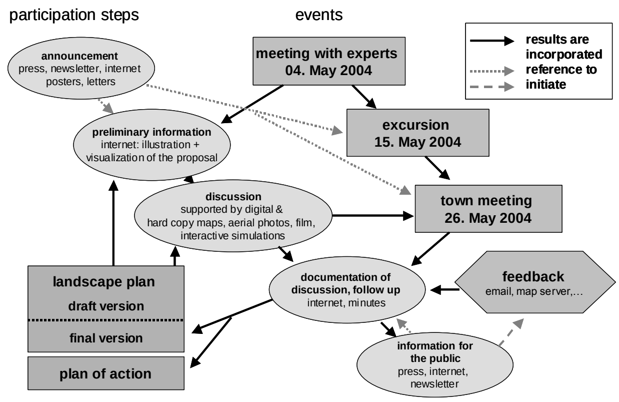

Fig. 4: Combined use of new and traditional media in the course of a participation project

3.2 Results: Analysis of citizen participation

The evaluation of citizen participation in the interactive landscape plan –both online and traditional participation – considered all kinds of comments and communication related to the landscape plan: letters and emails, telephone conversations, minutes from meetings and discussions related to the participation phases and projects, annotations on printed maps, and comments over the participation modules, the online discussion forum and online forms. Each remark or mark on a map was counted as a comment, which means a letter or email can contain several comments. (The results presented in this paper are still of a preliminary nature.)

Feedback preferences with new media

Initially the city officials feared that the new and more impersonal means of communication would cause a flood of comments as well as produce non-issue-related or even offending comments. Neither of these has been the case in Koenigslutter. With an entire number of approx. 860 comments, participation turned out to be manageable. (Only comments (511) originating from the participation phases are considered in the following analysis.) Despite the development and promotion of new media within the project, by far the most comments arrived by traditional means, i.e. marks and written comments on the printed maps, contributions to discussions in town meetings, letter or fax. In the inventory phase, the new media was used primarily for making site-related comments by responding with the form linked to the map server. (At that time, the participation modules were not yet available.) In the design phase, email was the preferred type of new media, often along with an attached text document. Some citizens used the discussion forum to comment on the participation projects and to make general comments about the use of the internet platform, but it was not used for commenting on the draft of the landscape plan itself.

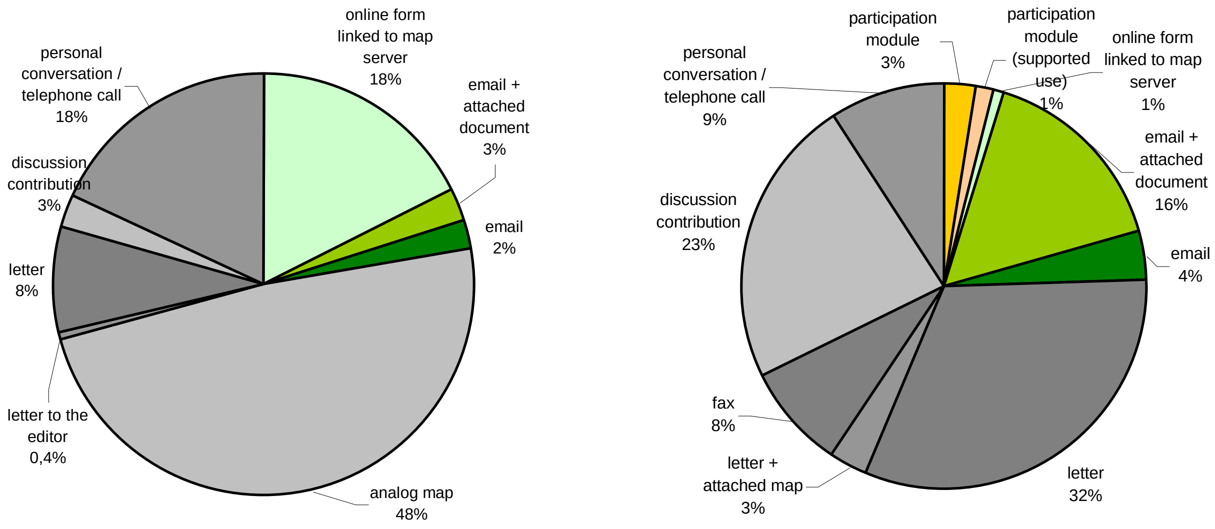

Fig. 5: Comments and feedback within the two participation phases (left: inventory phase, spring/summer 2003, right: design phase, summer/fall 2004), sorted after media usage

Correlation between content of feedback and choice of media

All submissions and feedback from users were classified according to the nature of the comment and the precision with which they could be processed. The responses fell into three main categories: either they focused on a specific area of the map or portion of the text; they pertained to the proposed planning measures or they were a general statement about the landscape plan as a whole. As an example, the following comments were classified in those categories:

- **Area- or text-related comments:**

correction to the biotope inventory relating to specific land parcels, mainly from grassland to fallow land

negative comments about specific proposed protected areas

opposition to specific measures proposed for habitat corridors because of anticipated conflicts with agricultural land use

- **measure-related:**

statement about the feasibility of low-intensity agricultural land use

refusal of proposed focus area for programmes for natural field borders because farmers were not informed in advance,

- **general statement:**

rejection of the landscape plan in general because disadvantages and a loss in farmers income were anticipated

Generally, comments that were submitted with the help of new media were the most precise, and were predominantly related to specific areas or text passages and – in case of the participation modules – even geo-referenced and automatically saved in a database that can be queried by the planners and city administrators. Additionally, online-forms, such as the report forms used in the "animal of the month" campaigns, produce more complete and exact information. Both aspects improved the quality and efficiency of the planning process. Letters, faxes and discussions, on the other hand, tended to be of a more general or thematic nature and less specific.

The reasons for the relatively small amount of comments received over the participation modules are not completely clear. To some extent users reported problems with the use of the modules, finding it somewhat complicated to use or not having the nessecary plug-ins installed. However much of site-related feedback was received as comments on printed maps. Therefore, it can be assumed that there exists potential for increased online use of object based feedback and participation modules.

The analysis of the data shows that most of feedback from the citizens consisted of general, comprehensive statements about the landscape plan or addressed a measure in general. Neither of which were related to a specific portion of the map or text. The participation modules, as they are developed today, are not geared towards people who are used to composing their comments in letters, in which general comments about a range of issues are discussed. User also stated that they perceive writing a letter as an official and reliable way of communicating their opinions and comments to the recipient. The new techniques still have to prove their reliability.

Categorizing the comments into "precision classes" does not say anything about the quality of their content. It can be said about all three types of comments that they are helpful in development of the landscape plan and that the participation modules – as a conclusion – provide an additional means for participation and help process site- or text-related comments. However, they cannot replace the other means of communication. Further development of these software tools should address the user wishes to comment on broader issues using different types of comment interfaces.

3.3 Implications for the planning process

Public participation, as it was implemented in Koenigslutter, has several implications for the planning process:

- The frequent meetings and discussions forced planners to prepare and present intermediate results more often than usual in the planning process. The use of GIS require the planners to formulate site-specific proposals with unavoidable accuracy. It is therefore more difficult in the conceptual phase of the planning to convey the tentative character of "planning in progress" to the citizens.

- Citizens comments during the inventory phase were not integrated directly into the database, but first checked in the field by the planner. This helped the planners to identify and correct discrepencies in the biotope inventory that were caused by misinterpretations of the aerial photos. Participation in this phase can, on the one hand, truly improve the quality of the data but, on the other hand, it also means additional work for the planner. Furthermore, the planner needed to respond to all the public submissions, explaining whether and how the comments would be integrated into the plan. Thus, additional feedback loops and more time are necessary in the inventory phase and participation processes of the planning process, which requires additional resources. The fast communication via internet raises the expectations of citizens that database changes should occur immediately. In many cases this is not possible, but it still requires a confirmation and response to the citzen comments, thus creating an additional task in the process.

  However, the online participation in Koenigslutter did help to make improve the effectiveness of the plan preparation. In the initial phase, the biotope inventory was based primarily on the aerial photo interpretation of the site, with minimal field work, due to financial restrictions. Through the comments from the citizens in the inventory phase, field work could be concentrated on critical issues and sites. Thus, using participation efficiently can also save money.

- It was found in Koenigslutter that the citizens preferred to discuss specific, concrete planning measures which they could imagine rather than abstract planning objectives. Therefore planning content that would normally be developed later in the planning process, during the measure development phase, was presented during the participation projects – which in Koenigslutter already started while the phase of analysis was still going on. This meant planners had to develop specific planning proposals while the analysis phase was still in progress. To avoid such complication in the planning process, participation projects should be carried out later in the planning process in order to benefit from concepts and data already prepared and available.

3.4 Participation in a sector plan: How does that fit together?

From the start, participants need to understand how much influence they have on the planning decisions and how their comments will be incorporated into the landscape plan, otherwise their enthusiasm can turn into frustration. In other words, the opportunities but also the limits of participation must be made clear, which is, admittedly, a difficult und time consuming task. The fact that the landscape plan in Lower Saxony is an independent assessment based solely on an environmental perspective, means that it also does not consider the feasibility of implementation. This presents considerable limitations for influence on the plan by the public and other agencies. In the inventory phase, however, broad participation can offer the planner valuable information and local knowledge, to improve the data and to clarify important issues. The development of a comprehensive concept of objectives for nature protection and development though requires the professional knowledge and experience which a planners can provide and offers little possibility for public involvement. In situations where a choice between alternatives of comparable environmental value must be made, there is then an oportunity for public participation. Also the comprehensive concept of planning measures is not intended for immediate implementation, but rather shoulc be considered as a source of proposals for possible future development. Therefore, it is not opportune to completely rule out the proposed measures, which meet with momentary negative reactions of local interest groups, as was sometimes the case with farmers in Koenigslutter.

The experience in Koenigslutter makes it clear that a plan of action (Handlungskonzept), which stems from landscape plan, is an important instrument for incorporating the suggestions developed in the participation phases. The plan of action helps to structure the results of all the discussions, opinions, concerns and hints for possible cooperation in the implementation of measures as well as to support political decisions about the timeframe and content of the implementation of the landscape plan. Currently the plan of action for Koenigslutter is being prepared including a number of additional town meetings with the public. It is recommended that the action shall be reviewed as a political programme by the city council.

4 VISUALISATION

The goal of the visualization in landscape planning is to help citizens understand the spatial and temporal processes in the landscape, to comprehend the planning proposals as well as to promote communication. Visualization was used in Königslutter to assist the participants to understand and to evaluate planning proposals in order to become an active participant in the planning decisions. In the research project the following questions were addressed:

What role does the visualization play in the communication with citizens?

Which visualization methods are suitable for the planning process and for which tasks?

What advantages and disadvantages do the different visualization methods demonstrate in a planning situation?

Which organisational and content difficulties arise when visualization is used in the planning process?

4.1 Visualisations methods employed in the project

A wide range of visualization techniques were tested during the planning process in Königslutter in order to determine which characteristics of the visualization are important for citizens in different planning phases. The Visualization techniques employed ranged from low end, non-geo-referenced methods of landscape visualization such as digital photomontage, panorama photos to high end real-time virtual reality software such as Lenné3D system. and offered a variety of interactive options and levels detail of realistic representation.

In each of the planning phases a variety of techniques were employed. In the inventory and analysis phase of the landscape plan **2D maps aerial photographs** and **panorama photos** were used to visualize the existing conditions in the study area. In the development of planning goals and measures, planning proposals were simulated with **photomontage, sketches** and **3D-landscape models**, which were generated from the GIS data. Renderings of the 3D landscape model produced with **Visual Nature Studio (VNS)** illustrated the visual effects of planning proposals with before and after versions, which could be clicked on or off. A **virtual 3D model** (**VRML)** exported from the VNS project with Scene Express (add-on from 3D Nature) offered citizens the opportunity to explore the spatial effects of the proposed measures interactively in internet. Finally the system **Lenné3D** was used to visualize planning proposals in the context of nature protection scenario development. Lenné3D, which is being developed and tested by ZALF[23], offers a real time exploration of a 3D model from eye-level in conjunction with a site overview with **3D Maps (LandExplorer).**

Also developed during the project was a tool to convert the still images, produced by the various visualization techniques, into interactive images, in which the individual planning measures could be turned “on or off”. (see Fig. ABC) With a image processing software, the individual measures are divided into different layers. The tool produces an interactive HTML version of the image.

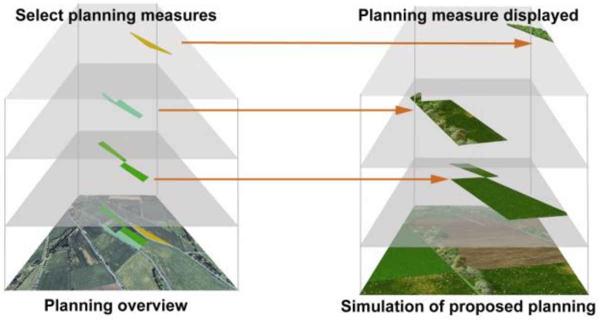

Fig. 6: Structure of interactive still images

4.2 Visualization in the Participation projects

In the first citizen participation project, citizens discussed the possibilities to improve the landscape visual quality in their community. The kick-off event for the discussion was a bicycle tour through the various landscape areas of the community and a citizen evaluation of the landscape quality. Afterwards, a virtual bicycle tour with panorama photos and opinion questionnaire in the discussion forum was accessible on the internet site. During a community meeting citizens discussed the visual effects of a proposal for new hedgerows in the landscape with the help of an interactive photomontage, in which the various hedges could be shown or hidden(turned on or off). Citizens also simulated their own vision of the landscape in a hands-on workshop using photomontage techniques.

In a second series of citizen participation sessions, primarily farmers but also other interested citizens, discussed scenarios which addressed soil erosion using simulations created by four different visualization methods: sketches, photomontage, Visual Nature Studio, and Lenne 3D. All four visualization types were used in the discussion and the citizens’ reactions were observed. The participants were divided into four groups, each with a moderator and an observer. The groups rotated around four stations where

[23] Zentrum für Agrarlandschafts- und Landnutzungsforschung e. V., Münchenberg

simulations, created with different visualizations techniques, were presented and available for use in the discussion. At each station, the planning measures proposed in the scenarios were discussed using the available visualization. A technician operated the visualization, while citizens discussed the planning measures for twenty minutes at each station. Afterwards the participants expressed their opinions about the techniques.

A further citizen participation project addressed a concept for the renaturalization of a stream floodplain. A film, which is also available in internet, explained stream renaturalisation and showed the opinions of various interest groups was shown in the meeting. An interactive simulation, which was produced with VNS, gave an overview of the planning measures and was linked to before and after eye-level views of the planning. A simulation of the planning area in 15 years was prepared with Scene Express and presented as a virtual reality model using VRML

4.3 Participant reaction to the visualization

User reactions to the visualizations used in the town meetings were gather with questionnaires, interviews, in experimental situations as well as by participatory observations. (Oppermann & Tiedtke 2004) The visualization was tested in the context of three thematic participation projects which addressed the issues of visual quality assessment, soil conservation and river renaturalization. Interactive maps were available in the internet which documented and demonstrated the current information available from the landscape plan.

Citizens want interactivity

The citizens welcomed the visualization and used it actively in the discussions to locate their comments or to illustrate or emphasise their ideas. The citizens felt that the visualization helped them to understand the “where” and “how” of the proposed planning measures. Especially the before and after simulation of individual measures, which could be turned on and off, was frequently employed by citizens in the discussions. The comparison of planning alternatives and conditions provided an important method for helping citizens understand and make decisions about the effects of the proposed measure and constitutes a minimum requirement for content interactivity of visualization systems. In addition the citizens used the visualization actively in the discussion in order to explain their ideas, instructing the technician to pan to the areas in question or wanting “to go there”. The possibility to view different perspectives of the landscape was important in the communication with citizens.

2D supports orientation

The experience showed that the 2D maps and aerial photos were an important orientation tool for the citizens and they provided a good means for documenting the comments provided by citizens. Some citizens had difficulty to orient themselves in the 3D visualizations. On one had, citizens wanted to observe the planning from different perspectives. On the other hand, many citizens found the changing position, which the interactive navigation offers, difficult to follow and, thus, the orientation was more difficult. The experience indicates that 2D visualization can not be replaced by 3D and that the spatial orientation was best achieved through a combination of the two.

Realistic but not too photo realistic

The citizens in Königslutter desired a photo realistic representation of the planning measures. However, it was observed in the meetings that citizens were quick to point out the weaknesses of the simulation, e.g. standardized hedgerows, seasonal discrepancies in the flowering plants with the photo realistic visualisations, such as photomontage, VNS and Lenné3D, which promote a high expectation of correctness. in some cases this distracted from the discussion or led to mistrust in the validity of the visualization. Never the less, when asked, they found the less photo realistic visualizations in Scene Express and VNS sufficiently realistic to understand and assess the proposed planning measures. The objective of the visualization and the quality of the available data are decisive in determining how detailed the visualization should or can be. The challenge for the visualization remains to find a level of detail which was sufficient to illustrate the planning, but which also suggests the proposal or tentative character of the planning.

Live vs. online

All of the visualization methods could be presented in the town meetings as well as in the internet, with the exception of Lenné3D, whose real time presentation is not accessible in the inernet. A third of the participants in the meetings who were asked, voiced the intent to view the visualized results of the meeting in the internet. However, far fewer had viewed the information on the internet site prior to the town meeting. The visualization sparked interest in the plan. The visualization in the internet provides the participants with the opportunity to review the planning proposals without interruptions and in their own time. The internet presentation must also take into consideration the possible technical limitations experienced by the users, i.e. slow internet connection, outdated hard or software, availability of plug-ins, and offer visualizations in a variety of resolutions.

Participants wish for more

Most of the participants were excited by the visualizations but disappointed that the technology did not support the possibility to immediately visualize their suggestions or planning ideas. The interactive presentation of new content in the visualization remains a task for future software development. Citizens also request the 4D visualization of the landscape, in order to see the development and growth of the planning proposals over time. This too remains an important task for future development.

5 CONCLUSIONS

With the implementation of the Aarhus convention, citizen participation in the planning process is no longer a luxury but a requirement. Online participation is one possible approach to address these new challenges. The experience from the Interactive Landscape Plan in Koenigslutter shows that the new media provides useful new channels of information and communication with citizens during the landscape planning process. The new media, however, can not replace traditional participation methods and should be considered a supplement to traditional media. An intelligent mix of media which include internet, press articles, and personal interaction gives the most benefit to participation and the planning process.

Open source programs make solutions for online planning available at low cost for communities with limited resources. In the context of the Interactive Landscape Plan, open source applications were developed which can be used in other online landscape planning support systems. The flexible "tool box" of applications which were implemented in Koenigslutter includes: CMS, map server, participation modules, a soil conservation decision support tool, interactive still images and educational programs. The modular concept of the "tool box" allows communities to implement the components which suit their needs.

The experience in the Interactive Landscape Plan showed that digital feedback in the planning process has advantages for the planner. Comments can be processed much more efficiently and the information they contain is generally more precise and complete. The possibility to process spatially referenced comments, which the participation module offers, is seen as a promising opportunity to satisfy the growing demand for citizen participation not only in landscape planning, but also in related planning sectors. Although the absolute number of people who took part in online participation in Koenigslutter was not as high as initially expected, it was a good response relative to the number of citizens who normally attend community meetings in Koenigslutter. Moreover, the online participation improved the amount and quality of information available to the citizens who took part in the planning process over the internet. Ultimately, it is the quality and not the quantity of participation that is decisive in the landscape planning process

The promise of participation raises expectations among citizens about their potential to influence the planning. At least in lower Saxony, the opportunity and extent to which citizens can influence the landscape plan is limited. In Koenigslutter, these limitations were overcome through the development of a plan of action (*Handlungskonzept*) for the implementation of the findings of the landscape plan, which supports the political decision process. From the start, it is important that the framework, in which citizen participation can influence the planning, is made clear from the beginning, otherwise enthusiasm can turn into frustration.

Visualization in the planning process in Königslutter was welcomed by citizens, who actively used the visualizations in discussions to locate and illustrate their comments. Traditional 2D visualization techniques such as maps and aerial photos should not be discarded in favour of new interactive and 3D techniques. Instead, a combination of the different visualization techniques best helps citizens to understand and evaluate the simulated planning proposals. The choice of visualization techniques used to present and illustrate landscape planning issues depends greatly on the planning phase and the planning task at hand. Furthermore, the effective use of visualization techniques is a challenge for the moderator of a meeting, who must be familiar with both the content and use of the visualization. Ultimately, the effectively integration of visualization into the planning and participation process requires good project and time management with all parties involved.

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Spatial data system in Slovenia

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ABSTRACT

In the end of year 2003 was in Slovenia accepted several new legal acts concerning with spatial planning and building. One of those was "SPATIAL PLANNING ACT". In its chapter five is defined "spatial data system" in Slovenia. New Spatial planning Act define that state and municipalities shall maintain a spatial data system to monitor the spatial planning and management situation. The Minister of the Environment was in year 2004 lay down detailed instructions for the contents and the manner of maintaining the spatial data system, on the connectibility of data, and on the conditions for computer access to databases and on the availability of data from them. In this paper are described some details about those detailed instructions and some activities for establishing spatial data system in Slovenia.

KEYWORDS: Spatial data system, spatial planning, real-estate, spatial data, computer access to databases

In the end of year 2003 was in Slovenia accepted several new legal acts concerning with spatial planning and building. One of those was "*SPATIAL PLANNING ACT*". This act regulates the spatial planning and the enforcement of implementation measures for the planned spatial arrangements, and ensures the building land development and the maintenance of a spatial data system. One of Fundamental Goals of Spatial Planning and Management are to achieve a spatially harmonized and mutually complementary location of various activities and to provide spatial opportunities for a balanced development of the community. Spatial planning stakeholders are the state authorities, local community bodies, and other bearers of public authorities who make decisions or participate in making decisions on the issues of spatial planning and management. The state and local communities, and local communities among themselves, shall co-operate in the matters of spatial planning and management, particularly in planning the development and location of activities with spatial impact, which refer to the common use of natural resources, common transport, energy and municipal facilities, and to other spatial arrangements in connection with the environmental protection, nature conservation, and protection of cultural heritage.

In chapter five of Spatial planning Act is defined "*spatial data system*" in Slovenia. "*Spatial data system*" is described as the system of preparing, collecting, and maintaining data banks in the field of spatial planning and other matters of spatial planning and management.

The act define that state and municipalities shall maintain a spatial data system to monitor the spatial planning and management situation. The spatial data system shall contain databases referred to in this Act, and other databases related to spatial planning and management provided by law or by a local community ordinance. The spatial data system shall be based on mutually comparable and interrelated geodetic data, records, and other data bases, harmonized with the statistical data banks.

The Minister of the Environment was in year 2004 lay down detailed instructions for the contents and the manner of maintaining the spatial data system, on the connectibility of data, and on the conditions for computer access to databases and on the availability of data from them.

Spatial planning stakeholders shall be obliged to exchange data among themselves, and to supply the Ministry of the Environment and bodies within its composition with their documents and other regulations containing the requisite data in the prescribed format and relating to spatial planning and management, whereby it shall be provided for the traceability of the changes to the data, which are relate to each other within the databases referred to in this Act .

Following new datasets was defined as a part of spatial data system:

- Legal Regimes Database
- Administrative Acts Database
- Actual Land Use Database
- Data on Public Infrastructure Networks and Facilities

The legal regimes database shall present spatial planning documents and data extracted from other documents, laying down spatial arrangements, implementation measures and spatial planning restrictions. The legal regimes database shall be presented in the land cadastre and shall be linkable to the cadastre of buildings. The Ministry of the Environment, shall set up the legal regimes database, and maintain it in collaboration with the municipalities. The Minister of the Environment, in agreement with the ministers responsible for the contents and maintenance of the legal regimes database, shall specify in detail the contents and the manner of maintaining this database, its interconnectibility, and access to the database.

The administrative acts database shall contain data from administrative acts relating to construction. The Ministry of the Environment shall maintain the database, while data shall be entered in this database by the administrative authorities responsible for issuing them. The database shall be maintained in the land cadastre, and in the cadastre of buildings as imported data.

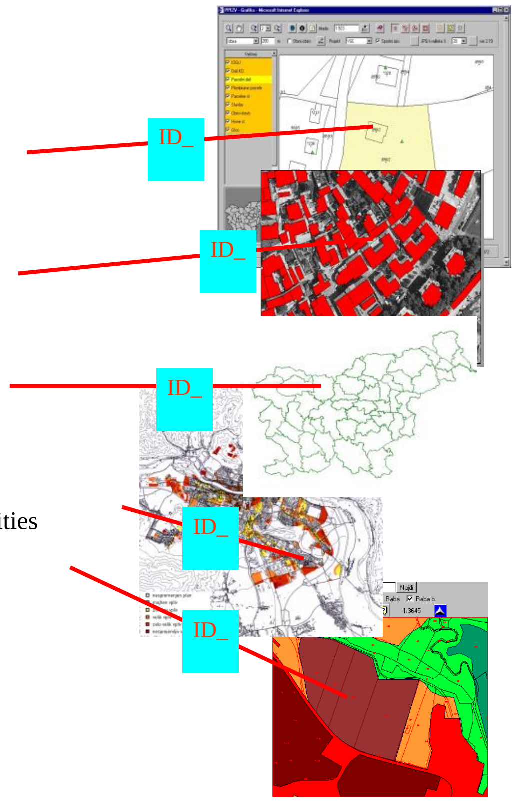
UNIFIED IDENTIFIERS IN SYSTEM,

- land parcel ID from land cadastre,

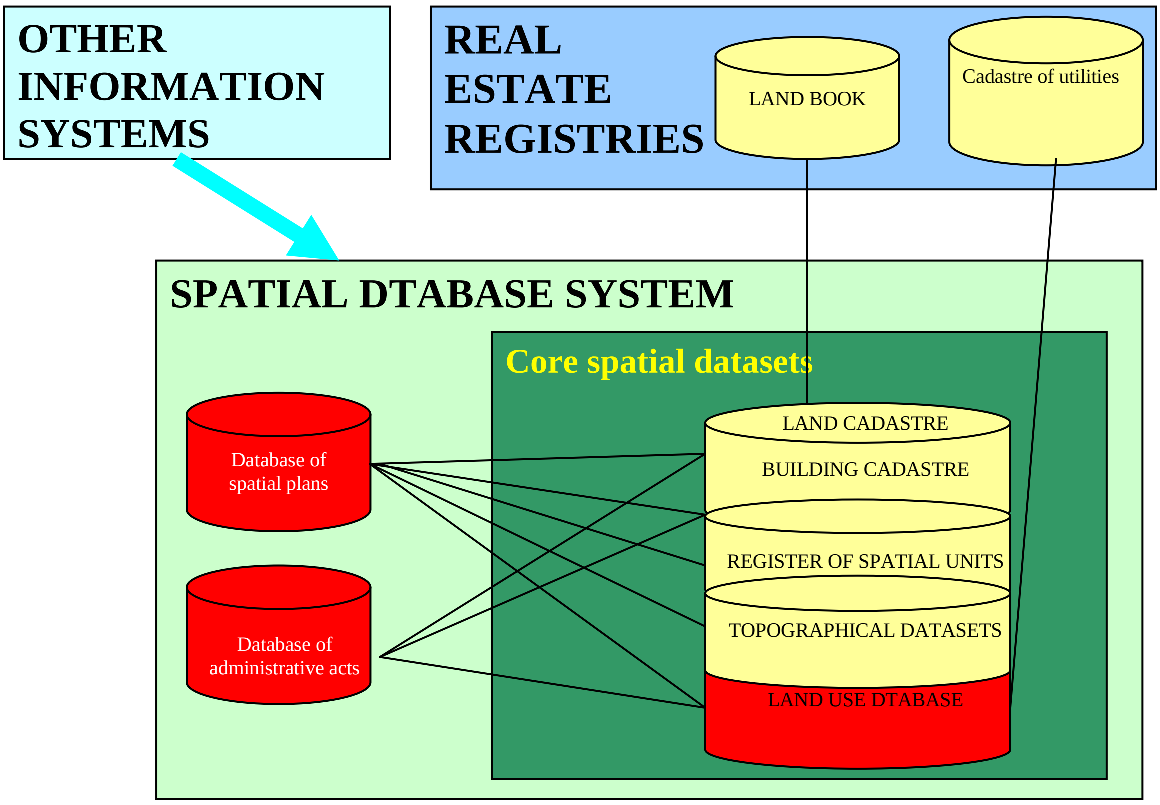
- building ID from register of buildings,

- administrative unite ID from register of spatial units,

- identification number of land use and utilities infrastructure from database of land use



"CONCEPT OF SPATIAL DATA SYSTEM"



The actual use database shall be data on the actual use of the physical space pursuant to the regulations governing the keeping of records on real estate, detailed data on the actual use, kept on the basis of other laws, and data on the public infrastructure networks and facilities

Data on public infrastructure networks and facilities shall be maintained in the cadastre of public infrastructure based on data on the already built public infrastructure networks and facilities and data supplied by investors after the completed construction. Summary data on the types and positions of the public infrastructure networks and facilities shall be maintained by the body responsible for land surveying affairs in the topographic database – connectible to the land cadastre – on the basis of data recorded in the cadastre of public infrastructure. Any change to the data in the cadastre of public infrastructure, which also denotes the change of data in the topographic base, shall be recorded and supplied to the body responsible for land surveying affairs within three months of its emergence. The municipalities and the ministries responsible for individual public infrastructure networks and facilities shall provide for the maintenance of the cadastre.

The databases, which are not provided with the level of confidentiality or if such confidentiality is not limited by other regulations, shall be public.

Everyone shall have the right, in compliance with the law and upon payment of an official charge, to access the data and to obtain data from the databases. The Governmental departments and local community bodies shall not be obliged to pay such access charge. Access to the databases shall not be recorded. In accordance with and under conditions provided by the regulations on keeping records of real estate, it shall also be possible to access or obtain data from the land register and the cadastral buildings register, records of the state border and the register of spatial units linked to the data in the databases.

For the purpose of preparing spatial planning documents, for administrative procedures, and maintaining databases, the spatial planning stakeholders shall have the right to access and obtain all data on real estate and their owners, including personal data, kept in the land cadastre, the cadastre of buildings, and the land register. These rights also include the right to obtain data from the records on the state border and the register of spatial units, including computer access to such data.

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Spatial planning indicators – the geoland approach

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1 INTRODUCTION

The Spatial Planning Observatory (OSP), which is part of the Integrated Project **geoland**, funded within the 6th framework program of the EC, will generate products and services based on Earth Observation (EO), geo-spatial and statistical data. The project aims at developing a project portfolio that covers some key issues of spatial planning frameworks and concepts, especially the ESDP (European Spatial Development Perspective) with ESPON (European Spatial Planning Observatory Network, ESPON 2004) as one of the measures for implementing the ESDP, as well as national and regional spatial planning directives and sustainability strategies. The products and services comprise indicators, spatial typologies and scenarios, presented in tabular, graphical and map forms.

Widely used frameworks for indicator development are the Pressure-State-Response framework of the OECD and the DPSIR – Driving Forces-Pressure-State-Impact-Response framework of the EEA. Land cover change as derived by EO-based methods, has been related to the DPSIR as a "pressure indicator", which characterises the depletion of natural resources. At the same time, the status of land cover (that characterizes the intensity of land use) and of the depletion of natural resources can be regarded as indicators for state and impact. Both frameworks do not explicitly include the aspect of land potential, which may be expressed as land attractiveness for people or as the degree of (potential) biodiversity. Land potential, however, can be considered a loop factor in the DPSIR framework in the sense that it is on the one hand impacted (to a variable degree) by driving forces/pressure/state factors, and on the other hand constitutes a driving force by itself by attracting people or companies to certain places where landscapes attractiveness is high. The indicators conceived on the basis of user requirements take this effect into account.

In this paper a selection of indicators on European, national/transnational and subnational level will be presented. These indicators relate to the DPSIR framework and include in addition aspects of land potential. They characterize driving forces and pressure related to demographic developments and their manifestation in land consumption per capita and settlement structures. State of and impact on the environment is represented by land cover/use patterns, agricultural intensity, and availability of recreational areas. These indicators form the basis for spatial typologies and scenarios to be developed in the course of the **geoland** project.

Besides these aspects on the supply side of the products and services there is the question of how users actually digest and utilise the provided information for spatial planning decisions or other purposes, such as reporting obligations. The EO based products and services constitute not only information from another than conventional data source, but also in some respects a new type of information, i.e. spatially explicit information. This offers not only additional application potentials, but also bears the necessity to adapt to their utilisation. In addition, the information provided is directly linked to concepts such as the DPSIR and sustainable development, and thus has to be evaluated and used in this context.

2 DATA AND TEST SITES

The indicators were developed in cooperation with an end user consortium comprising European, national and sub-national organisations. At the European level representatives of the ESPON projects, DG Regio, Metrex and Eurocities gave input to the OSP. The Austrian Institute for Regional Studies and Spatial Planning and the Austrian Federal Environment Agency represent the users on the national/transnational level. At the sub-national level the State of Vorarlberg supported the developments.

In the first phase of the project 14 indicators have been defined, seven for the European level, three for the national/transnational and 4 for the sub-national level (see table 1). These are subdivided into four product groups, including two for the European level, and one for both the national/transnational and subnational level. All indicators at European level are based on aggregated CORINE land cover (CLC) data and statistical information. The national indicators are built on full resolution CLC data, regional indicators on refined land cover data of CLC type.

CORINE Land Cover is a compilation of national land cover inventories, which are integrated into a seamless land cover map of Europe. The resulting European database is based on a standard methodology and nomenclature (EEA, 1999a). At European level the data base is available in a 100m grid format, representing the first two levels of the three level nomenclature. Currently an update (CLC 2000) of the first data base (CLC 1990) is being produced by the national teams of the participating countries, which should be available by spring 2005.

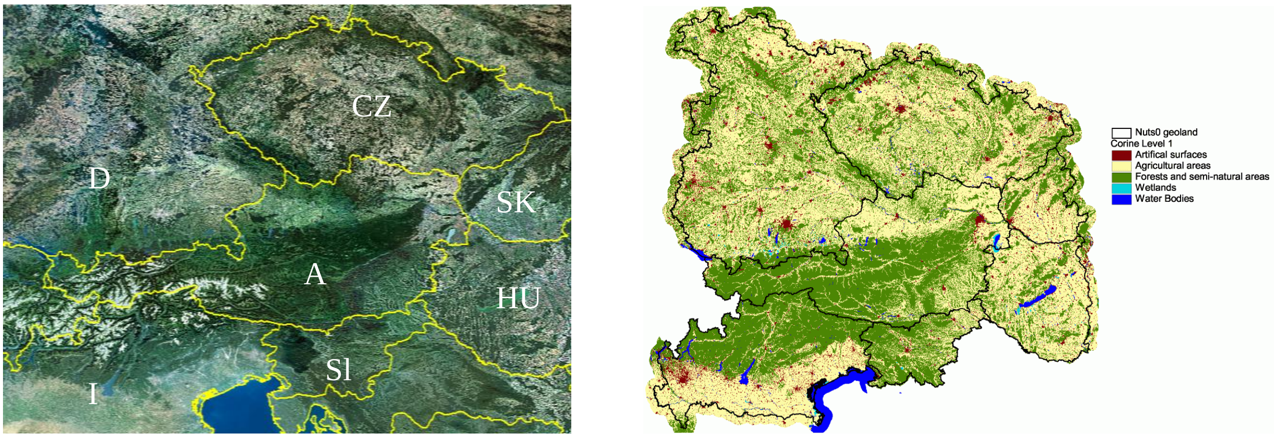

Fig.1: European test site a) MERIS satellite data mosaic b) CORINE land cover level 1

The statistical data at European level are derived from the REGIO database, Eurostat's harmonised regional statistical database. REGIO is a domain of the General Statistics of the New Cronos database. It contains 14 different collections, such as agriculture, demographic statistics, economic accounts, education statistics, environment statistics, community labour force survey (annual average and second quarter), migration statistics, science and technology (research and development, patents), structural business statistics, health statistics, tourism statistics, transport and energy statistics and unemployment. These data are available at NUTS3 level which is used as spatial reference on the European scale. National and sub-national analysis refers to districts and communes (NUTS5) and applies data from national statistical offices.

Three test sites have been defined for the production of indicator products for demonstration. For the European level an area of approximately 420.000 km^2 located in central Europe has been chosen, covering several nations including new EU member states. The test site represents a wide range of heterogeneous geographic landscapes including Alpine areas, costal zones as well as flat terrain with metropolitan and rural areas. It comprises the Czech Republic, Austria, Slovenia and parts of Germany, Slovakia, Hungary and Italy. Figure 1 gives an overview of the European test site.

The test site for the national indicators covers the area of Austria, the sub-national test site covers the area of Vorarlberg. In the course of the project these test sites will be extended by the transnational test sites of Linz – Budweis and Vienna – Bratislava. Additional sites comprise three of the MOLAND areas, namely the Northern Ireland, the Algarve and the Dresden-Prague corridor (EEA 2002).

European indicator set (NUTS3)
1.1 Proportion of artifical surfaces
1.2 Population density within urbanised areas
1.3 Access to nearby public open areas
1.4 Recreational areas within citizen reach
1.5 Agricultural intensity
1.6 Landscape diversity
1.7 Proportion of protected areas
National indicator set (districts)
2.1 Percentage of built up area of permanently habitable area
2.2 Land cover dispersion
2.3 Agricultural land use intensity
Sub-national indicator set (communes)
3.1 Percentage of built up area of permanently habitable area
3.2 Usability/attractiveness of remaining permanently habitable area
3.3 Degree of urban sprawl
3.4 Land cover dispersion

Table 1: List of indicators

3 INDICATOR DERIVATION AND BOTTLENECKS

The European indicator set comprises four indicators, which refer to the urban sprawl and to the urban and urban-rural attractiveness of land in terms of outdoor activities and three indicators referring to rural/environmental issues. The national and the sub-national indicator sets comprise three and four indicators respectively referring to urban/rural/environmental issues.

The methodology for deriving these indicators is based on GIS functions, especially intersections of EO data with other geo-spatial data and statistical information. Thus the technology for producing these indicators is entirely state of the art, but data quality and homogeneity can be regarded as a bottleneck. At European level, currently only aggregated CLC data with 100 m ground resolution is available, which is quite a rough data base for localised analyses, even though the results are subsequently aggregated to NUTS3 units or maps of the scale 1:1 Mio. In addition, statistical data may not be homogeneous over large European areas, and the NUTS3 regions themselves constitute a very uneven reference basis in terms of size and administrative basis in different European countries. Although full resolution CLC data (polygon representation on level 3) is available at national level, this might still be not sufficient for localised analyses, due to the minimum mapping unit of 25ha. Especially landscape diversity is known to be underestimated when derived from CLC data. In addition, CLC data heavily underestimate land cover classes that frequently occur in small patches, especially built up areas, which are not captured at all in many small communities.

At the sub-national level constraints exist mainly with regards to the costs of regularly updated land cover data. Potential users often argue that there is no need to acquire satellite imagery, since the regions are covered by aerial photography every 5 to 7 years. Thus in many regions, there might be a lack of willingness to pay for (additional) space-based EO data. Aerial photography, on the other hand, is costly to analyse, although costs are decreasing with the new automated techniques available today. In addition, image acquisition every 5 to 7 years might not be frequent enough for applications related to environmental reporting obligations.

Beside the constraints stated above the actual challenge of the work is the current lack of experience in building combined indicators linking (highly aggregated) land cover data with aggregated statistical data. But exactly this combination represents the major benefit of these indicators as localised (i.e. geo-referenced) information is offered instead of pure statistical data (EEA 2001). This provides additional information; for instance population density and its evolution can be related to the actually built up area; or access of the population to green and recreational areas can be directly estimated by looking at the local surroundings, instead of using pure statistical aggregated figures indicating only the quantity but not the accessibility of those areas. Consequently, these land cover based indicators express more precisely the living circumstances of people and issues of spatial developments in urban and sub-urban areas.

For the remaining paper we will concentrate on a set of selected indicators, describe their characteristics and method of production, and discuss their benefits and limitations.

3.1 Population density within urbanized areas (European level)

This indicator refers to the actual population density that occurs within built-up areas in contrast to the traditional measure that refers to population per statistical area, such as NUTS3. Assuming that people live in residential areas rather than in the fields or forests the population number of a statistical unit can be assigned to the actual built-up areas within this unit. Calculation of this indicator requires information on land cover – in particular on artificial surface types (CLC class 1 and sub-classes) – and on population statistics as provided by Eurostat on a NUTS3 level.

The indicator can be based either on the entire artificial surface areas or limited to residential areas. The first approach represents the general land consumption per capita, including commercial, industrial and transport related areas etc., while the second approach gives an indication on the density of housing within residential areas.

Representation of the indicators can be based on polygons or a regular grid. For the first approach the land cover layer is intersected with NUTS3 polygons, the proportion of the relevant land cover classes per polygon is calculated and the population data divided by it. This approach gives one value for each NUTS3 polygon. The grid-based approach goes one step further by mapping the calculated density measures on the relevant land cover units leading to a spatially refined density map. This layer is then intersected by regular grid allowing to calculate a density measure for each grid cell. Figure 2 compares both representations of the indicator for the European test site.

3.2 Recreational areas within citizen reach (European level)

This indicator represents the proportion of attractive landscapes (as potential recreational areas) within a specified distance from residential areas. For each “residential cell” the amount of “recreational areas” within its reach is calculated, for instance within a circle of 10 km, to express residential area attractiveness for short one-day or weekend trips.

Recreational areas are defined as green urban areas, forest and semi-natural areas, wetlands and water bodies within a specified distance from residential areas. In order to calculate this indicator raster representation of the land cover map is required (as e.g. provided by the CLC100m grid). First the recreational areas are given one common class code, next the focal sum of this class for a circular neighborhood is calculated for each grid cell. The resulting grid is intersected with the residential areas in order to assign each residential grid cell the number of recreational cells within reach. Summing up these aggregated values for the each NUTS3 polygon and harmonizing the result by dividing by the number of residential cells within the NUTS3 polygon leads to the final indicator. Figure 3a shows the indicator for the European test site.

3.3 Agricultural intensity (European level)

This indicator refers to the percentage of arable land and permanent crops on the potential utilizable area. The potential utilizable area may be taken either as total agricultural area or as agricultural area plus forests and semi-natural areas. In the first case the indicator represents the ratio between intensive and extensive agriculture, as the total agricultural area without arable land and permanent crops leaves meadows and pastures. The latter approach represents the importance of intensive agriculture in terms of agricultural land consumption for the area under investigation.

In order to calculate the indicator the NUTS3 boundaries are intersected with the land cover layer and for each polygon the area of the single land cover types is calculated. The total area of arable land and permanent crops is then divided by the total agricultural area or the total vegetated area respectively. Figure 3b shows the result of the former approach, i.e. the degree of agricultural intensity.

3.4 Degree of urban sprawl (Sub-national level)

All indicators on sub-national level refer to communes (NUTS5) as spatial entity. The calculation of these indicators relies on standard GIS operations such as intersection and spatial statistics. Data sources for indicators on sub-national level are SPOT-based land cover classifications (minimum mapping unit: 0,25ha for artificial surfaces, 1ha for non artificial surfaces) for two dates (1990/2000) as well as national statistics. In contrast to the European indicators this allows for the analysis of changes over time.

The urban sprawl indicator describes the degree to which urban area elements are fragmented. The indicator is calculated by dividing the actual border length of built-up areas by their minimum border length (Forman, 1995). The latter is represented by the perimeter of a circle that has the same surface area as the built-up area. Built-up area comprises residential areas as well as industrial, commercial and transport units. The indicator can be presented in various map versions or as table (see Figure 4).

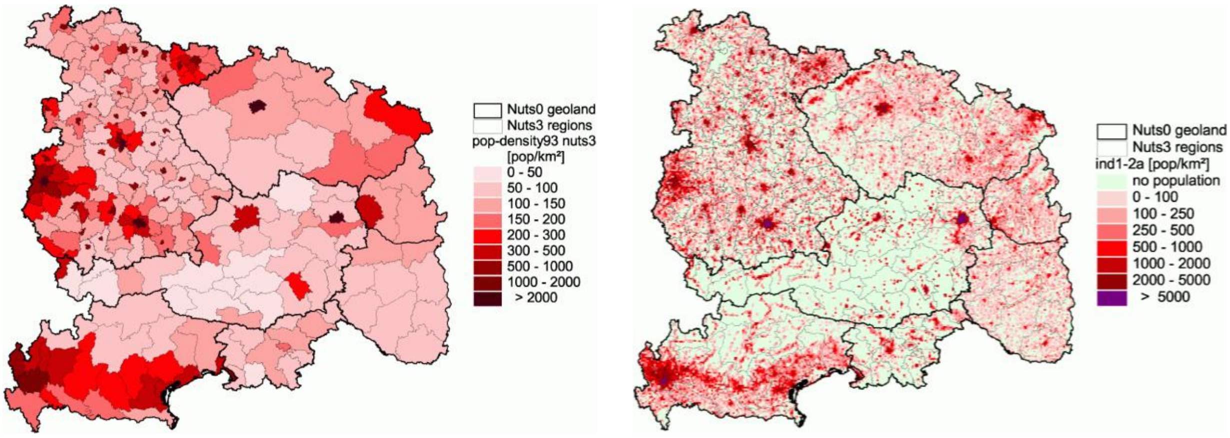

Fig.2: Population density a) polygon representation, b) grid representation

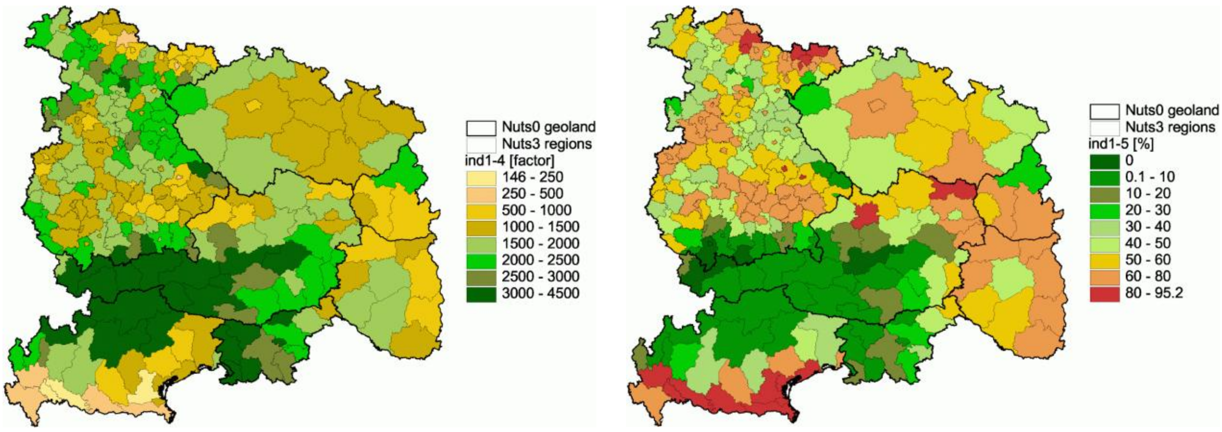

Fig.3: a) recreational areas within citizen reach, b) agricultural intensity

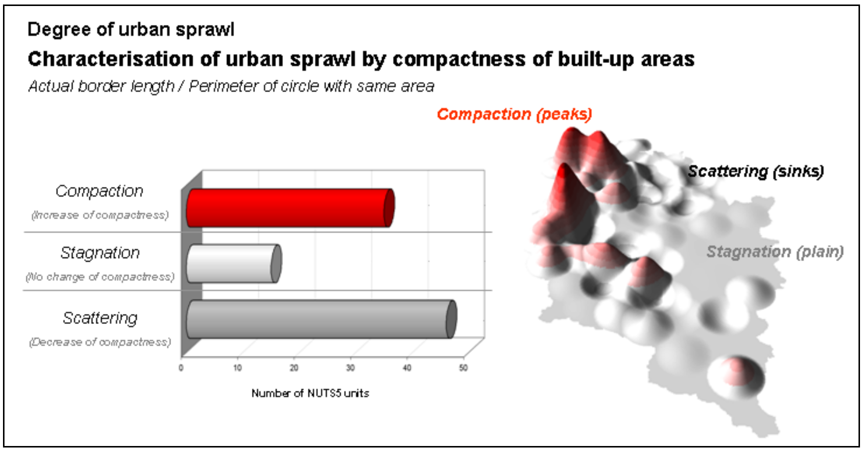

Fig.4: Urban sprawl indicator at sub-national level (Vorarlberg)

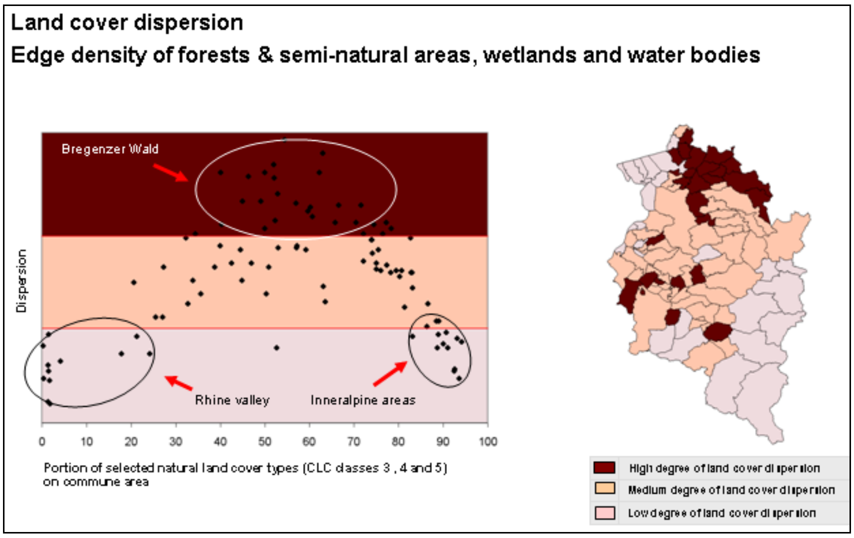

Fig.5: Land cover dispersion at sub-national level (Vorarlberg)

3.5 Land cover dispersion (Sub-national Level)

The dispersion of single or groups of land cover classes provides a measure for the size and distribution of land cover elements and landscape diversity. At this spatial level, the indicator is calculated on detailed land cover data with minimum mapping units of 1 ha or smaller to show variations at a larger scale (1:25.000 to 1:100.000).

Land cover dispersion is indicated by the edge density of selected, non-artificial land cover types, including CLC classes 3 (forests and semi-natural areas), 4 (wetlands) and 5 (water bodies) with their relevant subclasses. The calculation of the edge density is based on the number of boundary pixels between adjacent land cover objects divided by the area under investigation.

The raster approach allows for two levels of aggregation; firstly a continuous surface can be generated by applying a moving window approach, secondly the indicator can be calculated for any irregular spatial entity such as administrative units (see Figure 5). Depending on the approach the result is either a polygon layer or a regular grid where each polygon / grid cell represents the degree of land cover dispersion within its area. The indicator can be either presented as map or as table (only for polygon approach).

4 DISCUSSION

All indicators described above are the results of a first approach and basis for discussion with the users. In the following chapter the outcome of these discussions is presented in terms of problems encountered related to data quality and availablitiy, uncertainty of definitions and potential improvements of the indicators.

4.1 Data sources and quality

One basic source of information is CLC data. At the time of the production of the demonstrators only CLC 1990 data were available for the European test site. Though the production of CLC 2000 land cover maps is nearly finished they will not be available before 2005. This fact limited the presented approach to monotemporal analysis, but analysing the change of indicators over time will be an issue for future work.

In terms of data quality the grid representation of CLC was found not to be sufficient for certain analyses. This is less due to the spatial resolution of 100m – which seems to be appropriate when working on a European scale – but more related to the minimum mapping area of 25ha. In particular for small built-up areas but also for certain agricultural structures the level of spatial detail is too coarse. This has an effect on both the spatial and temporal variability and significance of the indicators. Many land cover changes are not recorded because they are below the minimum mapping unit; likewise, the character and diversity of landscapes – in as much as it is related to smaller landcover objects - is not expressed in the data.

Statistical data were acquired from the REGIO data base available at Eurostat. Besides the complex structure of this data base – requiring interactive data retrieval in order to produce a GIS compatible attributed polygon layers – problems occurred when searching for historic data. Linking land cover with statistical data requires more or less identical acquisition times of both data types. As the reference year for CLC is 1990 statistical data from that time are needed. Unfortunately statistical data from the New Member States are not available before the mid 1990s.

Another difficulty arises from the varying sizes of the NUTS3 areas in different countries. While in the new Member States the size of NUTS3 areas averages out to about 5.000 km^2, in Germany they come down to 1.000 km^2 in rural areas and to 100 km^2 for urban areas. The smallest NUTS3 area of the European test site has a size of less than 36 km^2, the largest a size of more than 11.000 km^2. Comparison of statistical data is somewhat hampered by these disparities but the introduction of land cover data and the referencing of land cover based indicators to a common European grid can help to improve the situation.

4.2 Indicators

Looking at *population density in urbanized areas* we face the problem of lack of land cover detail. As this indicator builds upon the amount of urban area that is partially underestimated due to mapping constraints – as discussed above –, population density can be overestimated. This effect appears e.g. in the North of Austria where many settlements are dispersed and thus fall under the minimum mapping unit of 25ha. As the population is actually distributed over a larger area but only mapped to central villages, the density within these villages will be overestimated while the surrounding land stays “empty”.

Deriving the density from population per residential area shows how densely people live in cities, while also indicating the structure of the residential area. This can also be demonstrated by the reciprocal of the density that yields land consumption per capita; high land consumption indicating single family housing, low land consumption indicating apartment buildings. However, having only one type of residential land cover – on level 2 of the CLC nomenclature no differentiations are made on urban densities – only one density value can be calculated per administrative unit not allowing any differentiation of urban structures. In case of two or more residential land cover types, the population distribution can be weighted according to the residential structures, leading to different density values within one administrative unit.

If the calculation of the population density is based on artificial surfaces in general – including industrial, commercial and transport areas in addition to residential areas – the indicator relates not only to housing issues but also to economic activities of the population. Suggestions were made to introduce GDP as a socio-economic parameter and relate it to the land consumption.

The indicator on *Recreational areas within citizen reach* turned out to be an interesting representation of landscape features. As it takes local patterns into account we again face the problem of spatial detail in the land cover representation. The distance applied is to be seen as a proxy variable but does not represent the actual effort to reach recreational areas. Discussions with the users lead to the conclusion that this indicator should not be limited to residential areas but could be improved by introducing population numbers. Applying population density per residential area allows calculating the amount of recreational area available per capita, thus refining the significance of the indicator.

Agricultural intensity represents the ratio between intensive agriculture and extensive agriculture or vegetation cover in general. Problems occur if the absolute amount of agricultural area is small and dominated by one of the parameters. This occurs for example in the urban NUTS3 areas in Germany (Stadtkreise), where the few agricultural areas are mainly intensively used and therefore the indicator shows a high agricultural intensity (higher than in most rural areas, where at least a certain amount of agricultural land is used extensively). A solution to this problem could be the introduction of absolute numbers as thresholds – i.e. as long as only a minor amount of the area is agriculturally used the indicator is set to a “no significant agriculture” status.

Still under discussion is the question whether this land cover information could be linked with agricultural statistics. As agricultural intensity is only partially described by land consumption the introduction of agricultural production might improve the significance of the indicator. However it is not yet clear how these data sets can be combined in a meaningful way.

The sub-national indicator *Degree of urban sprawl* resulted in a characterisation of urban sprawl by the compactness of built-up areas. Applied to the test-site of Vorarlberg this led to a separation into regions which are affected by increase, stagnation or decrease of compactness of the built-up areas (see fig. 4). Areas with an increase of compactness are found in the Rhine valley and in the most southern part of Vorarlberg (Montafon). In the Rhine valley with it’s high population density the existing settlement areas are getting densified and settlement dispersion is avoided by legal spatial planning instruments (Grünzonenplan) of the State Government of Vorarlberg. In the Montafon the compaction is induced by the tourism in this Alpine region. Scattering settlements can be found in the Bregenzer Wald and in the Klostertal areas. Especially the Bregenzer Wald region is one of the most attractive single housing areas in Vorarlberg due to the neighbourhood to the Rhine valley and the landscape attractiveness.

The sub-national indicator *Land cover dispersion*, which from the methodological approach is based on the edge density of forest and semi-natural areas, wetlands and waterbodies also led to a separation of Vorarlberg into specific land cover characterised areas. In the spatial and statistical analysis the Bregenzer Wald comes out as one of the most attractive landscapes due to a high land cover dispersion factor. Further on, the Rhine valley has been classified as region with a lower landcover dispersion value and a small proportion of the selected land cover types on commune level. Also the inneralpine areas have been classified with a low land cover dispersion value (due to the level 1 class aggregation) but with a significant proportion (nearly 100%) of the CLC classes 3,4 and 5 of the administrative areas.

5 RELEVANCE FOR SPATIAL PLANNING

From a technical point of view, the digestion of the provided indicators, i.e. digital maps and statistics, by the information systems of the users does not constitute problems today, as GIS can be regarded as mature and widely introduced technology. The key question is that of application concepts for the provided information. How and for which goals can these indicators support decision makers and spatial planners?

The presented portfolio only constitutes a selection of indicators out of a huge variety of possible products. They were selected as they provide fundamental and policy-relevant spatial information, but the portfolio remains to be under development. Thus the indicators reflect existing spatial planning/policy making guidelines (e.g., sustainability of land use in the sense of the long-term maintenance of the required land use functions and the natural heritage, European spatial cohesion) and analysis frameworks (DPSIR), as they were derived in relation to these. The knowledge of the concepts and spatial planning targets guiding the indicator selection/definition are consequently the basis for their utilisation. The capital questions that are determining their usage by policy makers are:

- What is the direct message of the indicators and what its significance? In practical terms: What do they describe and "does it matter?"
- What are the causal relations between the origins and the consequences of the environmental problems and what is their ranking in terms of leverage and impact? In practical terms: Which policy targets in a given territory are to prioritise and what are the key causal factors to pay the most attention to or what are the most efficient measures to improve things?
- What are the effects of policies? Has the state of the environment improved? Which measures are likely to improve it?

In addition, the provided indicators can be used to raise public awareness on these issues and to strengthen public support for policy measures (EEA 1999b).

The utility of the provided information for spatial planning or the design of spatial policies is directly linked to whether the products/services fulfil the criteria listed above. In that respect the indicators presented in this paper can by no means be considered a comprehensive and stand-alone information basis for spatial planners. They do, however, present spatially explicit answers to crucial questions - from a sustainable development point of view – when dealing with territories, e.g., how intense is human pressure on land, how are the impacts on the landscape from both, a biodiversity point of view and in terms of land attractiveness for recreational purposes, and how are these things developing over time?

Further improvements of the practical usability of the presented portfolio will arise from the derivation of spatial typologies from the indicators, from spatial disaggregations of population distribution via the distribution and character of the built up area and census data, and from urban growth modelling. These measures and developments will strengthen the assessment potential of the products, their relevance for the population distribution at regional down to local scales, and their potential for policy impact assessments.

6 CONCLUSIONS

The described indicators demonstrate the usefulness of EO based information in particular when linked to statistical information. However, improvements are required both in terms of land cover specification and indicator definition. In order to use land cover data efficiently more spatial detail is needed. While the thematic detail of CLC level 2 is generally sufficient – except for residential areas where different density classes would be helpful – the minimum mapping unit of 25ha is much too large for detailed analyses.

Thematic differentiation of built-up areas that goes beyond basic land use classes such as residential, commercial, industrial etc. should not be based on EO data alone, but should rather be derived in conjunction with statistical data. Linking statistical and EO data in general is not a straight forward process, except for some simple exercises such as spatial disaggregation of population numbers. However, even this simple example shows the benefit that can be gained from the disaggregated information. Applying a regular grid instead of polygons for representing socio-economic data might help to overcome the problem of the varying sizes of administrative areas.

Still missing, at least at the European level, is the demonstration of EO as monitoring tool. Comparing the changes in land use with socio-economic developments should yield further interesting results. With the provision of CLC2000 the development of indicators over time will be demonstrated.

Finally the content and the applicability of some indicators will be analysed and adapted or additional indicators will be produced. These final indicators shall then be the basis for typologies and scenarios to be developed in the course of the geoland project.

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FAVELAS VIA SATELLITE
Spatial Analysis of Slums

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ABSTRACT

According to the Global Report on Human Settlements (United Nations, 2003), almost 1 billion people (32% of world population) live in squatter settlements or slums. Recently, the perspective over those settlements has changed, from harmful tumours which would spread around sickly and unhealthy cities, to a new perspective that interpret them as social expressions of a more complex urban dynamics. However, considering a report from UNCHS - United Nations Center for Human Settlements, in relation to illegal and disordered urbanisation issue, some of the main challenges faced by cities are related to mapping and registering geographic information and social data spatial analysis. In this context, we present, in this paper, preliminary results from the research Favelas Via Satellite. It is a study that aims to interpret city from the perspective of urban texture, using for this purpose, high resolution remote sensing images. We have developed analytic experiments of "urban tissue" samples, trying to identify texture patterns which could (or not) represent distinct levels of urban poverty associated to spatial patterns. Such analysis are based on some Complex Theory concepts and tools, as Fractal Dimension and Lacunarity. Preliminary results seems to suggest that the urban tissue is Fractal by nature, and from the distinct texture patterns it is possible to relate social pattern to spatial configuration, making possible the development of methodologies and computational tools which could generate, via satellite, alternative and complementary mapping and classifications for urban poverty.

1 INTRODUCTION

This paper sinthetises preliminary results from the research Urban Dynamics, originally developed by the authors within the Group for Studies on Technology and Sustainability Applied to Architecture and Planning, from the Faculty of Human Sciences – ESUDA, Recife, Brazil. This document is divided into three sections: Contexts, Concepts and Analysis.

In Contexts, one presents a global view of issues that are somehow related to the main purpose of the research, discussing possible relations between urban poverty and its interpretation from the point of view of urban morphology. At the second part, Concepts, some theories and analytical tools are presented, with the purpose to develop a morphological analysis that allow a preliminary comparison between geometric complexity and spatial data interpretation, obtained from satellite images: Complexity, Fractal Dimension, Lacunarity. Spatial analysis is the focus of the third and last section, which includes a brief description of the softwares applied that were used (FracLac and ImageJ), the analytical process applied in each experiment, image selection and preliminary results.

2 CONTEXTS

Urban spaces, because their complexity, need to be object of multiple and complementary analysis, in order to permit a basic level of comprehension of their dynamics, including a diversity of perspectives, as the social, economic, political, and cultural ones. This research intends to contribute towards a spatial perspective to urban spaces and their complexity. In this context, complexity is approached through analysis of images which can be then confronted to statistic datas and social-economical and cultural information. The city is so observed as a collection of spatial patterns and textures, which integrate a rich and diversified mosaic, that actually hide within itself an apparent aleatoriety, a sign of a non-linear order.

To understand the city from the point of view of form and space, one needs initially to synthesize the complex relations that exist on urban environment, through the carefull election of relevant elements to the chosen approach, highlighting only what is essential under the morphologic perspective. This synthesis exercise is not a simple one and frequently it is misunderstood as analytical reductivism. It is needed, therefore, to understand Urban Morphology (here defined as method and concept related to urban study through the perspective of form and space) not as an exclusive analytical method, but as a complementary tool among a wide variety of possible urban environment analytical tools .

Through this approach, where form and space describe aspects of urban environment, the main issue is to observe patterns that would morphologically characterise the object or system. When forms are planned or they are expression of a classic geometry, mathematically linear, so pattern analysis seems to be a straight and obvious analytical exercise. But, what should one do when form and space apparently do not offer signs of logic or linear order? How would one study spatIal patterns that seems to be an expression of the complete absense of pattern? (figure 1). At the same time, there is an intriguing issue: would the reincidence of that apparent disorder, observed in urban structures, mainly in non-regular areas, be a deep sign of a hidden order? (SOBREIRA, 2002).

All these focus on irregularity and diversity is somehow related to a relatively new concept of Urban Planning (Latin American's governments approach since the beginning of the 1980's), based on the preservation of the morphological structure of the slums and, at the same time, their improvement or upgrading, in terms of basic infrastructure, facilities and urban services. But despite those efforts to acknowledge diversity, slums with different inhabitability patterns are still being considered similar. As a result, only a few number of slums (or areas within them) are being treated by local authorities, while other areas, where sometimes are more problematic and need much more attention, are still not being considered as a priority (BARROS FILHO, 2000). Thus, the understanding of different morphological patterns among slums seems to be an way to improve the manegement and planning of such settlements.

Figure 1: Aerial view of squatter settlement in Caracas, Venezuela.

3 CONCEPTS

3.1 Fractals: Geometry and Complexity

Questions about complexity and apparent disorder of form did not appear in discussions and observations of cities. Spatial pattern analysis of objects and systems that seemed to be logical but that could not be explained by traditional tools and theories from usual mathematics and Classic Geometry started to get scientific respect through Benoit Mandelbrot (1983), and his classic book, The Geometry of Nature, through which the author presents his ideas of what would be known, in the near future, as The Fractal Geometry. In other words, the geometry of the universe that, by nature, is non-linear.

The idea of logic in Fractals is related to observing an object through successive scales. A circle, a square or a triangle (classic examples of Euclidean Geometry) keep their properties, independently of scale of observation. These are objects that can be described according to a linear geometry, that is non-fractionary, as new details will not be noticed as one observe the object closer. But, if one observes a seacoast map, as an example, one will find that the closer the view, more details will be noticed, more roughness, protrusions, complexity. Ferns are truly examples of fractal geometry, as the closer we look at it, more details will be found, similar through scales. A similar pattern one can observe in the city: at each scale of observation, a variety of details, forms, textures. Generally, all systems, objects or geometric patterns which reveal a richness of details through scales, have fractal properties and can not be described by Euclidean Geometry. Nowadays, several studies affirm that city is a systems with fractal features, and that is not a simple expression of rethoric. Such studies confirm that cities are the result of a non-linear logic, whose patterns can not be measured by usual concepts and tools from Classic Geometry (BATTY & LONGLEY, 1994; FRANKHAUSER, 1997; SOBREIRA, 2000). After all, considering that, as Mandelbrot´s said that “clouds are not spherical, hills are not connical, coastlines are not circles, trees are not smouth and lightnings are not straight lines“, one could affirm that cities are not like the orthogonal, one-scale, chess tables.

3.2 Fractal Dimension

The Fractal Dimension quantifies the degree of irregularity or fragmentation of an object of spatial pattern (MOREIRA, 1999). There are several ways to measure the fractal properties of an object or geometrical structure. One of the easiest and more common procedures to quantify fractality is the box-counting method, whose result is the fractal dimension of an object or image. A box-counting fractal dimension indicates the level of complexity or the amount of details through scales (BATTY & LONGLEY, 1994).

3.3 Lacunarity: analysing texture

Considering that cities are naturally born fractals, and admitting that urban textures present a wide variety of patterns, how would one distinguish one texture from another? Or, how to identify differences within similarities? The concept of Lacunarity was stablished and developed from the scientific need to analyse multiscaling texture patterns in nature (mainly in medical and biological research), as a possibility to associate spatial patterns to several related diagnosis.

Focusing on the urban perspective, if one observe intra-urban and consolidated squatter settlements (*favelas*), despite their apparent disorder, the conclusion will be that they share the same spatial features, regarding fragmentation and scaling of morphological structure, wherever in the world (SOBREIRA, 2001). But, if fragmentation patterns reveal what is the common feature in favelas, on the other hand, a more detailed view of *favelas* urban textures will reveal a socio-economic and cultural diversity, so typical of these settlements.

Lacunarity can be understood as a complementary measure to fractal dimension, as it describes the texture of a fractal or any other spatial pattern. Lacunarity is related to size distribution of empty spaces (lacuna) of an image. Generally, if empty spaces in an image with fractal properties present a huge diversity of sizes, it will have a high lacunarity pattern of texture; or, if a fractal is almost invariant in its empty spaces sizes, lacunarity wil be low. Several fractals can be generated and present the same fractal dimension, however, they can be characterised by distinct textures, related to different lacunarity levels. Applications to lacunarity were firstly registered in researches related to image processing in Ecology, Medicine, Biology and other related fields (GARDNER et al, 1996). Our conjecture, in this paper, is that one can use lacunarity as an indicator of urban texture and, probably, as a tool that will permit to associate satellite images to social and economic patterns.

Regarding texture analysis of urban spaces registered by satellite images, lacunarity is the more appropriate analytical tool, specially if associated to fractal analysis, as they are multiscalar measures, that is to say, they permit an analysis of density, packing or dispersion through scales. Lacunarity measures are not based on a unique scale, but through multiscalar graphs that reveal the texture variation at several scaling levels. At the end, it is a measure of spatial heterogeneity, directly related to scale, density, emptiness and variance. It can also indicates the level of permeability in a geometrical structure.

Ben Wu and Sui (2002), in a paper about urban segregation analysis in residential areas through lacunarity, present an algorithm based on a sliding box with a varying size. According to that algorithm, the lacunarity to a box (square section of an image) of size "s" will be:

$$\mathbf{1 + (var(S)/E^2(S)),}$$

where E(S) is the average and var(S) is the variance of mass values of boxes of size "s". Variance is the square of standard deviation ($var(S) = std(S)^2$).

A low lacunarity, generally, indicates homogeneity, while high lacunarity means heterogeneity. The higher the lacunarity, the bigger will be the variation of pixels distribution in an image. In other words, high lacunarity means that pixels are grouped in a wide variety of sizes of islands, surrounded by a widely variant emptiness, indicating heterogeneity of spatial pattern or texture.

4 ANALYSIS

4.1 Computational tools: FracLac and ImageJ

Spatial analysis of complex objects as the city requires a considerable capacity of data processing. Dealing with fractal and lacunarity analysis, in which scale multiplicity is a basic issue to understand the complexity of systems or spatial patterns, this task would not be possible without computational aid. It is not casual the direct relation we can observe, mainly from the 1960's, between computational development and the advance of research findings related to Complex Systems.

To develop analysis of urban textures in this research the computational tool applied is FracLac, a freeware Windows-based application associated to a image processor (also freeware) called ImageJ, both used and disseminated by scientists and researchers interested in issues like high complexity analysis of spatial patterns and textures, from a wide variety of fields.

4.2 Experiments and Preliminary Results

Images analysed in this paper were initially selected according to samples availability and morphological features, considering both regular and irregular patterns. Samples of high resolution satellite images were selected, originally captured by the IKONOS (Space Imaging – Brazil) and freely available to download through the internet, only for no-profit research and evaluation purposes. Experiments, as they were developed in this research, are divided in two approaches: fractal dimension and lacunarity patterns.

The fractal dimension was obtained through ImageJ that applies the boxcounting algorithm. The procedure is simple: the program generates grids over the analysing image, successively, each time with box (grids units) of a different size (2,3,4,6,8,12,16,32,64), depending on parameters defined by the user. To each size of box, it is registered the number of box that contain at least on pixel inside. From this procedure, FracLac calculates the Fractal Dimension, that is the slope of the log-log graph, in which the x-axis means box size and y-axis means number of pixels.

In this analysis we selected three images from the city of Campinas, Brazil: 02 regular (orthogonal geometry) samples and 01 irregular (favela) sample (figure 2). The preliminary result is that all the samples present similar Fractal Dimension. Despite natural expectations of possible differences in fractal patterns because geometrical dissimilarities of the urban samples, we could argue that, irrespective of spatial configuration, both one pattern and another are rich in details through scales, as would be expected if we remember that we are dealing with real cities and not just geometrical patterns or textures. So, as they are complex structures, we could agree with the conjectures presented by researchers as BATTY & LONGLEY (1994) and FRANKHAUSER (1997), according to whom the City is Fractal.

The second experimental analysis refers to the use Lacunarity concepts to evaluate urban textures, selected from satellite images. In this case, it was also used FracLac and ImageJ as computational applications. The algorithm of FracLac that calculates Lacunarity is based on sliding box counting, as described previously. Accorging to this algorithm, the box slides over the whole image, registering the number of pixels inside the box at each stop of the sliding process. At the end, it is calculated the average and standard deviation of the number of pixels registered in each stop. FracLac calculates Epson – E (actual box size / maximum box size), average, standard deviation and Lacunarity, that can be viewed through numbers and graphs which show the lacunarity variation through scale (according to distinct box sizes). Actually, the best way to analyse lacunarity is not through isolated numbers, but through graphs that ilustrate its variance across scales. To be analysed, the pictures need to be converted to binary images.

Figure 3 shows the main results obtained from analysis of samples in Campinas, São Paulo. As one can observe, differently from fractal dimension, which indicated similarity among the structures, when the issue is lacunarity it is possible to distinguish two groups of configuration and texture. The regular (orthogonal) areas present, in average, higher values of lacunarity, what is probably a consequency of the outstanding emptiness of spaces, associated to large and regular avenues, and overall low density. On the other hand, when analysing the *favelas*, the result is low lacunarity, indicating low permeability, resulting from typical feature of such urban structures: highly dense occupation and tortuous alleys.

Figure 4 correpond to confrontation of data of two favelas in two distinct cities: Campinas and Rio de Janeiro. Differently from what could be expected, that would be similariy of patterns, the two irregular areas diverge considerably in their lacunarity patterns. If one observes the results and at the same time analyse the spatial configuration, one will understand that differences result from morphological and social particularities of each community.

So, results of these preliminary experiments with lacunarity patterns seem to indicate important reflections:

I. If Fractal Dimension reveals that distinct parts of the city are similarly complex, Lacunarity complement that analysis, revealing differences of textures hidden by similarities in fragmentation and scale;

II. It is clearly possible to distinguish, through lacunarity graphs, differences of textures related to regular and irregular areas;

III. When a comparison is stablished between favelas, one can observe that differences of density, urbanisation, land parcelling and, probably, levels of urban poverty, generate distinct textures that will be reflected in lacunarity patterns;

5.3 About Image Processing and Analysis

We have seen that Fractal and Lacunarity analysis are basically texture-based pattern interpretation. As it requires binary images for application, a question arises: how the process of binarisation influences the results?

Naturally, as we use different process to ´binarisation´, the results will difer, as we will have different textures. Even though, we can observe through analytical experiments using IMAGEJ that changes in binary process do not change the fractal nature of the image (because the richness of details through scales is mantained). So, the main issue in this regard is not to discuss the best process of bynarisation, but keep the same criteria through the whole sequence of images to be analysed. Doing that, we will be able to establish comparative analysis, whatever the chosen binarisation process. If the purpose is comparing images which apparently represent spaces with distinct levels of inhabitability, the main procedure we have to keep in mind is keeping the same analytical process to all samples, so that it will be possible to properly analyse the results, limitting the changing variables. There would be a problem only if we had chosen a different process of binarisation to each new sample of image.

So, the answer to the question "how the binarisation process affects results" is: changes in binarisation process obviously will change the fractal dimensions, but it does not change the fractal nature of the images. So, to establish a proper comparative analysis, we just have to choose the binary process that seems to keep the main visual properties of the original image, and repeat the parameters to the whole set of image samples to be analysed.

In analysis through binary images of urban textures, dissimilar land uses with different absolute radiances, such as built and non-built areas, if covered by shadows or by vegetation could have similar slopes of their spectral reflectance curves and may appear similar (LILLESAND & KIEFFER, 2000). That would affect the results, if analysis were depending on strict identification of built or non-built elements. But the approach suggested in this paper is based on texture, irrespective of being built or non-built elements. This analytical methodology does not depend on direct and strict visual interpretation of satellite images.

Afterall, should the binarisation process be supervised or non-supervised by the image analyst? In this context, we can suggest a non-supervised approach assuming that, in this case, it is not necessary to classify land use types from the image, such as built and non-built areas, because the image's spatial elements are considered as inherent parts of a specific global texture pattern generated by the combination of such features. This approach can also be justified by the fact that a supervised binarisation procedure requires a great deal of training and practice and it is not necessarily replicable from place to place and time to time (WEEKS, 2003). A supervised approach is also both time-consuming and is particularly subjetive (DONNAY, BARNSLEY & LONGLEY, 2001). Moreover, intensive field survey should be necessary and can often be problematic in some slums, especially those where accessibility is inhibited for security reasons (BAUDOT, 2001). However, the texture patterns resulted from a non-supervised binarisation procedure do not properly resemblance their original satellite images and the comparison between them can lead to wrong conclusions because they are affected by different surface materials and illumination conditions, presence of clouds, etc. To avoid that, the original images should be previously analysed, classified and properly selected before the binarisation process.

In this sense, the combination of shadows, trees, voids, cars, river, buildings, plots or the absence of all these elements in the *binarised* image will generate a specific kind of texture. What one should focus at that moment is whether the way those elements are interrelated and distributed through the image will correspond to a texture and specific pattern that could allow any kind of classification. Thus, in this case, trees or shadows are not problems or barriers to image interpretation, as they can be interpreted as inherent parts of a global texture that characterises a space. That is the main difference between analysing satellite images through methods as lacunarity (focusing on global texture), in comparison to the traditional analysis of direct observation of photos (focusing on specific elements). We all know it is hard to intepret images traditionally, focusing on speficic elements, because of resolution levels and barriers, as trees, shadows and other elements usually seen as barriers to the viewer. But, interpreting textures, the elements usually seen as barriers are simply compositive elements of a general texture.

5 PERSPECTIVES

We suggest that, considering preliminary results, that high resolution images, when combined to computation tools, analytical procedures and theoretical concepts based on Complex Systems approach, can be powerful instruments to manegement and monitoring urban spaces.

At the same time, if on one hand one can observe how complex and similarly fractal the urban structures are, on the other hand, one can not deny the diversity of patterns and textures behind similarities. Fractal Dimension reveals what is in common among those structures, that is the multiplicity of scales and inherent social complexity. Lacunarity reveals a possible relation between texture and economical, social and cultural patterns.

We believe that a natural and inevitable step towards spatial analysis of cities and its urban structures and consequently its morphological correlation with social events will be the attempt to establish relation between spatial and geometrical patterns and social and economical data, specially when associated to GIS and Remote Sensing techniques (BARROS FILHO, 2000). To achieve that expectation, it is necessary concentrate effort in municipalities, with the purpose of make viable and accessible all the technology and scientific knowledge that presently is restrict to academic groups and institutions.

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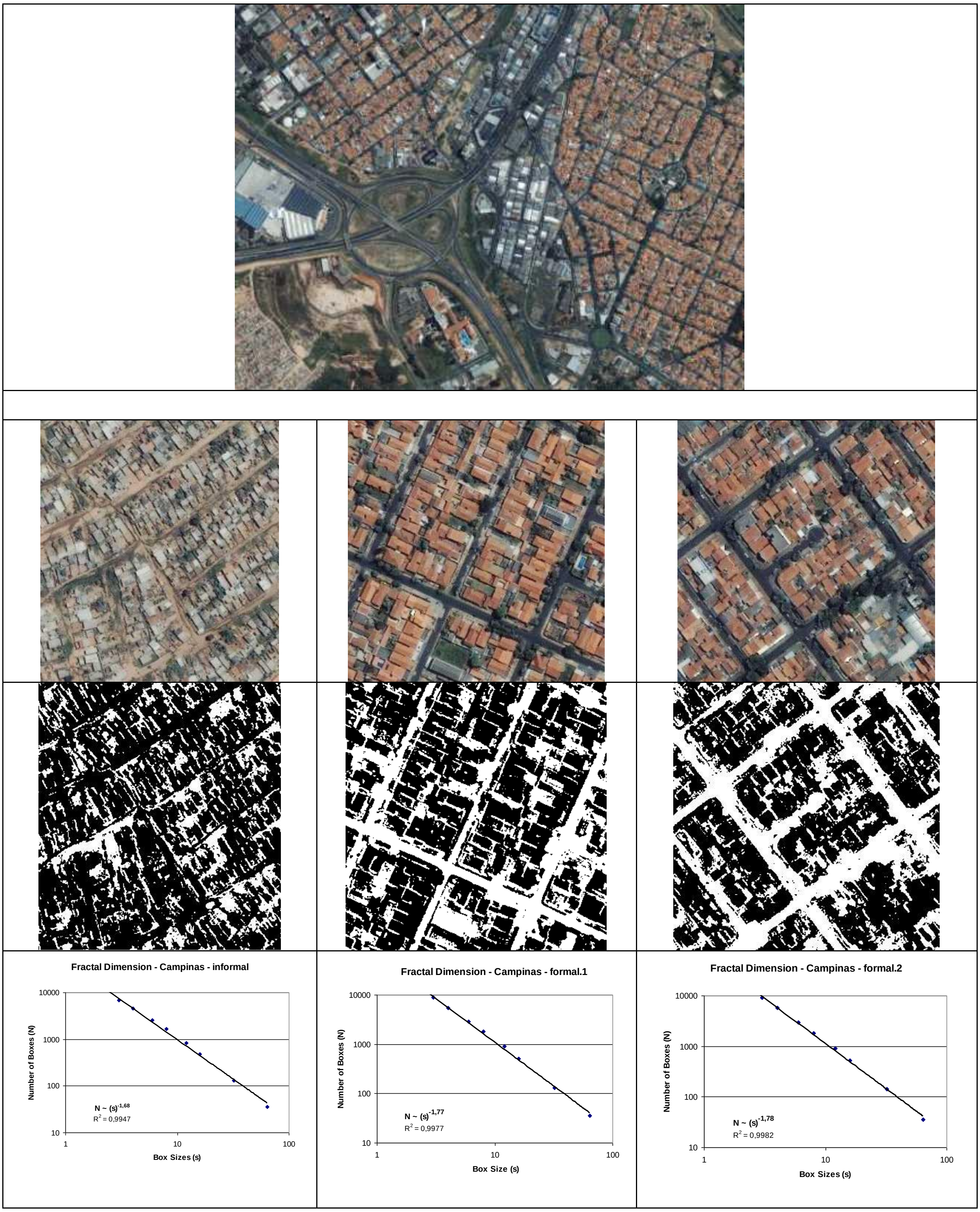

Figure 2 – Satellite Images - Campinas - SP - Source: Space Imaging - Brazil.Top-down: sample of Campinas - SP; samples of regular and irregular (*favelas*) areas; binary versions of images; Fractal Dimension (D) - logxlog graph indicating relation between the number (N) and size (t) . Fractal Dimension is indicated by the graph slope.

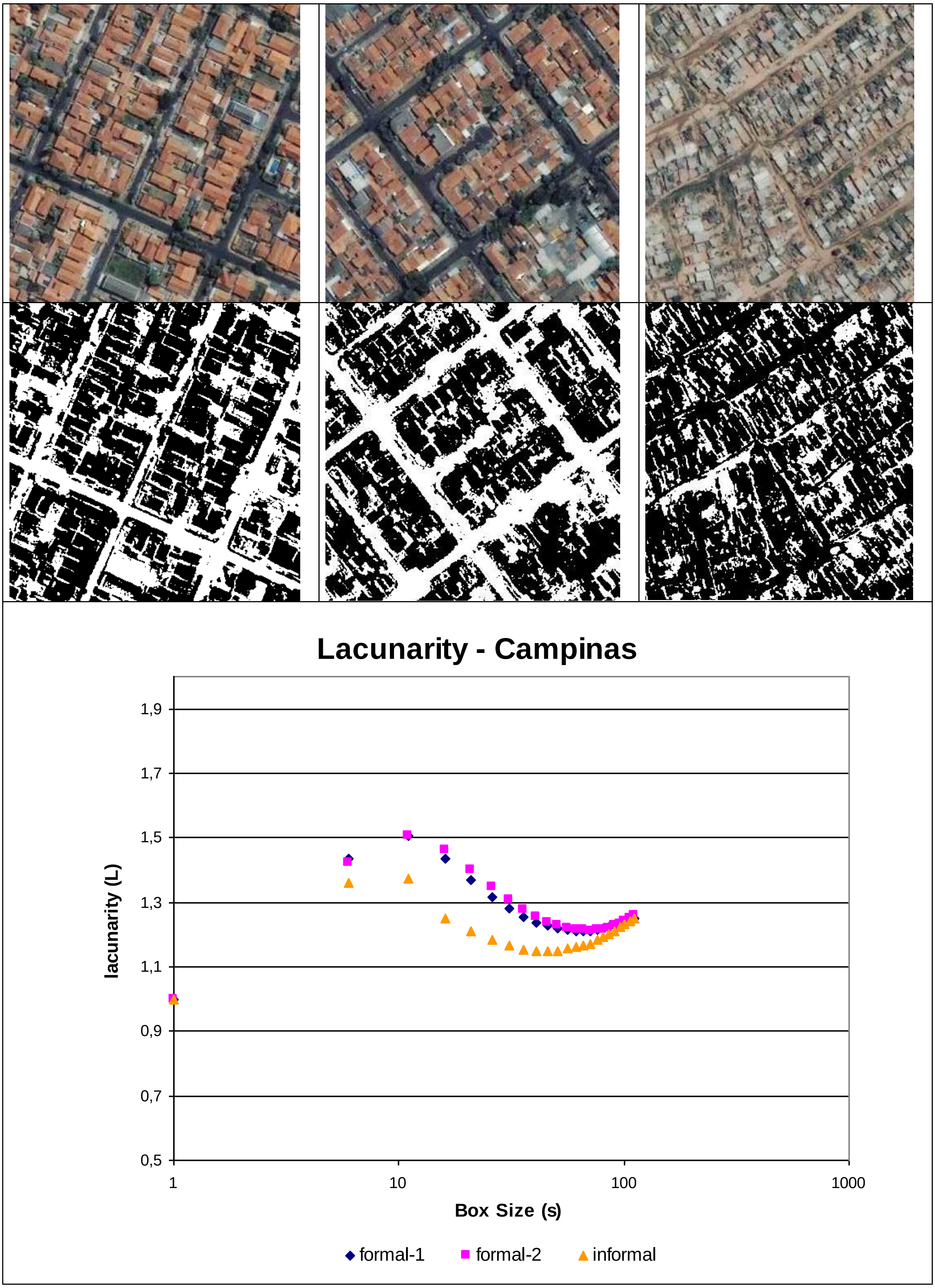

Figure 3 - Lacunarity - Campinas. Top-Down, Left-Right: samples of satellite images, binary versions of samples, lacunarity graph, describing variation through scales.

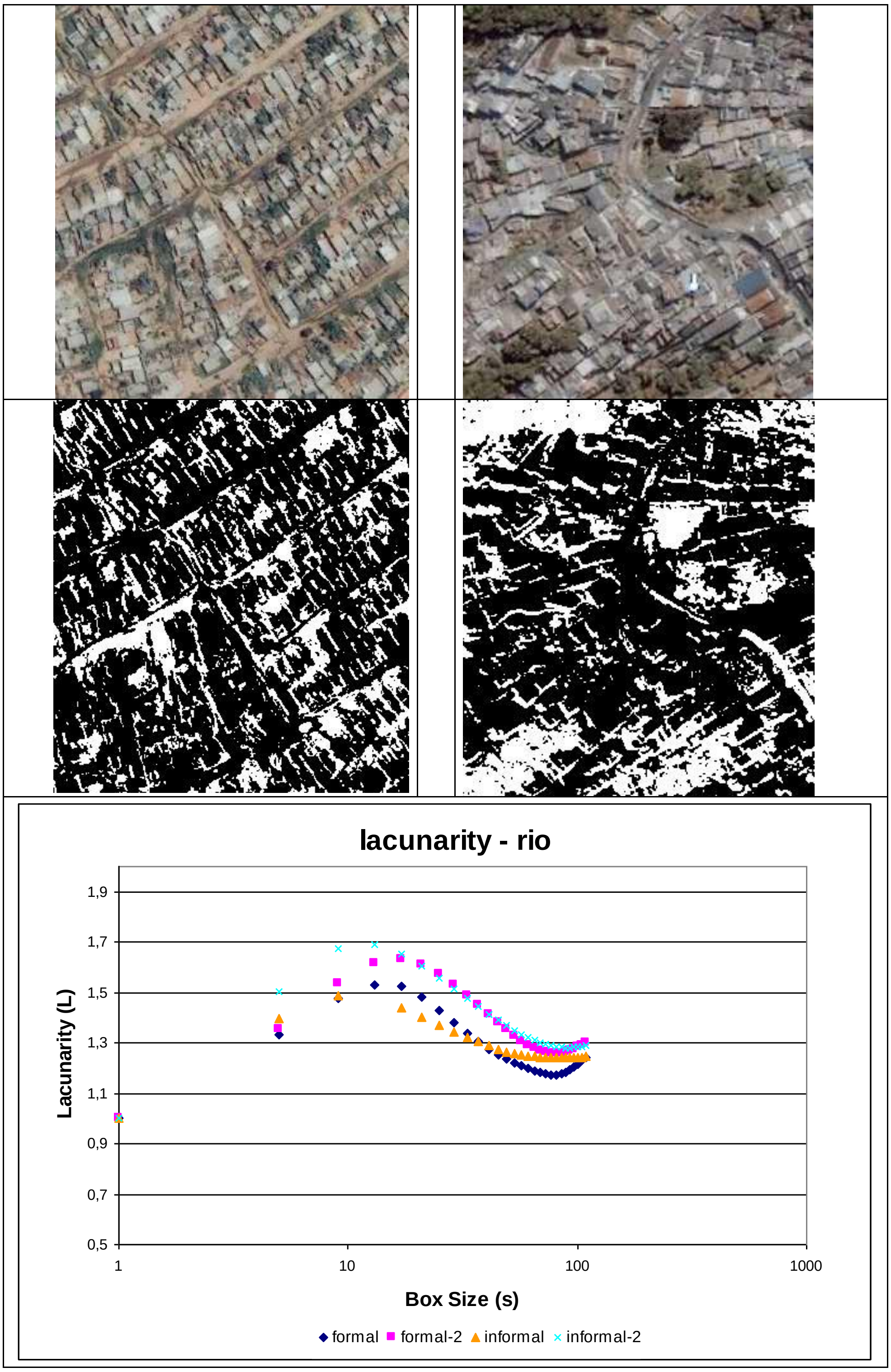

Figure 4 – Lacunarity Graph - Campinas (left) and Rio de Janeiro (right).

Transboundary landscape structure to determine the environmental situation of traditional land-use activities in Austria and Czech Republic

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ABSTRACT

This investigation was carried out to demontrate the usefulness of landscape metrics as information source to inform in a quantified way on the diverse shaped landscape of Waldviertel's (A) and Trebon Basin's (CZ) transboundary EUROREGION Silva Nortica (German: Nordwald). Landscape has been shaped over centuries by different political systems with respective landscape management policies and agricultural practices, implemented by using different technological tools, what at the end lead to the diverse face of the landscape what we are looking at today. The landscape metrics were calculated on vector maps derived from a pixel-based classification, based on a Landsat scene from year 2002. A semantical approach was used instead of correlation and factor analysis to select a set of structural indices suitable for the quantitative assessment. The study area was devided into subregions using the formerly tightly closed border to divide the Czech from the Austrian part. The landscape analysis were conducted for both regions individually and later compared to each other. The resulting numbers quantify significant differences in the values and indicate the visually graspabale non-similar pattern for both sides of the border. These findings indicate that anthropogenic influences based on different political framworks and rules, create landscapes of different behaviour, processes and functions.

1 INTRODUCTION

The (political) factors influencing landscape management in this Czech-Austrian cross-border environment have changed dramatically during the last decades of political transformation. In this context it is claimed by several authors (Herzog et al. 2001; OECD 1997) that methods to properly monitor the effects of these changes in land use and land cover are necessary. For this purpose, common agreements on core sets of indicators are currently to be aspired from international initiatives for landscape change evaluation (e.g. EU Natura 2000 Directive based on the Fauna-Flora-Habitat-Directive (92/43/EEC)). However, to finally arrive at an expressive, understandable and publicly acceptable set of landscape metrics, there are still several obstacles to overcome. First, the existing state of the landscape to be examined is not investigated in sufficient detail, that is to provides information about the absolut condition currently existent. Yet, it is strongly necessary to correlate the derived metrics values with the existent underlying condition. Secondly, different landscapes with their distinct environmental conditions still poses high hurdles to the spatial transferability of metrics. Therefore, comparing two landscapes with different prerequisites still causes problems to the landscape analyst. Thirdly, the focus of the studies can often vary and therefore a unique statement on the quality of the landscape as a combination of the individual interpretation of the resulting values remain difficult. Despite these facts, landscape metrics are in scientific discussion and their importance for landscape management is stated higher and higher (Forman 1995, Blaschke 2000).

The faces of the landscape are determined by various types of land cover patches representing different types of anthropogenic land-use and natural systems, forming ecological relations (networks) and thus create biodiversity. Over decades the landscape mosaic is regularly subject to change with patches continously experiencing change in their size and shape. Meaningful interpreted with sufficient knowledge on the local spatial structure and environmental conditions, landscape metrics can thus provide helpful indications on the inter-patch relationships, turned out by processes and as a result can tell us something on the integrity of the ecosystem within the continually alternating landscape (Klug, Langanke, Lang 2003). However, understanding and describing the contemporary local (environmental) conditions not just base on the gradual monitored changes of different states of the landscape in the past, as it has been done in most prior applications. On the contrary, it seems to be important to describe the landscape's condition individually by applying and interpreting landscape metrics just to one representative point in time.

The task to promote cross-border sustainable development in the region Silva Nortica, poses today equally a challenge and an opportunity to bring new tools and methods into practice. This is, among others, to perform a problem-adequate structural analysis of the landscape under consideration. The transboundary region Silva Nortica is a place where traditional land-use activities are still fostered, in particular agriculture development, carp cultivation, and forestry. Nevertheless, since the fall of the former Iron Curtain it is to assume, that the structural reforms in agriculture, the risen transnational traffic and the related constructional upgradings in this once remote area will have a substantial influence on the fragile network of the local ecosystems, like e.g. the valuable wetlands of the Luznice water catchment area. These developments are asking for reactions by landscape planners and -policies, whom themselves for their work have to rely on solid quantifiable statements and informations regarding current and expectable trends of land use. Landscape metrics are foreseen to provide information regarding the configuration and composition of the landscape (Farina 2000). Thereby the measured values describe spatial elements by unfolding the overall structure of the landscape, referring to underlying processes and functions (Klug and Zeil 2004). This is performed by the description of single landscape elements (patches) and their class aggregates with special attention to their problem-specific interrelations.

2 METHODOLOGY

Landscape metrics are beeing used in several disciplines since the 1950`s by Paffen (1953), Haase (1964), Neumeister (1972), Haggett (1973), Garten (1976) and Stöcker and Bergmann (1978) as well as several american landscape ecologists (Forman and Godron 1986, Riiters et al. 1995, Tuner et al. 2001), but software, able to reasonably exploit the expressivness of the metrics became first possible with the arrival of powerful GIS environments in the late 1970's. Since that time, geographers and landscape ecologists promote landscape metrics as a tool for landscape structure analysis. Landscape ecology as a discipline is based on the premise of strong interrelations between ecological functions, processes and change, taking into account the underlying pattern of spatial elements and ecosystems and their relative distribution. To these belongs the flow of energy, material and species in relation to size, shape, number and condition of the unique components of the landscape (after Walz et al. 2001). To analyse these complex relationships between structure and processes, new methodologies and concepts came up using landscape metrics to monitor and evaluate changes (Forman and Godron 1986, Blaschke 2000). The structure of the landscape is the expression of local diversity from which we derive conclusions to functions of nested ecosystems. In that sense, functions refer to the importance of system components as storage and modulator of processes, where processes are the summarizing term of relations and dependencies between compartments in representation of energy and matter flows. In the 'natural landscape' (German: Naturlandschaft) abiotical elements predefine the representation of land cover and land use elements. Following this concept, landscape metrics are problem-adequate as indicators to characterize anthropogenic influences on the landscape level. Thus, relations between the natural area and the cultural landscape can be analysed and deficits be shaped.

2.1 Shape and location of the study area

To describe the systems on both side of the border we need a spatial representation. For this purpose, appropriate delineation of a problem adaequate study area can be defined in several ways. One way is to take administrative units whereas other types, according to Simpson et al.(1994), Knick and Rothenbuerry (1997), Mladenoff et al. (1997) include e.g. watershed zones (catchments) or 'natural landscape units' as described by Herzog et al. (2001). Regarding this survey it was our intention to give a comparing view on this heterougenous landscape on a rather coarse (regional) scale. Therefore, a representative subset was choosen, located directly at the border line in form of a boundingbox with a total area of 70.000 ha and having its geographical extremes at 48°80`N - 49°20`N and 14°60`E – 15°00`E (figure 1). The study area is subdivided into two pieces and covers parts of Southern Bohemia’s Trebon Basin in Czech Republik (CZ) in its northwestern and parts of Austria’s (A) Northern Waldviertel in its southeast extend, located in the geographical center of the recently (2002) established cross-border region EUREGIO Silva Nortica The vegetation consists mainly of a mix of coniferous forest, water and grassland. Principal ecosystems to find here are fish ponds, forest, xerotrophic sand societies, grassland and intensively used agro(eco)systems. The industrialized agro-production, aimed at maximizing yields became the prime agricultural policy objective for years on both sides of the border, with the consequential implementation of this policy leading to the creation of large field units, in particular in the communistic planned economies. "This large size was at least in part due to standard reclamation practices, which were in fact designed to create landscapes with optimal conditions for industrialized farming" (Herzog et al. 2001). However, one of the side effects of the enlargement of the field sizes was, that most of the ecological infrastructure were removed as well, leading to a reduction in ecotones, ecotopes, hedgerows, single trees and therewith a simplification of the landscape matrix.

Fig.1: Transboundary region Silva Nortica – Red line, Biosphere Reserve Trebonsko – Yellow line, Boundary CZ-A – dashed black

2.2 Goals and objectives (why, for what, purpose)

The description of the landscape and its characteristics by means of landscape metrics will contribute to develop an understanding on the things, which have had a shaping effect on the region under consideration over the last decades. Here, along the former Iron Curtain border the landscape is still structured very heterougenously, already detectable by the human eye. Thus, referencing each state on both side of this *divided* entity will provide us with a wide range of de facto values each metric can exhibit. Therewith we are able to calibrate the ranges to relative minimum maximum of values and derive conclusions about the meaning of these differences. Having identified the meaning of the differences by applying a proper interpretation, the attained knowledge about these effects and (driving) factors can thus later be introduced into regional cross-border development efforts. The awareness and recognition of ongoing processes hereby serve as a base to enable stakeholder and expert rounds, to guide the landscape toward a sustainable future.

2.3 Data used

A five class (forest, arable land, grasland, settlements and water) deep pixel-based classification of the Landsat ETM 2002 scene (21st of July) was produced using Erdas Imagine 8.7 software. This classification was taken over from a change detection study from 1991 to 2002 carried out by Stroebel et al. (2004) in the Iron Curtain project (http://www.geo.sbg.ac.at/projects/ironcurtainweb/). The classification was first converted from ESRI Grid file to ESRI Shapefile and finally exported to ArcGIS 9.0, where the indicator calculation was performed by using the Arc GIS extension vLate (Vector-based Landscape Analysis Tools Extension, http://www.geo.sbg.ac.at/larg/vlate.htm) developed by Lang and Tiede (2003) in the EU funded project SPIN (EEVG 1-CT-2000-019, www.spin-project.org).

Prior to the calculation process with vLATE, a critical pre-processing step had to be carried out. The underlying data needed to be processed by a dissolve procedure to harmonise the polygons showing a size smaller or equal than 1000 m². This reduction of the total number of patches was essential to eliminate the so called "salt and pepper effect". The reduction of polygons lead to a higher performance of the calculation algorithm in vLATE, fully aware of the content based influences of these pre-processing steps. Due to the reduction of polygons the real small scaled landscape structure with the numerous small sized lakes and the characteristic agricultural plots on the austrian side was generalised. Nonetheless, the represented general states of the landscape structure on both sides could be remained and kept directly distinguishable. Another argument for this pre-processing is the focus on the aspired meso-scale dimension with a cartographic representation of 1:50.000, which allowed for generalization. Moreover, it must be considered, that one pixel of the Landsat ETM 2002 scene was 900 m^2 (30 by 30 km), with the consequence, that one area at least must have comprised two pixels.

2.4 Selection process

To reduce the numerous metrics available to a manageable set, we applied a semantical approach after Klug et al. (2003), where purposefull small sets of indices where identified, that nevertheless adequately reflects the major landscape properties taking into account the underlying (management) question to be answered. This statistical method not urgently avoids redundant information or doubling-up of similar information due to correlations (Riiters et al. 1995, Herzog et al. 2001) but contribute to the progress of knowledge due to the remaining carrying capacity of the potential indicator information. The selection of the metrics therewith is not an arbitrary task, but instead should be transparent and pursuable. The preferation of indices remain from the recommendations stated in the database IDEFIX (Indicator Database for Scientific Exchange) developed by Klug et al. (2003). These recommendations are revealed from literature reviews, previous projects and experiences with landscape metrics. Thereby one main goal was to avoid ambiguous interpretation of one and the same representation of a metrics value. The indices used here follow the groupings proposed by Lang and Klug (2003), limited to the categories of size and shape, since they found suitable to answer the here posed questions in the most comprehensive manner.

2.5 Calculating, mapping and interpreting landscape metrics

As Lang, Klug and Blaschke (2004) and Gustafson (1998) figured out, several open GIS-based software solutions exist, that can be used to perform a quantified landscape structure analysis, but less solutions exist to do so on vector datasets. In this study, the indices were calculated using the ArcGIS 9.0 extension vLate 1.0 (Lang and Tiede 2003). As most of the calculation procedures are based on class level and the results are presented as tables, charts and graphs (see chapter 3), the spatial representations in form of thematical maps is generally found not meaningful for this sort of analysis.

3 RESULTS

Size metrics

The landscape metrics values are reflecting the trends identified from the visual interpretation of the satellite scenes and from the areal statistics. At first sight, the metrics show, that forest dominates the land cover in the overall study area (see Table 1). In contrast, Built-up areas have exhibits the lowest quantity. However, with regard to the total Number of Patches (NP), grassland (Grld) dominates in both regions clearly in front of forest (CZ = 33.98 %; A = 45.00 %) whereas the share of arable land in the landscape is more dominant. Both indices indicates a rural setting of the study area with a focus on small patched grassland distribution and greater agricultural farming plots. The third important landscape structuring cover type is built, though here occupying just about 2-3 % of the the total area.

Tab 1: Total area (TA) and Number of Patches (NP) of SA, Silva Nortica

CLASS	Area CZ (km²)	%	Area A (km²)	%	NP CZ	NP CZ (%)	NP A	NP A (%)
Forest	261285.16	56.24	135500.76	53.64	548	16.58	383	13.67
Arab	129095.66	27.79	83353.83	33.00	781	23.63	560	19.99
Grld	57441.27	12.36	26035.74	10.31	1123	33.98	1265	45.15
Built	10630.41	2.29	7460.11	2.95	763	23.09	581	20.74
Water	6144.85	1.32	244.90	0.10	90	2.72	13	0.46
TOTAL	464597.36	100.00	252595.33	100.00	3305	100.00	2802	100.00

Mean Patch Size (MPS) is an indicator for the grain of the landscape (McGarigal 2002), together shown on class level with the Patch Size Standard Deviation (PSSD in Table 2. Comparing the MPS shows considerable differences between the two areas for the classes forest, grassland and water. In general it could be figured out, that MPS of the landscape classes on the Czech side is significantly larger than on the Austrian side. This observation is confirmed by the Coefficient of Variation (CV). This indicates on one hand, that the general fragmentation of landscape on the Czech side is not very much proceeded, what on the other hand, does not wonder, still taking into account the former large scale planned agriculture and pond cultivation practice on Czech side. In contrast, the rather small scale agriculture and pond cultivation practice in Austria got again underlined by these numbers.

Table 2 Mean Patch Size and Patch Size Standard Deviation for study area Silva Nortica

CLASS	MPS CZ (km²)	MPS A (km²)	PSSD CZ	PSSD A	CV CZ (%)	CV A (%)
Forest	476.80	353.79	7172.47	3751.47	1504.30	1060.37
Arab	165.30	148.85	1125.59	1285.56	680.96	863.69
Grld	51.15	20.58	202.60	52.64	396.10	255.76
Built	13.93	12.84	61.40	69.85	440.71	543.97
Water	68.28	18.84	115.82	25.25	169.63	134.06

Further landscape metrics as Total Edge (TE) and (MPE) are calculated to provide information on the heterogeneity in the landscape by calculating the length of perimeter and edges of adjacent class-patches. The results are presented as average values for each class. Arable land has the highest TE expressed as share of percent of the Austrian resp. Czech area (A = 38.79 %; CZ = 32.70 %). That is, that the total class of arable land on Austrian side is more fragmented and interspersed than the one on the Czech side. In distinction to this, the class forest has the largest Total Area (TA) on both sides (Table 1). The MPE represents minimal differences in classes characteristics. As a consequence of the industrialized farming on the Czech side, the MPS of arable land increased and the shape of the plots got a more geometrical order. Additionally, the forests were arranged to comparatively larger areas, whereas smaller pieces and ecotopes has been removed.

Table 3: Total Edge (TE) and Mean Patch Edge (MPE) metrics for study area Silva Nortica

CLASS	TE CZ (km)	TE CZ (%)	TE A (km)	TE A (%)	MPE CZ (km)	MPE A (km)
Forest	1524.34	30.33	1085.88	28.00	2.78	2.84
Arab	1643.15	32.70	1504.31	38.79	2.10	2.69
Grld	1364.40	27.15	985.51	25.41	1.21	0.78
Built	395.90	7.88	296.06	7.63	0.52	0.51
Water	97.45	1.94	6.60	0.17	1.08	0.51
TOTAL	5025.24	100.00	3878.36	100.00	1.54	1.46

Shape Metrics

Two important measures describing the complexity of a single patch are the Mean Shape Index (MSI) and the Mean Perimeter Area Ratio (MPAR). MSI is 1 when the patch is circular and tends to 2 with the patch getting a more narrow and rectangular form. The MSI calculated for the study area shows similar values on both sides of the border (Table 3). This is due to the more or less equal aggregation or clumpiness of the patches of the classes compared. Convoluted patches are rare and the shape of the agricultural plots are more or less rectangular. The MPAR non-standardized index additionally describes the shape complexity of a patch. This means, the smaller the MPAR the more compact is the patch.

Table 4: Shape Metrics for study area of Silva Nortica

CLASS	MSI CZ	MPAR CZ	MSI A	MPAR A
Forest	1.604	0.067	1.667	0.063
Arab	1.635	0.069	1.733	0.067
Grld	1.644	0.062	1.588	0.067
Built	1.447	0.081	1.451	0.08
Water	1.403	0.04	1.279	0.067

Diversity Metrics

To measure and monitor landscape diversity, landscape metrics can contribute to the understanding how processes of (human) interferences affects the landscape`s richness over time. Shannon`s Diversity Index (SHDI) is a popular measure of diversity and somewhat more sensitive to rare patch types than Simpson`s Diversity Index (SDI). SHDI = 0 when the landscape contains only 1 patch, which is equal to the meaning of no diversity. SHDI increases as the number of different patch types (e.g. Patch Richness) increases and/or the proportional distribution of area among patch types becomes more equitable. However, SHDI is recommendet to use only with a Patch Richtness (PR) greater than 100 (Yue et al. 1998).

Shannon`s diversity index is more sensitive to richness than evenness. "Thus, rare patch types have a disproportionately large influence on the magnitude of the index" (McGarigal 2002). Simpson`s diversity index on the other hand is relatively less sensitive to richness and thus place more weight on the common patch types. Simpson`s Diversity Index (SDI) is a dominance index weighted towards the abundance of the most common land use / land cover type rather than richness (Magurran 1988). Therefore it should be less dependant on the number auf land cover types than SHDI. Both indices have been applied by several landscape ecologists to measure the aspect of landscape composition within landscape structure (e.g. O'Neill et al. 1988). Calculating Shannon's Diversity measure here, the index shows almost the same values for both sides in the study area. The same is with Shannon's Evenness Index, measuring the distribution of patches (Table 4). That means for Shannon's Evenness Index neither a dominating nor an even distribution of area among patch types. However, there is no area with a primarily dominating allocation of a specific land cover type.

Table 5: Diversity metrics for study area of Silva Nortica

Index / Side	CZ	A
Number of Class	5	5
Shannon's Diversity	1.082	1.045
Shannon's Evenness	0.672	0.649

4 CONCLUSION

Landscape metrics have been proved useful in assessing the current conditions in this Czech - Austrian transboundary landscape and allowed to link assumed historical landscape shaping reasons to index numbers. Thereby the subdivision of the test area into subthemes of border regions proved helpful, especially on class- and landscape scale. In contrast to other delineated study areas, which are chosen on a more or less arbitrary basis, the subregions allow specific consideration to be linked to system characteristics and enable us to distinguish between the effects of major driving forces which have taken place over time on the respective side. The configuration of a landscape is represented by landscape metrics through mapping polygons and their describing features, such as number, size, and shape. In our case, the metrics used indicate on a comparable diversity on class level for both sides. However, more significant differences appear when the Number of Patches (NP) is taken into account. It indicates a major fragmentation on the Austrian side, although its Total Area (TA) is smaller than on Czech side. The size metrics report that the Total Area of each class does not depend on Number Of Patches (NP) (Table 1), which means that the grade of patchiness on the Austrian side is higher.

The detailed characteristics of the landscape on both sides of the border could be described more clearly with the Mean Patch Size (MPS) and the Patch Size Standard Deviation (PSSD). Applying these indices, continuously higher values describing the main classes (forest, grassland and water) are to be observed on the Czech side. As the MPS and the PSSD can be used to describe the grade of (anthropogenic) segmentation of the landscape, the higher values of MPS and PSSD on Czech side in view of forest and grassland may be the result (and the affirmation) of the taken conservation measures (as part of the study area is piece of the RAMSAR wetland zone and the Biosphere Reserve Trebonsko) and therefore an absences of large sized industrial activities. Moreover, the remaining larger agriculture plots in this fertile area on the Czech side (Table 2) can be interpreted as a cultural heritage of communist times, resulting as a special process-value-indication. The industrialized agricultural production aimed at maximizing yields became the prime agricultural policy objective, while the implementation of this policy led to the creation of large field units.

The absence of excessive human development in this transboundary area in general can be represented by the Coefficient of Variation (CV), which is concerning the classes Built and Arab higher on Austrian side. The assumed driving force behind the landscape change was the fact, that the border region was not settled for years but instead was intensivly agriculturally used. In contrast, the higher grade of urbanization and more economical activities on the Waldviertel`s side is to be taken cautiously (and is obviously wrong, taking the full EUREGIO area into consideration) as in communist times border areas were generally limited to military purposes and the Biosphere Reserve Trebonsko with its core zone has a mayor share of the study area.

Variations in the values of the shape metrics (MSI and MPAR) could be observed. The MSI for the class Water on Austrian side is lower than all other classes. This is owed to the fact, that the commonly small sized ponds on Waldviertel side were represented in the original landcover classification (Landsat scene = 900 m² resolution per pixel) just by 1 - 2 pixels with the consequence, that they could not develop more complex shapes when converted into polygons (scaling and generalization effect).

The Mean Perimeter Area Ratio (MPAR) informs how the landscape mosaic is structured by describing the complexity of patch shape. On both sides, the class Built has almost the same value (Table 3), and as such indicates that the size of the urban areas are smaller and less compact compared to other classes. This observation is confirmed by the values of Mean Patch Shape (MPS). For class Built there is to notice, that although size and shape of the patches are almost the same on both sides, they do not exhibit the same intensity of fragmentation.

The elaboration of indicators describing landscape structure by means of landscape metrics is an important contribution to a comprehensive description and understanding of the fragile network of adjacent ecosystems forming the face of a landscape. In this sense, the indices have the ability to relate structure and functionality in different landscape types. Thus, the combination of remote sensing, GIS and landscape ecology as innovative tools can be very supportive in decision making processes with respect to sustainability of landscapes and their resources as well as future planning strategies. However, there is a large potential for pitfalls and misinterpretations arising with easy to use software products developed (Lang et al. 2004). Therefore, the analysis of spatial structure is only useful when applied meaningful to the ecological phenomenon under consideration; to avoid taking place of unwanted future development dynamics (Klug et al. 2003).

Especially after the accession of Czech Republik to the European Union it seems to be obvious, that due to the dynamically altering political processes this transboundary region was and still will be subject to manifold changes in the near future. It is therefore planned to cover these changing processes in a follow-up analysis with regard to the beaviour of the metrics to the (expected) alteration of the landscape on both sides of the border.

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European Node of the Urban Application Center for KOMPSAT-1/2 derived products

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ABSTRACT

The well established scientific and technological collaboration between the Korean Aerospace Research Institute (KARI) and the Austrian Research Centers - Seibersdorf research (ARCS) triggered the idea for the joint development of an Urban Application Center, targeting the needs of the urban planning and urban monitoring domain of governmental and other non-profit organizations. Data from the Very-High-Resolution Multi-Spectral-Camera mounted on KOMPSAT-2 misson (operated by KARI) will provide the major input to a semi-automated processing chain, delivering geocoded and thematic products. As a first step the thematic information extracted from the satellite data will use a classification scheme based on 6 classes. The European Regional Node, located in ARCS, of the Urban Application Center will provide coverage of larger cities in Europe, Africa and the Near East.

To access the Urban Application Center for searching the catalog, presenting and selecting the results and later to access the available data at the Urban Application Center a WebMapServer (WMS) has been implemented. The OpenSource WMS of the University of Minnesota, which already provides a WebFeatureServer (WFS) and soon will provide a WebCoverageServer (WCS), together with the spatial enabled PostGIS/PostgreSQL database was chosen and extended to the special needs of the intended services provided by the Urban Application Center.

1 INTRODUCTION

With the signature of a Memorandum of Understanding (MoU) for space research cooperation by the Ministers of Science and Technology from Austria and Korea, a very important milestone in the well established scientific and technological collaboration between the Korea Aerospace Research Institute (KARI) and the Austrian Research Centers - Seibersdorf research (ARCS) was achieved. This MoU was signed in September 2002 and was a starting point to develop an extended cooperation between KARI and some European aerospace organizations for KOMPSAT mission utilization.

One of the ideas which were triggered was the joint development by KARI and ARCS of an Urban Application Center, which should target the needs of the urban planning and urban monitoring domain of governmental and other non-profit organizations. It was further envisaged that the high-resolution (HR) Earth Observing Camera (EOC) on the KARI KOMPSAT-1 satellite should provide the major input to fit the needs of this user community. This concept was soon after extended to target the future KOMPSAT-2 Satellite as the major data input source. A second MoU, signed by the two Ministers of Science and Technology in November 2004, confirmed the ideas and themes developed and established by the team so far.

While the EOC delivers panchromatic images with a spatial resolution of 6.6 x 6.6 m and an image swathwidth of approx. 17 km, the very-high-resolution (VHR) Multi-Spectral-Camera (MSC) mounted on KOMPSAT-2 (scheduled for launch in December, 2005) will provide one panchromatic channel with a spatial resolution of 1 x 1 m and four multi-spectral channels with 4 x 4 m spatial resolution with an image swathwidth of approx. 15 km. These basic conditions make images recorded by the KOMPSAT satellites very suitable for the application in and around urban and sub-urban areas.

In this paper, the concept of a KOMPSAT regional application center, a joint development between KARI, ARCS and other European partners is presented. This includes the establishment of an additional KOMPSAT-2 downlink in Europe, and the developments of a state-of-the-art user service system for urban and sub-urban monitoring.

2 COOPERATION: KARI - ARCS - DLR - NLR

One of the limitations for KOMPSAT-2 data acquisition is the available downlink capacity. The increase of this capacity, has been another target of the joint work of KARI and ARCS. An European downlink facility was conceived to be installed to increase the accessibility of KOMPSAT data especially to the Urban Application Center but also to European users in general [1]. As a side effect such an additional downlink opportunity would assist KARI in optimizing the utilization of KOMPSAT-2 without impact on its original mission. The use of download facilities in Europe will greatly increase its capacity without loosing any coverage over Korea. While the ability to record and download data is a prerequisite for any further uses, it is by no means a guarantee that the data will be accepted and used by the community. In Europe this data archiving and retrieval system for KOMPSAT-2 data is currently under development. This catalogue will also be linked to metadata catalogues as run by the European Space Agency (ESA), to ensure even wider access [2].

Since there already are highly qualified antenna systems in Europe, either under the auspices of the ESA or under the patronage of national space agencies, it was decided that KOMPSAT reception should be organized based on partnerships with European organizations operating these receiving stations. Consequently, the German Aerospace Center (DLR) and the Dutch National Aerospace Laboratory (NLR) could be successfully taken aboard and have upgraded their systems for the reception of KOMPSAT-1 and KOMPSAT-2 data streams.

The successfully performed, experimental reception of data from KOMPSAT-1 at European stations is seen as a test case to build-up the necessary institutional communication channels, process mechanism and partnership confidence:

KARI (Fig. 1) builds and operates the KOMPSAT satellite series, provides access to the data, and also plays a key role in the development of the Urban Application Center.

DLR currently makes available resources at the wide coverage Neustrelitz receiving station (Fig. 1) and storage capacity. Future plans may include the provision of additional downlink stations as well as the development of services based on KOMPSAT data, positioned mainly in the "Disaster-domain".

NLR brings into the cooperation their small, robust and highly mobile RAPIDS station (Fig. 1), which can easily be transferred to any place in the world and be operational within a day after arrival. It can provide a local real time reception capability to support disaster management activities and data acquisition campaigns in remote areas. NLR is colocated with the Geomatics Business Park (GBP). For the companies of GBP, the RAPIDS ground station is meant to serve as an access point for real time high resolution imagery for monitoring and mapping of urban and agricultural areas.

ARCS is Austria's largest Contract Research Organization (Fig. 1) and well established in the European Earth Observation community with respect to both data user and information infrastructure programs. In this cooperation ARCS is responsible for the coordination of this initiative, the development of the Urban Application Center and is the primary interface between Europe and KARI.

On May 19th, 2004 the first 17 x 784 km image strip from the KOMPSAT-1 satellite was successfully downloaded in Europe at the Neustrelitz receiving station [3]. Soon after that an image acquisition from the KOMPSAT-1 satellite was also successfully carried out at NLR's RAPIDS system.

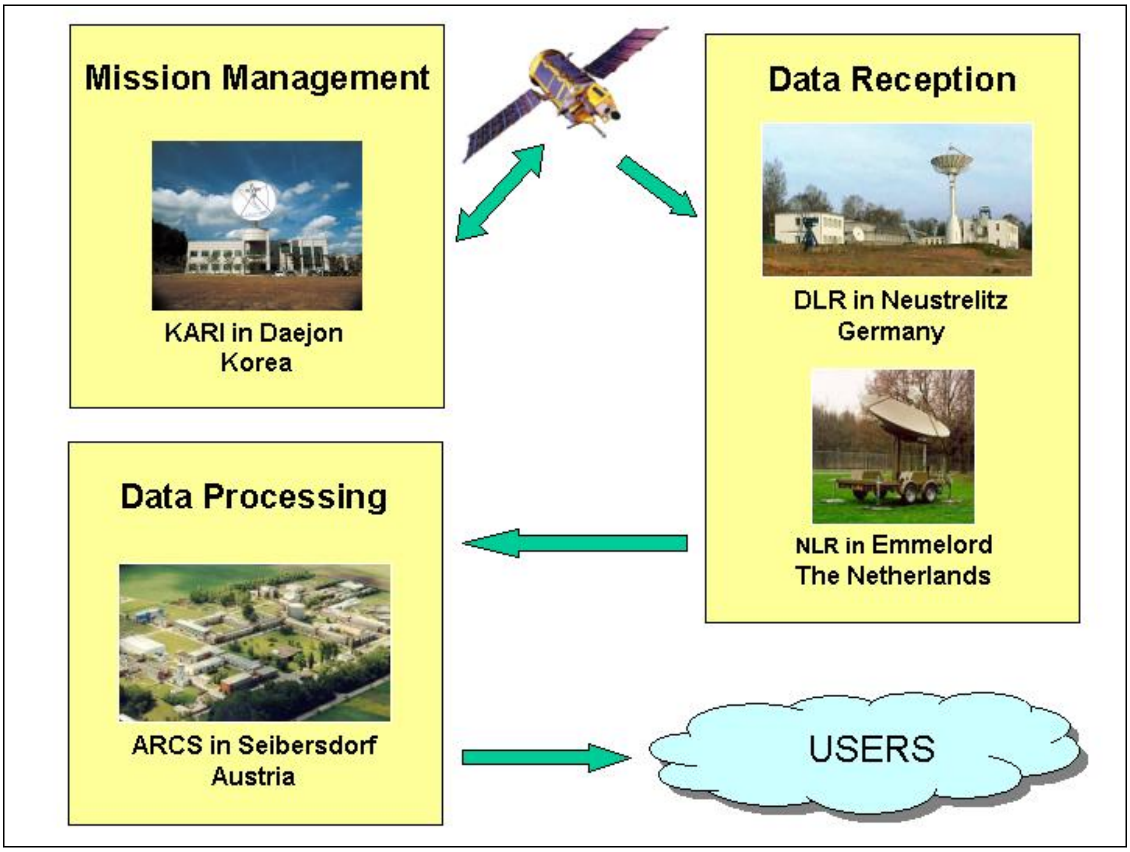

Figure 1: The basic concept of the work-sharing and data flow of the international cooperation

3 PRINCIPLES OF THE URBAN APPLICATION CENTER

The aim of the Urban Application Center is to offer enhanced products derived mainly from KOMPSAT-2. These services will be based on the principles of a high degree of automation, easy access to data and services and availability to both expert and non-expert users. Processing will be carried out with a high degree of automation, ideally without any interaction by a human operator. This way the data can be generated online, on demand or directly after reception. If any human interaction is necessary or should be made available in order to enhance the quality of the results this might be provided only on a special request basis. The results of this automated processing will probably not match those that can be obtained by custom made processing and they are not meant to replace them. However, they will be sufficient for many applications requiring a fast overview over an area and offer enhanced products to customers who do not have the means to carry out the tasks themselves. At a first step the thematic information extracted from the satellite data will use a classification schema based on 6 classes (vegetation, sealed areas, arable land, water, shadow, clouds).

The European Node of the Urban Application Center, located in ARCS, will provide coverage of larger cities in Europe, Africa and the Near East. The corresponding Korean Node, located in KARI, will cover Asia, Australia, and for the time being the American Continent. However, similar processing routines are applied to ensure that consistent quality is maintained independent of the processng node. Special attention will be placed on urban change products over so called third-world "Megacities". There, often the most basic spatial planning tools and maps do not exist and satellite based imagery and derived information products can provide valuable guidance and tools to locate where and which changes are taking place in and around fast changing sub-urban areas.

4 SERVICES OFFERED BY THE URBAN APPLICATION CENTER

4.1 User groups

As already pointed out, easy access to data is crucial for successful data dissemination. While access to data has been very much improved in the past few years, finding suitable data is still cumbersome as numerous portals have to be searched and querying of archives is often limited. So far the use of satellite images has therefore been limited to expert users who have the technical know how and equipment to find, access and process these data. This has also limited the acceptance of the use of satellite data in administration and other institutions. By making satellite data more accessible and by reducing the necessity to invest in software and time to learn the handling of it, the acceptance and number of uses can be greatly increased. With the internet being more and more part of our everyday lives, many barriers have already been removed and, provided that access is easy enough, satellite images could be enjoyed by a wider audience.

4.2 Metadata Catalog

The developments for the Urban Applications Center will include the possibility to search, view, and order available data and derived products. To attain this, metadata (information about the data) needs to be generated and made available as a catalog via various means. Here, the future clearly points to build and implement interoperable systems which can connect to and be accessed by larger entities (e.g. portals of space agencies like KARI or ESA) allowing a wider community to gain information about the existence of a certain service and access to the data and products available.

So far many space agencies and data providers already have catalogs [4] in place, each of them acting differently and often only accessible via its own interface. To find available data one needs to canvass multiple sites using many different interfaces and logistic systems.

ARCS and industry partners are currently enhancing the existing INFEO [5] catalog system, to be reinitiated by ESA in the eoPortal [6], by adding XML/SOAP (Extensible Markup Language/Simple Object Access Protocol) interfaces to overcome many existing problems, hindering an interoperable strategy allowing mutual interconnectivity and searches in multiple catalogs.

KARI is participating in this project and currently develops a new catalog system fully compatible with the specifications applying XML and SOAP technology. The final catalog will be connected with ESA's INFEO catalog systems and from both ends all connected catalogs will be accessible via their single entry points. The Urban Application Center's catalog will be built following the same standards and will finally also be connected to ESA's eoPortal.

4.3 Data Access: WMS - WFS - WCS

To access and search the catalog of the Urban Application Center directly, but also to select, view, and later also access the available data at the Urban Application Center a WebMapServer (WMS) has been implemented. The software is based on the OpenSource WMS of the University of Minnesota [7], which already provides a WebFeatureServer (WFS) and soon will provide a WebCoverageServer (WCS) which is compliant with the standards of the OpenGis Consortium (OGC). While the WMS allows maps to be constructed and viewed (i.e. as pictures in standard formats like JPG, PNG, etc.), the WFS can be used to distribute vector data (e.g. thematic products). Finally, the WCS will provide a way to access the full raster data and will therefore be used as a distribution mechanism.

The data management backbone of the implemented system is formed by the Postgres/PostGIS database connected to the WMS/WFS via extensive processing functions (using PHP as a programming language) developed at ARCS (Fig. 2). The functionality of the system is fully implemented on the server side, making it unnecessary to install any software (e.g. plug-ins, applets, etc.) at the client side. This is especially of interest for public entities where the users may not be able to install or download any software, whatsoever, due to security restrictions.
The implemented WMS can also act as a cascading WMS, combining layers of information of other WMS with the local available datasets and vice versa. After beeing released to the public, it will also allow to be accessed by other WMS and may deliver certain information contents to be included by those WebMapServers.

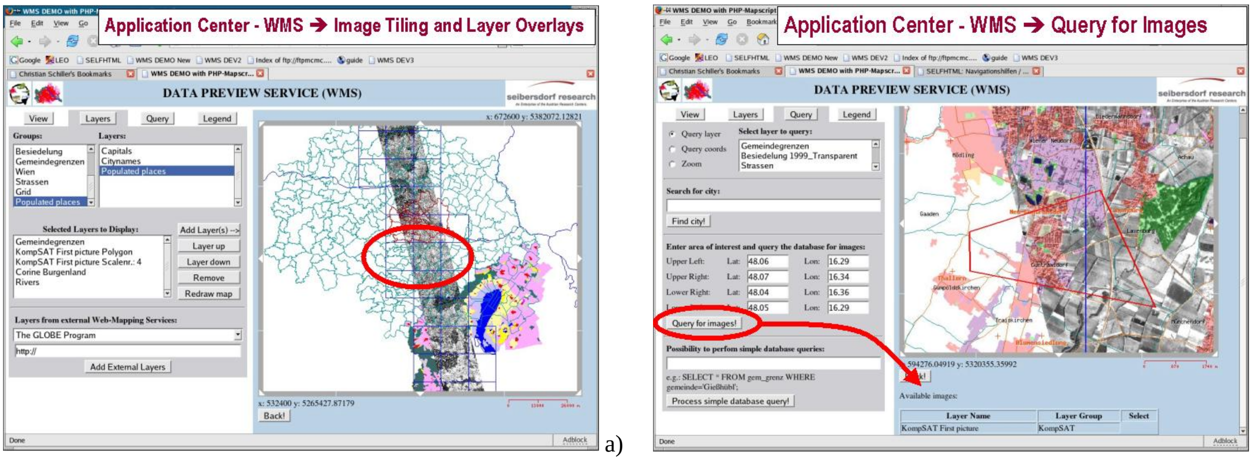

Figure 2: Prototype example snapshots of the WMS Interface for the Urban Application Center currently under development at ARCS. Beside the basic WMS functionality feature querying, a gazetteer, and WMS-cascading is implemented. a) for fast access a tiling scheme of large images is implemented. b) use query coordinates to search for available images and/or products

4.4 Service Support Environment (SSE)

The data processing steps required in the Urban Application Service will form a workflow which is intended to be implemented using recent European EO system developments. The SSE [8] currently developed for the European Space Agency will be used as system platform. Not only catalogs are combined but complete service chain building blocks are made accessible via a common interface. The SSE toolbox will provides the utilities for service and data providers to present their services and make them directly accessible by users. Furthermore, the possibility exists to combine such building blocks of services of various providers, forming new processing chains and products according to the users needs needs. The service providers formulate encapsulate tasks for a single well defined service by describing the input and output interface in a standardized way using XML and WSDL (Web Service Definition Language). With this technique an automated and controlled data flow is possible in a synchronous (online) or asynchronous (offline) way. ARCS already obtained system provider status for the SSE and will tie the Urban Application Center service chain into the SSE system.

4.5 Geocoding

When working with HR and VHR data, especially the geocoding of satellite data (applying geographic coordinates to the imagery) is known to be a very tedious, time consuming and therefore expensive task. Sensor models, as will be provided with KOMPSAT-2, will help reduce the time and costs for this necessary procedure. NLR knowledge and experience in development and integration of highly automated orthorectification tools – for rapid mapping applications - will support automation of this procedure. At the beginning of the service provision the geocoding will be based solely on the KOMPSAT-2 sensor model and ephemeris data provided. At a later stage the collection and implementation of a ground control chip database (GCC), which would allow better orthorectification results, is under investigation.

4.6 Image Transformation

In the context of this paper image transformation refers to the integration of two images in order to create a new one which contains characteristics of both images, a process also called image fusion. In our case the aim will be to use the multispectral bands together with the higher resolution panchromatic band to create high resolution color images. Various algorithms have been developed and for the planned services the emphasis will be on two which offer very different advantages to the users. One is called adaptive image fusion (AIF) [9], the other is a Hue-Saturation-Intensity (HSI)-transformation [10].

The AIF applies a modified sigma filter [11] to the panchromatic image with a given window size. At each position the two sigma range related to the central pixel is calculated and all pixels that fall into that range are selected. The position of the selected pixels is then transferred to the multispectral band where an averaging of these sub-pixels is performed. As by this process no spectral information is transferred from the panchromatic image to the multispectral bands, the spectral information is not significantly changed. This allows the resulting high resolution images to be used for classification purposes just as the original multispectral images.

The AIF leads to results that are spectrally very close to the original but not necessarily very suitable for visual interpretation tasks. For this purpose other methods have been developed such as the HSI-transformation. This technique converts the red, green and blue color bands into hue (dominant wavelength of the color), saturation (degree of purity of a color) and intensity (measure of brightness of color). In order to create a high-resolution multispectral image, the intensity band is replaced by the panchromatic band. While this method delivers good visual products its uses are limited to three bands and it is not suitable for further multispectral processing although very well suited for visual interpretation tasks.

4.7 Image Segmentation

Satellite data with high spatial resolution as provided IKONOS-2, QUICKBIRD and, in the near future, KOMPSAT-2 pose new challenges where data processing and classification routines are concerned. A high spatial resolution not only means more detailed images but also more complex images with many unwanted artifacts. One way to reduce this complexity and also create a basis for further processing is image segmentation [12]. The aim is to separate the image into homogenous regions. Size and shape of these regions depends on parameters selected for the segmentation. As it is planned to have as much automation as possible the initial segmentation parameters are calculated from the image based on its heterogeneity. On this the second segmentation is built by combining neighboring segments based only on color differences. This results in a segmented image were large homogenous areas, e.g. grassland, water bodies and clouds form large segments and heterogeneous areas such as urban areas remain divided into smaller segments. Based on features calculated for teach segment describing color, shape, neighborhood, and so forth, classifications can be carried out. A number of routines have been developed for the purpose of image segmentation [13], although at this stage processing is limited to using eCognition for segmentation and classification experiments.

4.8 Image Classification

The third category of services is the creation of thematic products, i.e. converting data into information. Traditional classification schemes such as the Maximum Likelihood Classifier tend to perform rather poorly on high resolution data, leading very often to an unwanted salt-and-pepper effect [13]. In the past few years, segmentation based classification procedures have proofed to be more suitable. Starting point for the classification provided by the Urban Application Center will be a segmentation as described in section 5.7. At this stage it is planned to concentrate on 6 classes (vegetation, sealed areas, arable land, water, shadow and clouds) although the proposed procedure makes it easy to add new classes if that is feasible. The classification is carried out on the bases of the segmented image. Features, which are calculated for each segment, are used to assign one of the six classes. These features draw on spectral as well as shape and neighborhood characteristics and are selected in such a way that they are as typical as possible to describe the classes in a very general way. As one of the premises for this center is high automation of services, it is the challenge to find parameters, or better yet, derive them from each image that lead to satisfactory results.

4.8.1 Application Example - Classification

As the AIF has already been presented in another context [14], results of the first classification experiments will be presented here. As a substitute for the type of data that may be expected from KOMPSAT-2, an IKONOS-2 scene, recorded over the city of Vienna on September 1st, 2000 (Fig. 3) was selected for the classification example. The study area covers approximately 5 x 5 km.

For the classification experiment both the multispectral and panchromatic images were segmented together on two levels using eCognition. On the first level a combination of form and color parameters were used (scale 10, shape 0.1, compactness 0.9). These segments were merged together on a second level on the basis of color difference between neighboring segments, using a threshold of 40 pixel-values. This leads to larger homogenous areas, without changing heterogeneous areas.

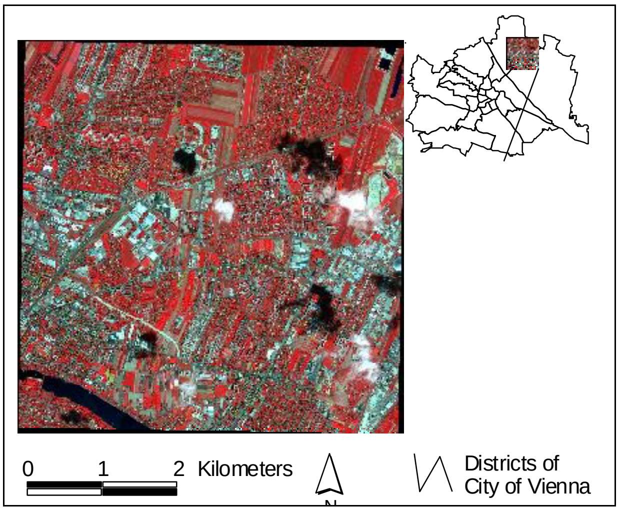

Figure 3: 432-False color IKONOS image of study area

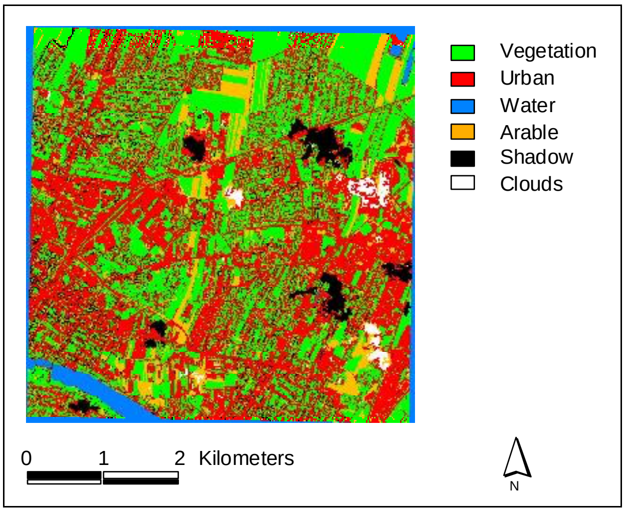

Figure 4: Result of classification

Class	Feature
Vegetation	Ratio of near infrared
Water	Ratio of near infrared
Sealed urban	Ratio of near infrared
	Std.dev. of near infrared
	Std.dev. of green
Shadow	Brightness
Clouds	No class of the above
	Brightness
Arable	No class of the above
	Brightness

Table 1: Features used for classification

For the classification, 6 classes (vegetation, sealed areas, water, arable land, shadow and clouds) were defined on the basis of selected features which are calculated for each segment. Table 1 gives on overview over the type of features used for each class. Ratio is defined as the mean value of an image segment divided by the sum of all spectral layer mean values. Brightness is the spectral mean value of all selected bands (here all bands were selected for the calculation of brightness) of an image object. The number of features was kept to a minimum in order to ensure that the classification can be easily transferred from one image to another. If the features are selected correctly then a transfer should only involve adjusting the parameters governing the functions for each selected feature.

Figure 4 shows the result of the classification. The density of urban structure (red) can be seen clearly in contrast to vegetation (green) and arable land (brown). Water bodies (blue) were classified as well as clouds (white) and shadows (black), cast either by buildings and clouds. Misclassification occurs where some shadows have been mistaken as water and where the contrast of roofs is very low, especially in areas with small individual houses.

5 CONCLUSION

The use of already existing European downlink facility will increase the accessibility of KOMPSAT data to the Urban Application Center and the European users. In addition it will assist KARI in optimizing the utilization of KOMPSAT-2 without impact on its original mission. The German Aerospace Center (DLR) and the Dutch National Aerospace Laboratory (NLR) could be successfully taken aboard an already ongoing cooperatioan between the Korean Aerospace Research Institute (KARI) and the Austrian Reseach Center -Seibersdorf research (ARCS).

The aim of the development of the Urban Application Center is to offer enhanced products based on the principles of a high degree of automation, easy access to data and services and availability to both expert and non-expert users. The results of this automated processing will be sufficient for many applications requiring a fast overview over an area and offer enhanced products to customers who do not have the means to carry out the tasks themselves. As services, which will be also accessible via the SSE, gecoding, image transformation, image segmentation, and image classification will be developed and offered. During the development of the Urban Application Center major attention is paid to stay interoperable with current systems allowing metadata (catalog) searching, data access, and service chaning (e.g eoPortal, SSE). This priciple is also realized for the interface, where an OGC conformant WebMapServer, WebFeatureServer and a WebCoverageServer together with a spatial enabled Database provide the necessary functionality for searching, viewing, and delivering data and information products to the user.
We hope that by making satellite data more accessible and by reducing the necessity to invest in software and time to learn the handling of it, the acceptance and number of uses can be greatly increased.

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Projects, which helped Slovenia to come closer to Europe - IT solutions from S&T to fulfill EU requirements

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1 INTRODUCTION

S&T Slovenia had the privilege to participate in the development of important IT infrastructure projects for Slovenian government in past 10 years. In this paper we will briefly discuss the used approach and the portfolio of the application solutions that helped Slovenia in the process of joining European Community.

Aster company, who was merged in S&T in 2002, started to work on governmental projects in 1993 with the project called "Registry of Spatial Units" for the Surveying and Mapping Authority of Republic of Slovenia. This project was a renewal of an existing registry that was maintaining only attribute data without any geographical (GIS) information. The content of the registry was very important for maintaining all other registers like Central Population Registry, Registry of companies, etc. Registry contains attribute and geographical data for all spatial units and house numbers. In reality this registry is the base for the address coding system that was later on used in all other important state registers in the Republic of Slovenia.

The concept of establishing the right order of development of key parts of the agricultural information system was the most important factor for success in providing computerized support for all base registers in the field of agriculture. Linking agricultural IS with the land information system that was developed in the same period at Survey and Mapping authority was crucial to provide integrated information system. The third big and important institution that S&T had the privilege to work for is Statistical Office of Republic of Slovenia. S&T implemented the statistical data warehouse for regional database and the software for dissemination of statistical data.

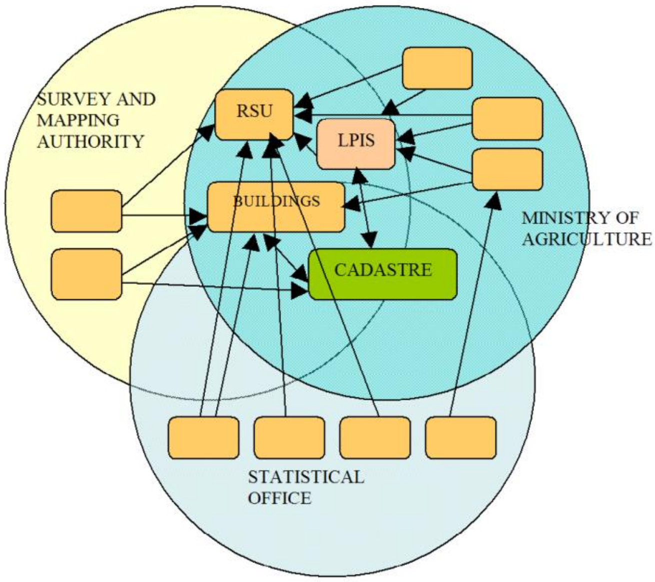

Figure 1: Integrated information system in governmental environment

2 APPLICATIONS FOR SURVEYING AND MAPPING AUTHORITY

The applications for Surveying and Mapping Authority are covering some of the base registers or cadasters that are maintained by this authority.

2.1 REGISTRY OF SPATIAL UNITS

The Registry of Spatial Units (RSU) is in production since 1995 and contains digital borders of all spatial units and also the centroids (x and y coordinates) of house numbers. The territorial units are: state, local communities, settlements, statistical districts, spatial districts (the lowest unit), cadastral communities, election units etc. The registry is serving as the main address coding system for all state level registries like Central population register, Register of companies, Telecom directory, etc. All the attribute and graphical data is stored in the Oracle database.

2.2 LAND CADASTRE - ATTRIBUTE PART

In Slovenia the Surveying and mapping authority is in charge for maintaining the cadastral database. Local branch offices are updating local databases and these changes are propagated during the night to the central cadastral database that is implemented in Oracle database. Web based application was prepared for viewing and the extraction of the cadastral data. This application is widely used in government to minimize the needs of processing paper documents in the procedures of acquiring different legal papers.

The system is also connected to the graphical part of the land cadastre and a graphical picture of the shape of the parcel is also produced.

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2.3 REGISTRY OF GEOGRAPHICAL NAMES

The purpose of the Registry of Geographical Names is to centralize the maintenance of all geographical names used in map production. Each geographical name gets unique identifier regardless of the scale of the map it appears on. Up to five coordinates are recorded for each occurrence of the geographical name on the map. The scales of the maps are from 1:1.000 up to 1:1.000.000. The registry of geographical names is always used together with digital orthophoto maps or satellite images to provide good orientation when displaying image data. The geographical names are subject of standardization process. The registry is not limited only to the territory of Slovenia but contains geographical names from neighbor countries as well. As these countries use different character sets the multilingual support is essential to fulfill the requirements for proper recording of different geographical names.

2.4 CENTRAL DATABASE OF GEODETIC POINTS

The Central Database of Geodetic Points contains all necessary data about main geodetic triangulation points for state level geodetic networks. Several kinds of geodetic points are stored in the database that is used for field measurements. For each geodetic point a scanned sketch with detailed information is stored in the database. The application has only the web interface. The information from the database is presented on the top of digital orthophoto maps and digital cadastral data (parcels). The surveyor is able to get all the necessary data about the network of geodetic points before he/she starts with the field measurements.

2.5 DISSEMINATION SYSTEM

3 APPLICATIONS FOR MINISTRY OF AGRICULTURE, FORESTRY AND FOOD

S&T started the development of agricultural information system in 1996. At that time some of the registers maintained by Surveying and Mapping Authority were already in production. In the first phase the development of the information system was focused on development the base registries which were in subsequent phases the base for other registers.

3.1 REGISTRY OF FARMS

Registry of farms is one of the base collections of data in the Ministry of Agriculture, Forestry and Food in the Republic of Slovenia. The registry contains base data about all the farms in Slovenia, their owners (holders), addresses, general data about farm (number of animals, land in use, etc…), data about the production capabilities (LFA – less favorite areas) and other necessary data that are then needed and are common for the whole information system.

Registry of farms maintains the data according to the changes that farmers are sending on special forms. The registry is using links to the Central Population Registry, Central Tax Registry and Companies registry for checking the linking keys and also some base data. All the addresses of farms and their holders are based on the Registry of Spatial Units.

3.2 LAND USE SYSTEM

The land use system is based on the manual interpretation of digital orthophoto maps in scale 1:5000. After the interpretation the land use data are intersected with the cadastral data and the result is used in the controlling mechanisms for different registries. Special software was developed for data acquisition of land use and also for intersection of land use and cadastral data.

3.3 REGISTRY OF GRAPE AND WINE PRODUCERS

The Slovenian wine law was one of the first laws that were harmonized with the European community. The registry of grape and wine producers is based on the Registry of farms and contains data about the vineyards, the production of grape, quality of wine etc… The territorial description of a vineyard is based on the land cadastre parcels that are forming the vineyard. The registry is also connected to the land use system. The software supports the production of all necessary documents (office automation system) and is used in more than 30 local offices in those parts of Slovenia where the grape is produced. The data model for the registry is quite complex.

3.4 REGISTRY OF ORCHARDS, OLIVE GROVES AND OTHER PERMANENT CROPS

The Registry of olive groves, orchards and other permanent crops is under development in year 2001. It is based on registry of farms and land use system and is similar to the Registry of grape and wine producers. The registry contains base data about all permanent crops and will be referenced in IACS system. The software will support the automated production of all necessary documents.

3.5 GRAPHICAL DATABASE

The graphical database consists of all the graphical data that are captured in different subsystems. In the graphical database there are vector data of land use, digital cadastral maps, territorial units, house numbers (centroids), scanned maps in different scales, digital orthophoto maps, different units from registry of grape and wine producers, digital terrain model and other data.

Some of the applications are done in client/server model, some of them were developed as internet/intranet applications. All the graphical data except images are stored in Oracle database and a transition to Oracle Spatial format is in progress.

The graphical database together with attribute data was **invaluable source for different kind of analysis and reports** that were used in the negotiation process with European Community.

3.6 LESS FAVORITE AREAS (LFA)

The definition of less favorite areas was very important in the negotiations for joining the European Community. The definition is based on a digital terrain model (25 x 25 m grid) and calculation of slope and aspect. The results are then applied on different territorial units. With the availability of the digital cadastral maps this information is available on the parcel level.

3.7 IACS

The financial aids in agriculture are the most important part of the agricultural information system. In the year 2000 the new subsidies based on the EC regulation were introduced in Slovenia. In the integrated administrative control system (IACS) the subsidies use all the available data for administrative control such as land cadastre, animal identification and registration system, farms registry, less favorite areas, land use system and others. The software supports the data entry, the controlling system and the automated production of all necessary documents.

Important part of the IACS is also the web based application for the on spot control that is using also GIS data.

3.8 ANIMAL IDENTIFICATION AND REGISTRATION SYSTEM

The Republic of Slovenia on 1st of January 2001 started the new animal identification and registration system. The system is tightly connected with the farms registry and stores data about all births of animals, movements, temporary movements and deaths. Part of the system is also a automatic issue of animal passports which are obligatory for all movements in the Slovenian territory and also to EU countries. The whole system is based on EU legislation and Slovenian extensions to these rules.

AIMCS (Animal Identification and Movement Control Scheme) system is an animal identification and registration (I&R) solution that can provide the most accurate cattle related data in the state. To achieve that, data entry and basic reporting functionality was developed in a way, that data can be entered and viewed virtually anywhere. This is done through web interface (users need only web browser) and a special PDA application. In order to minimize percentage of errors at entering data and to simplify system management, an advanced business rules engine is provided.

Security is an important issue. For that fine grained logical and geographical privileges can be set for each user or his/hers organization.

Advanced (pre-defined and ad-hoc) reporting is a key to retrieve valuable information from database. System provides solutions for both types of reporting needs.

Apart from movement tracking (where, when and why location of an animal was changed), animal’s health status is also crucial. Combination of these data is essential for controlling disease outbreaks. System allows storing of both types of data as well as appropriate reporting for that.

Based on data, which is received on daily basis, farms should be evaluated according to risk factors defined by government’s I&R unit. This is called risk analysis and is one of key factors when system is evaluated by European Union inspections. To support this, an advanced module for defining, running and viewing results of risk analyses is provided.

In some states multilingual and multi-character support is needed either from legal or general acceptance perspective. AIMCS system supports on-line changing of user’s preferred language and character set.

To achieve connectivity to other information systems XML, comma-separated text and Oracle replication mechanisms are available.

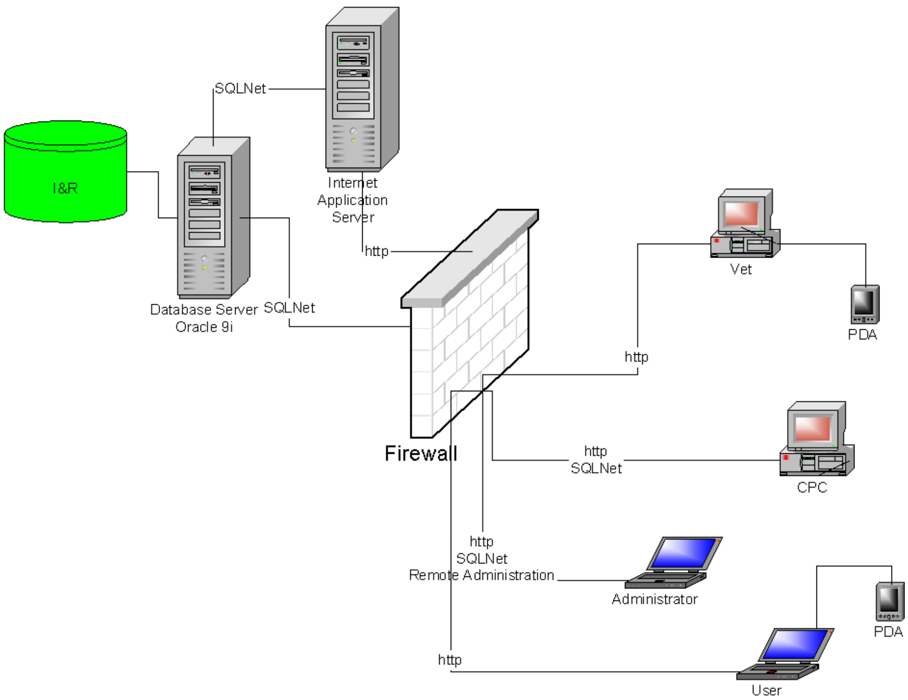


Figure 2: Basic structure of the system is shown on the following figure

4 SOLUTIONS FOR STATISTICAL OFFICE

S&T was together with some other partners involved in the development of the database of regional data for the Republic of Slovenia. The regional database contains data from different statistical sources and is linked to the Registry of Spatial Units. For the purpose of the statistical data warehouse a special "geo-dimension" was developed to enable monitoring of statistical data in different time periods regardless of changes in the territorial units which are changing all the time. This phenomenon is known as slowly changing dimension in the data warehouse.

Below are some pictures produced from regional database.

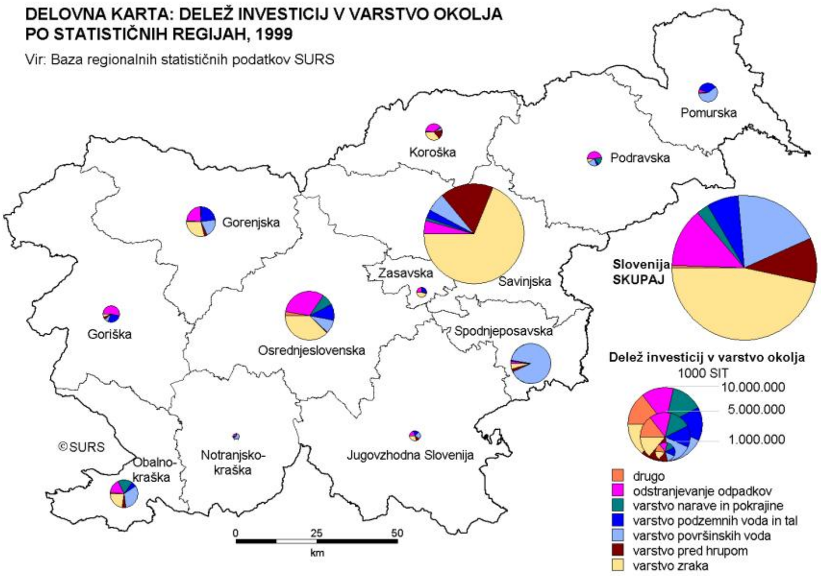


Figure 3: Investments in protection of environment

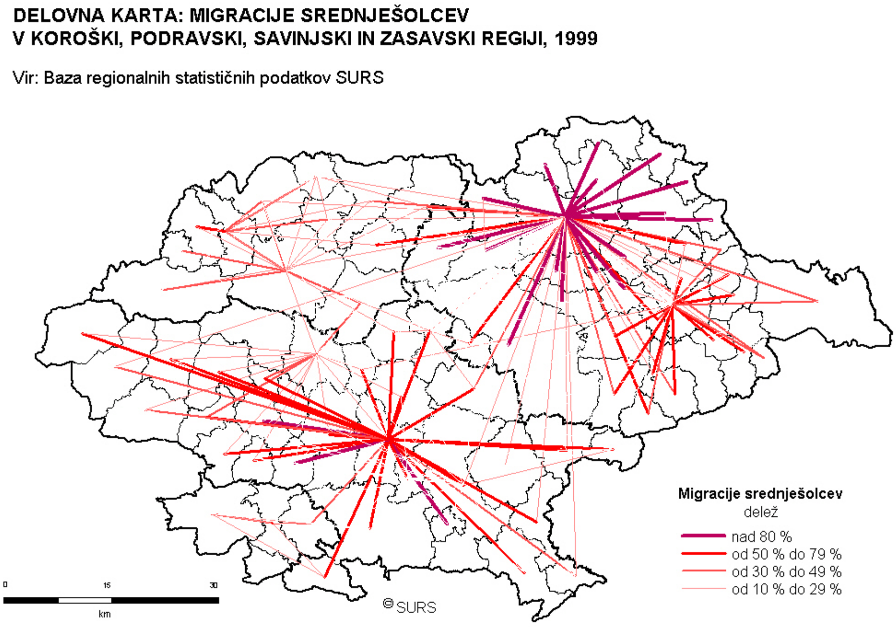


Figure 4: Daily movements of schoolboys in one region

The second project where S&T was involved was the IT support for data dissemination process for statistical data. This project, funded by PHARE, enabled statistical office to automate the process of preparing and dissemination of statistical data on the web.

5 CONCLUSION

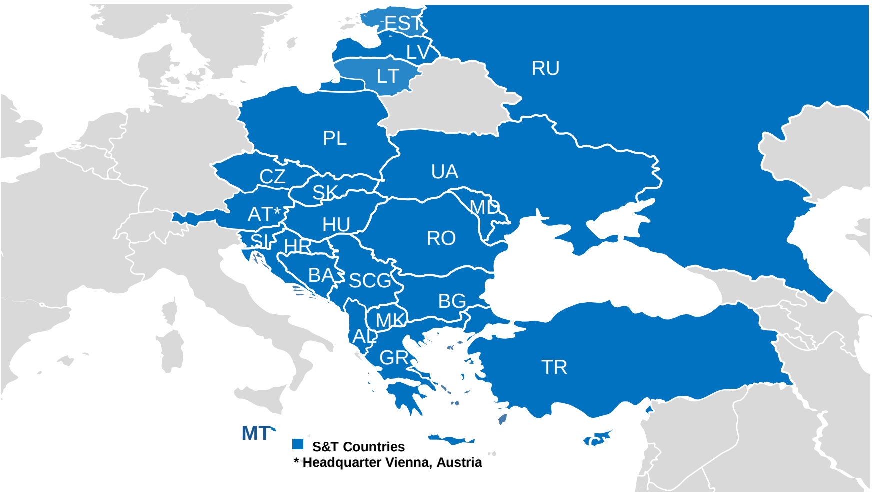
The above projects were the most important contribution of S&T that helped Slovenia to come closer to Europe. There are many other projects on which S&T was working in past 5 years. Some of them should be mentioned at least in the conclusion.

S&T has developed a system for maintaining school districts and school population prediction for the Ministry of Education and Sport. In last two years S&T has been developing the state-of-the-art Tactical Information System for Command and Control of Slovenian Armed Forces that is NATO compliant.

S&T System Integration & Technology Distribution AG

S&T presence in CEE

21 countries, 54 service locations, 1 300 employees



AT	Austria
SK	Slovakia
BG	Bulgaria
UA	Ukraine
RO	Romania
MD	Moldova
SCG	Serbia & Montenegro
HU	Hungary
SI	Slovenia
HR	Croatia
BA	Bosnia & Herzegovina
MK	Macedonia
PL	Poland
RU	Russia
CZ	Czech Republic
TR	Turkey
GR	Greece
MT	Malta
LV, LT, EST	The Baltics

Organization

Management Board

Regions

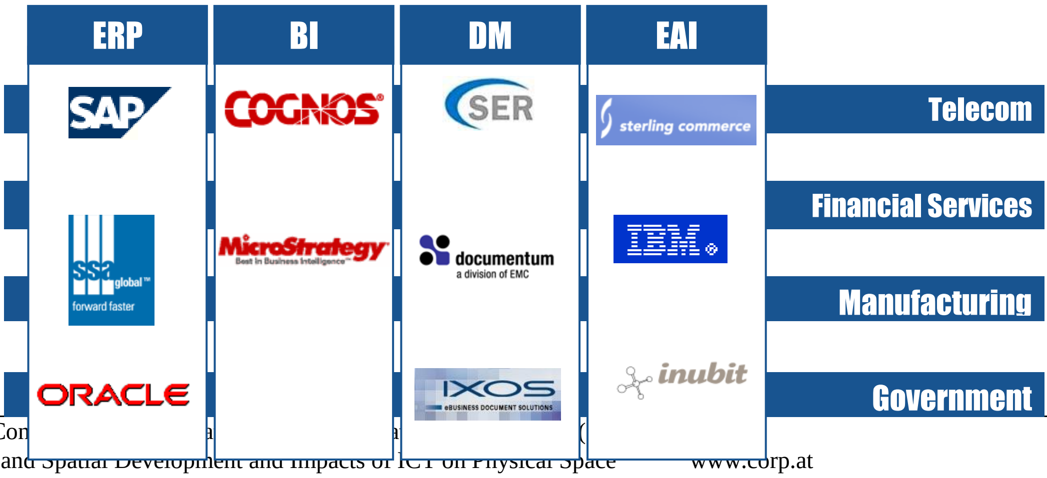
Central	Adriatic	South	East
Austria	Slovenia	Romania	Russia
Poland	Croatia	Turkey	Ukraine
Czech Rep.	Serbia & Montenegro	Greece	The Baltics
Hungary	Bosnia & Herzegovina	Bulgaria	Moldova
Slovakia	Macedonia	Cyprus	
	Albania	Malta	

Business Units

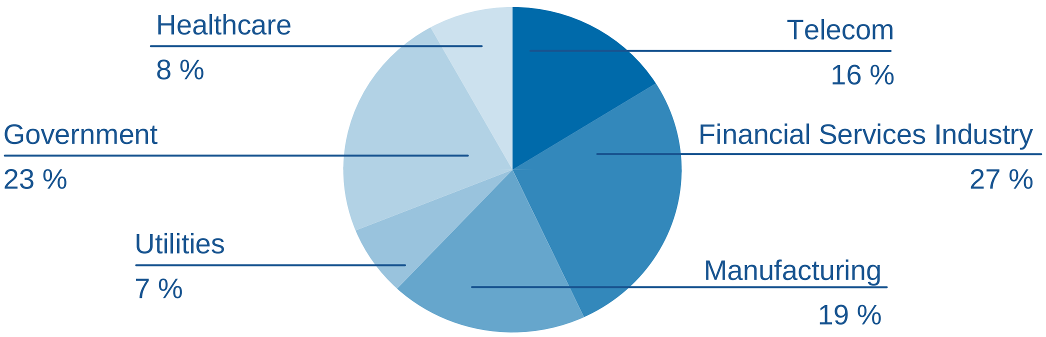
- Business Solutions
- Enterprise Systems
- Customer Support
- Managed Services
- Medical

- Telecom
- Financial Services
- Manufacturing
- Government

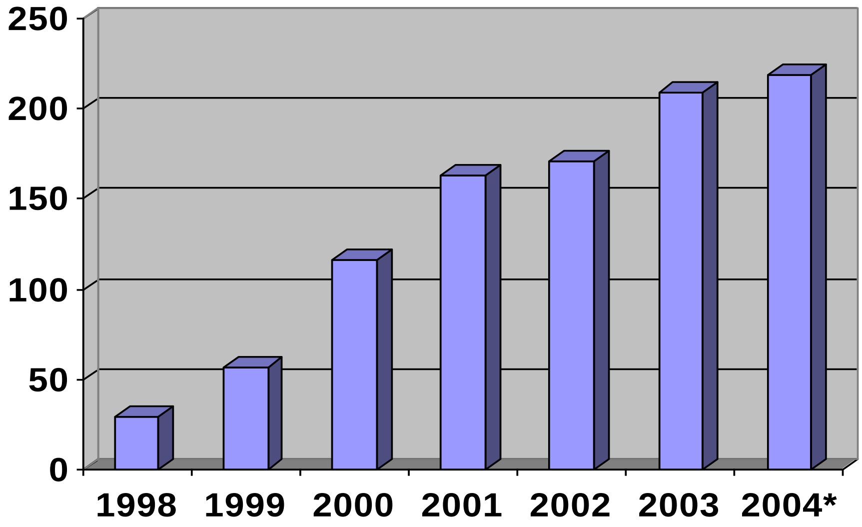
Strategic Focus



Sales per Industries (2003)



Growth (Total Revenues in Mio €)



*

The S&T Share: + 165 % in 2004

IT SOLUTIONS & SERVICES

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CyberCity Modeler: Automatic Texturing of 3D City Models
TerrainView-Web: 3D Web-VRGIS

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ABSTRACT

Cybercity Modeler is a sophisticated and proved tool for 3D-city model generation from aerial-and satellite imagery and LIDAR data. Further developments ensure the continousity of the data flow and optimize ongoing the data capturing and continuation. A new development was performed for the automatic texturing of facades from aerial and/or oblique images. Another important development was the integration into ArcGIS (ESRI). With the application www.map2day.at which was performed within a common project with Forest Mapping Management (FMM), Salzburg and ViewTec, Zurich a powerful and unique web-based 3D-GIS was created. For this development CyberCity AG - which is an ESRI business partner development, got an award for best software integration at the ESRI user conference 2004 in SanDiego in partnership with ViewTec and FMM.

1 INTRODUCTION

Large-area 3D city models generated by means of photogrammetry or laserscanning are predominantly used in urban planning, architecture and marketing (e.g. tourism, real estate promotion). Additionally they are requested as basic data for the gaming and entertainment industry.

CyberCity generates 3D city models semi-automatically from stereo aerial images or laserscanner data and developed the specialized software *CyberCity-Modeler (CC-Modeler™).* Besides the easy to use texturing of facades with terrestrial images, a new and efficient technology was integrated for the automatic texturing of facades and roofs from (oblique) aerial images (*CC-AutoTex*).

Recently *CyberCity-Modeler* was extended by the new tool CC-VisualStar which was developed as a photogrammetric workstation with special functionality for data continuation and 3D measurement. An efficient updating can be managed by comparing existing 3D city models with new aerial photographic information.

The 3D data can be managed in a commercial database using ArcSDE (ESRI) and be used for further analysis in ArcGIS (ESRI).

For real-time visualization, the 3D city models can be exported in Open Flight format (FLT) including level-of-detail (LOD) for geometry and textures. The professional visualization tool TerrainView™ (ViewTec AG) supports level-of-details and includes sophisticated functions for the real-time visualization of a huge 3D scenery including functionality for combining, moving and deleting objects in different formats. Web-streaming of landscape and city models allows TerrainView to view large data sets with high speed.

In cooperation between CyberCity, ViewTec and FMM Salzburg an application www.Map2day.at was developed, which makes use of the above mentioned developments. The Web solution allows companies, product and service suppliers to present their offer on the Web. Actually www.Map2day.at is the combination of GIS technology with high quality 3D-city model data and high speed real-time visualization on the internet.

2 GENERATION AND UPDATE OF 3D-CITY MODELS

CC-Modeler is a software tool for generation of 3D-city models. It was described in several papers (see www.cybercity.tv) and presented e.g. at Corp 2003 and Corp 2004. Data source is either aerial/satellite imagery or LIDAR. Generation and continuation of the data can be performed perfectly by using the CyberCity-Modeler module *CC-VisualStar*, a photogrammetric workstation. Following points are important for actualization:

- Comparison between existing 3D-city models and actual status shown in the actual stereo model.
- Deletion of objects which do not exist anymore
- Editing of objects which have changed between the different status
- Add new objects by direct modeling
- Management of the actual city model in a GIS database (incl. attributes)

CC-VisualStar requires a PC with a stereo-capable graphic card and monitor. With a shutter glass the stereo viewing is performed. VisualStar also has standard photogrammetric features like stereo-model orientation, automatic and semi-automatic measurement of aerial triangulation, DTM and DSM, orthophoto computation including mosaicking. A new tool for automatic generation of True Orthophoto is available since 2005.

To improve the geometric quality, *CC-Edit* was developed. *CC-Edit* is a CAD system specified for 3D city models and is used for improving the geometry of the models. Numerous functions for fulfilling geometric requirements like planar faces, parallel lines etc. can be applied and overlappings between adjacent buildings can be cleaned. Building footprints can be combined with the roof structure to get realistic overhanging roofs.

For working with 3D-models existing data is imported from a GIS database or file system and is displayed together with the aerial stereo model. This means that the older city model is overlaid with the new image information and differences and changes are visible immediately. Buildings, which do not exist anymore, can be deleted from the database. New buildings can be recognized because they are visible in the stereo model and not yet represented by the necessary vectors. These buildings can be measured and modeled directly. The modeling is performed automatically after measurement of the polygons defined by the boundary points and the inner points of the roof. The operator just measures points, the lines and vectors are created automatically. The modeling is performed without knowing about the roof structure. E.g. it is not necessary to tell the program if it is a saddle-, tent- or other roof.

The 3D-data can be managed in commercial databases with ArcGIS, ArcSDE (ESRI) or Topobase (C-Plan).

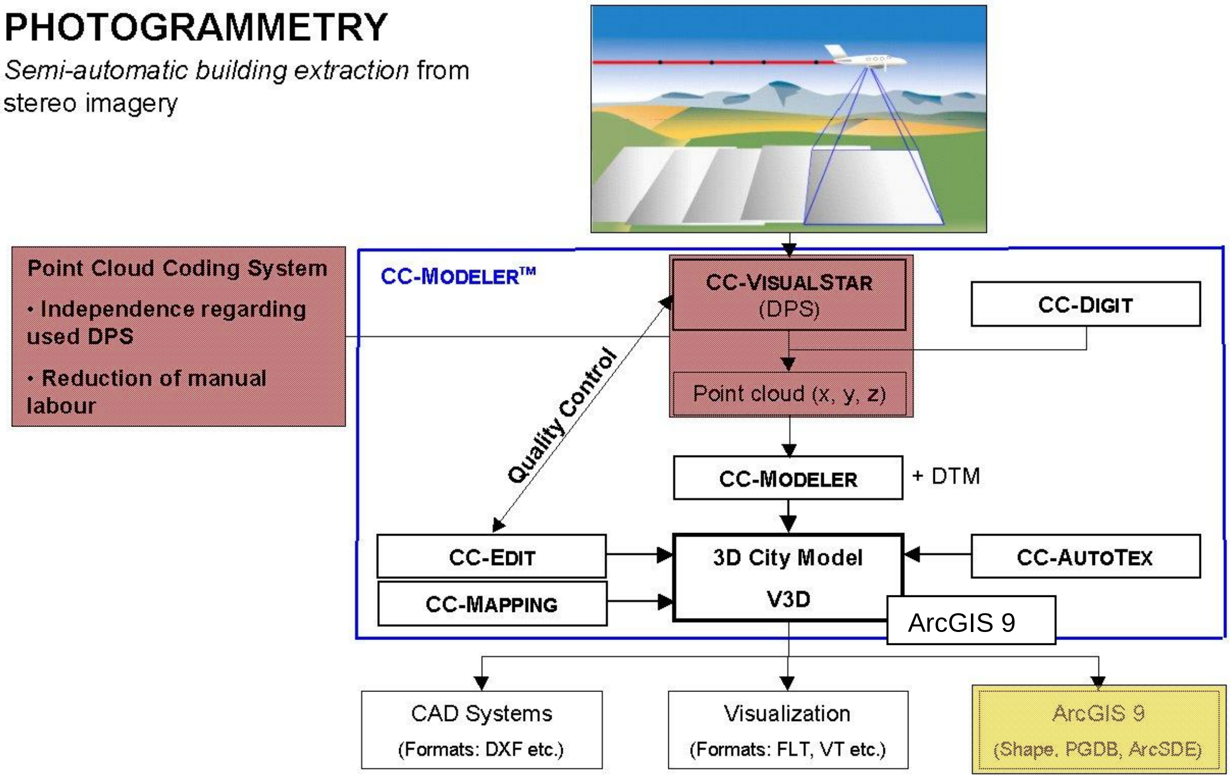

Figure 1: Workflow for Updating of 3D-city models in CyberCity processes and the management with ESRI Arc products

For more details we refer to www.cybercity.tv.

3 AUTOMATIC GENERATION OF FACADE TEXTURE

A software tool was especially defined to optimize texturing of facades. The goal was to reach a high degree of efficiency for big city areas. With CC-TLSAutotex or CC-Autotex, facade textures, which are taken from aerial images, can be put automatically on wall facades. This software module is an addition to CC-Mapping, where manually taken terrestrial pictures are handled or pictures within a library are used as generic texture.

In the meantime the ancient city of Salzburg was photographed from a helicopter using medium format cameras producing oblique images. More than 500 aerial oblique images were taken, each of them including about 30 to 60 facades. The image with the best quality for the individual facade was selected automatically by CC-Autotex. Facades of objects, which still were fully or partly hidden by obstacles, have been edited manually. Using this procedure the cost of texturing could be reduced drastically.

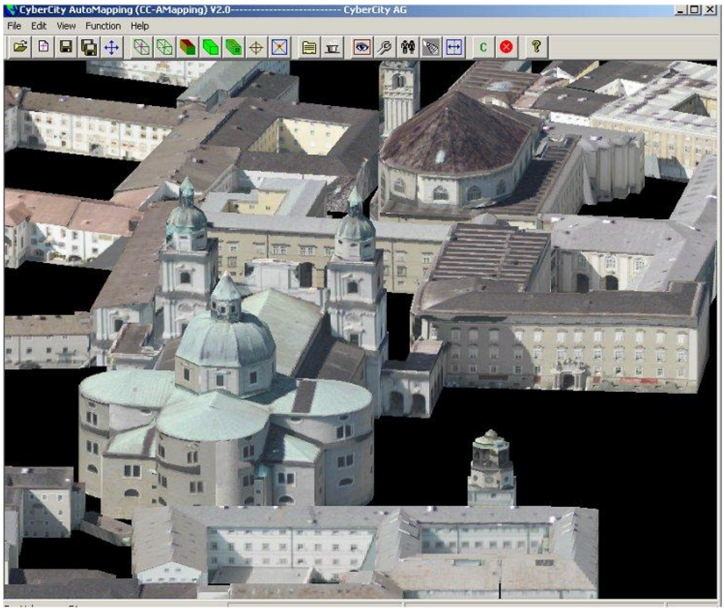

Figure 2: CC-AutoTex results of Salzburg

4 VISUALIZATION WITH TERRAINVIEW-WEB

The **TerrainView-Web** application is a state of the art Virtual Reality based software solution that facilitates the interactive visualization of high-resolution 3D-terrain data over the **Intranet**. Due to ViewTec's advanced software technology and innovative data management concepts, large amounts of data may be processed in real-time. Digital elevation models, high resolution orthophotos, satellite images, 3D-buildings and vector data provide the real time application with the information to display excellent high quality representations of complex terrains and landscapes. It was described in several papers (see www.viewtec.ch).
Spatial planning, works premises and city visualization, TerrainView-Web gives benefit by visualizing present or future building projects in a most attractive way. TerrainView-Web can include the corresponding information into the terrain model of your site, to visualize any preferred number of textured buildings. Optimization of production sites, marketing and public relation strategy can now be improved.

Main features of TerrainView/TerrainView-Web are:

- Web streaming support
- Import of 3D-models of different formats
- Manipulate objects
- Various modes of navigation
- Points of interest editor
- Advanced flight path editing
- Terrain paging
- Weather visualization
- Arbitrary resolution screenshots
- Stereo support
- Generation of digital video
- Information tree

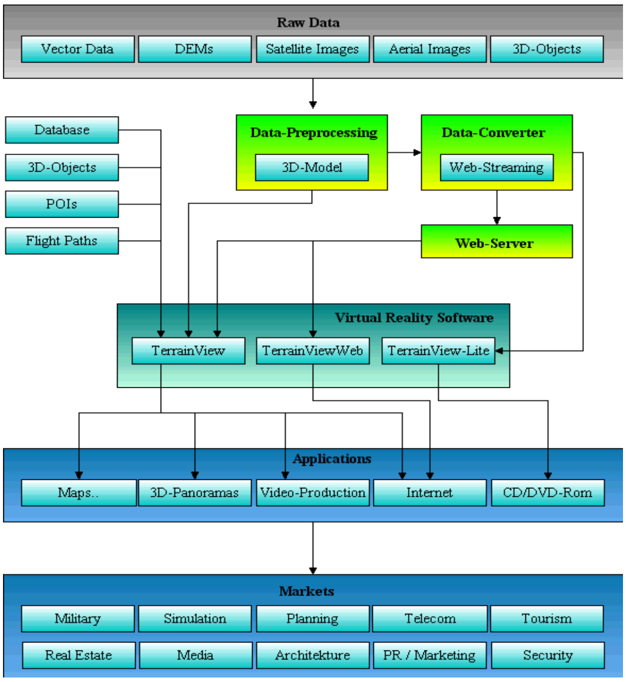

Figure 5: Workflow of Visualization

Web Streaming Support

With ViewTec's TerrainView-Web you are able to connect 3D-terrain databases through Internet. Cities like Munich and Berlin with more than 500'000 buildings can be streamed. The 3D-terrain data size is only limited by the available disk space. TerrainView-Web runs in conjunction with proxy servers and firewalls. All data streams are compressed and heavily encrypted. A standard Web Server e.g. Apache, IIS, and many others delivers and manages the 3D-terrain data over the Internet or private computer networks. While using standard server technology, the user has access to large sized databases that can be viewed over low-bandwidth networks in real-time.

A 3D scene for TerrainView-Web can be generated as a service by ViewTec.

ViewTec's data preprocessor supports all the well-known GIS data formats:

- Vector (NDA DFAD (all levels),USGS DLG,USGS LULC,NIMA VPF ESRI Shape (import/export) IHO S57 (NOAA ENC))
- Imagery (GeoTiff, TIFF, Arc Info World,GIF, BMP, JPEG, ECW, JPEG2000, NITF CIB
- Elevation(NIMA DTED (levels 0,1,2), USGS DEM, Arc Info BIL, ESRI Grid ASCII, ESRI Grid Float, Japanese MEM, Spanish ASCII, GeoTIFF (16 bit), Bitmap (8 bit), IGN DB ALTI, X,Y,Z (non-grided), Contour lines
- 3D-Objects (OpenFlight)

ViewTec includes the service to generate complex 3-D buildings from vector source data without any external modeling required. Buildings are generated rapidly and automatically based on the attribution of vector data and simple user-controlled parameters. Buildings produced with default or user-defined textures are properly oriented and integrated with the underlying terrain. ViewTec makes the creation of complex terrain features easy. 2-D linear and areal features can be automatically constructed through user-defined parameters. ViewTec supports automated feature generators construct cultural features with a high level of detail to user specifications.

The generated scenery can be interactively visualized by TerrainView.

Additional 3D models such as buildings, billboards, and cars can be imported to enhance the realism of the generated terrain. Currently the supported data formats are:

- Autodesk 3ds
- VRML 2
- Design Workshop dw
- Alias/Wavefront obj
- NewTek LightWave 3D lwo.

A TerrainView 3D scene can be exported to the internet using the TerrainView-Web Export option. The free TerrainView-Web plugin enables the Microsoft Internet Explorer to visualize the scenery over the internet. The number of additional objects for Web export is unlimited.

More details are described at www.cybercity.tv under publications and www.viewtec.ch .

5 WEB-SOLUTION – WWW.MAP2DAY.AT

Map2day.at is a web-based 3D GIS service with interaction between a 2D city map and 3D visualization. It is used as a marketing tool to allow organizations to present their services and products via the internet and shows their location in 2D and 3D.
Map2day.at is realized by cooperation amongst CyberCity AG, ViewTec AG and Forest Mapping Management (FMM) GmbH. It uses ArcIMS (ESRI) and interfaces to TerrainView-Web (ViewTec AG).
The query of the informative GIS database in the background is based on location, categories (e.g. tourism, public health etc.) and groups (e.g. hotels, golf courses etc.). Areas and distances can be measured easily and results are shown instantaneously. The application supports 12 languages and the appearance can be customized, allowing the selection of different color schemes.

The user can dynamically change between the 2D map and the 3D visualization that supports free navigation in the selected region. By selecting the location from the GIS query in the 2D map, the 3D window automatically navigates to the corresponding area in the 3D scenery. Hyperlinks to web pages or multimedia information can be accessed by integrated and defined icons.
Reality-based 3D city models by CyberCity AG and trees are combined with the 3D environment (DTM and orthophoto) and are web-streamed and optimized for the performance via Internet (see Figure 6).

The client (e.g. hotel or restaurant) can access their online administration page by using their username and password. They can manage entries (e.g. hyperlinks, promotion etc.) and keep the company data current, which makes this web-solution a powerful enterprise tool for tourism and marketing.

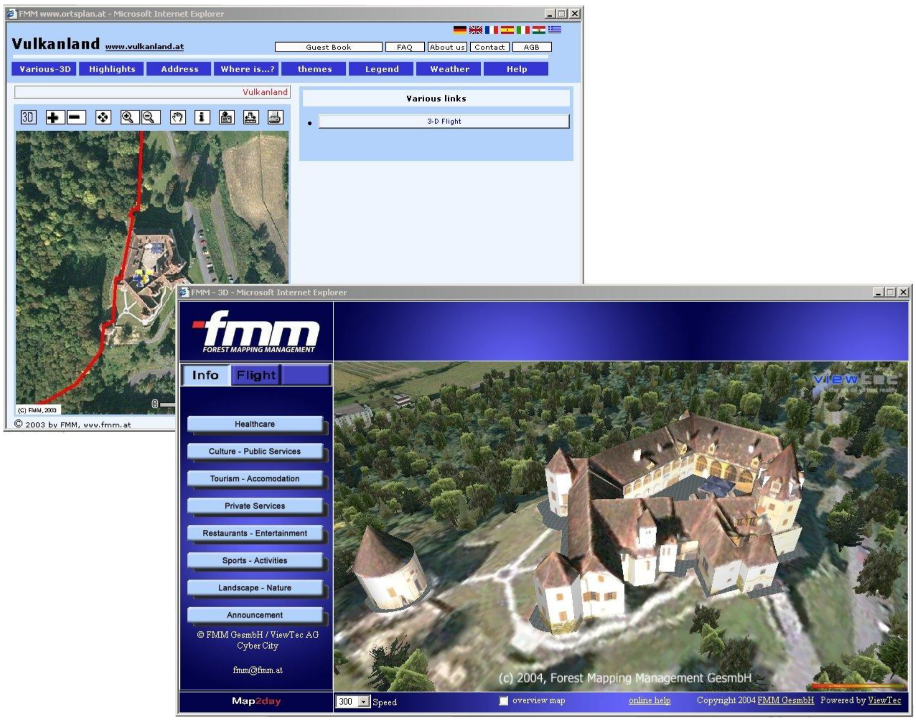

Figure 4: www.Map2day.at, a GIS solution with CyberCity's automatic textured buildings and realtime visualization with TerrainView-Web

6 CONCLUSION

CyberCity and ViewTec offer together new modules needed for updating and high-end visualization through the Internet. CyberCity's CC-VisualStar allows online updating and editing, CC-AutoTex the efficient texturing of facades with high quality and low cost. TerrainView now allows interactive modification of 3D-objects and permits the visualization of complex landscape and 3D-city models. Flight paths can be generated in a very sophisticated manner. CyberCity Modeler and TerrainView together are highly developed tools for most ambitious 3D-model applications.

7 REFERENCES

Publications, references and detailed information may be found on

www.cybercity.tv

www.viewtec.ch

CyberCity

The company CyberCity AG was established in April 2000 as a spin-off company of the ETH Zurich and offers software and services for the generation, management, editing and visualization of 3D city- and facility models. In the meantime CyberCity operates a branch office in Los Angeles (CyberCity LLC).

reviewed paper

Real-Time Rendering of Vegetation and Trees in Urban Environments

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1 INTRODUCTION

Vegetation and Trees in Urban settings are getting ever more important due to the increased focus on high quality living environments. Urban planning therefore needs to take vegetation into account at every stage. The availability of cheap 3D graphics hardware makes it possible to consider vegetation and tree rendering in general urban visualization systems.

In our System we have employed a number of different vegetation visualization methods, including point-based rendering, impostors and billboard clouds. Based on these experiences we have designed an urban rendering system that can deal with thousands of trees, facilitating real-time visualization of urban recreation areas such as parks and green-belts. Based on the application different techniques are used in order to provide optimal performance in each situation. Thus it is possible to render single trees with adequate detail for walk-throughs as well as whole woods for fly-over applications.

Such Real-Time walk-throughs and fly-overs of existing or planned urban-zones including huge amounts of vegetation can help urban planners in a variety of situations, e.g. visibility of buildings and street signs or placement of future vegetation.

Figure 1: Improved Billboard-Trees in an Urban Setting.

2 PROBLEM STATEMENT

Rendering trees and vegetation in the context of an urban scene represents a unique challenge: the main purpose of urban models is the geometric representation of buildings and streets and thus most effort has been targeted at these objects. Vegetation and Trees have been limited to very simple representations just to give a hint of their position and type. Nevertheless a complete urban enviornment without vegetation and trees is very unnatural and does not adequately represent a city. Thus it is necessary to render nicely looking trees without spending a huge portion of the available rendering budget just to make these trees look good.

3 RENDERING METHODS FOR VEGETATION AND TREES

In recent years three main methods for rendering vegetation have been developed: billboard-trees, impostor-based trees, and point-based trees.

3.1 Billboard trees

The simplest form of this tree-representation consists of two quadrilaterals that are positioned at a right angle to each other with two views of the tree from orthogonal viewpoints put into the texture of these quadrilaterals. This can be extended to branches and twigs by adding additional quadrilaterals with associated textures, and results in a representation of a tree by a small number of polygons [JAKULIN, MEYER et al., SPEEDTREE].

3.2 Impostor-based trees

Whereas billboard trees are represented by a small number of polygons (e.g. 2) that are fixed in their orientation, impostors are single quadrilaterals with texture that are always oriented towards the viewer. The earliest and simplest impostors were single views of trees that were always reoriented to face the viewer. As this can only be viewed as a hint for a trees existence, and does not adequately represent its shape, modern impostor-based systems change the displayed view depending on the orientation. Thus an impostor system is a dynamic rendering sytem that needs to regenerate the texture of each impostor that has become too inaccurate, as the vieweing angle and the original rendering angle have diverged. [SCHAUFLER & STÜRZLINGER]

3.3 Point-based trees

A different approach to rendering trees and vegetation is the use of points instead of triangles. This is based on the observation that the screen size of triangles that are rendered to represent objects like leaves or twigs is often smaller than a single pixel. By just using a single point instead of a triangle, it is only necessary to transform and work on a single 3-dimensional coordinate instead of three (for each vertex of the triangle) [WEBER & PENN, DEUSSEN et al.].

This approach can be extended to represent larger portions of the tree with only single points, if they only occupy a small number of pixels on the screen. Such a level-of-detail approach can be naturally included in a point-based renderer and can significantly improve rendering speeds.

4 IMPROVED TREES FOR URBAN ENVIRONMENTS

Based on the presented technologies we have employed a number of methods for rendering trees and vegetation. In the following sections we will give a more detailed description of how these techniques can be used, and their respective advantages and drawbacks.

4.1 Improved point-based trees

Representing the leaves of a whole tree by points leads to one specific performance problem: due to the density of leaves in a tree, a large number of points that are drawn onto the screen will be later covered by closer points an thus a signifcant amount of rendering time is wasted on invisible parts of the geometry.

Based on this observation, a method for generating multiple view-dependent representations for each tree is a promising approach for speeding up rendering times.

Our algorithm for high-performance point based trees uses this idea and therefore has two stages:

Pre-processing stage: In this stage the tree is rendered into a buffer from a number of different view directions that are grouped into multiple sets (around 20 to 30). For each set of directions statistics are maintained for each point that has to be rendered. Based on the number of pixels a specific point has covered during rendering all the directions in a set, the point is assigned an importance. The points are then sorted according to this importance. Thus for each set of view directions, a single sorted list of points is generated that represents the tree as seen from any of the included directions.

Rendering stage: When rendering a tree, the actual view direction is classified with respect to the view direction sets used in preprocessing. The set that most closely represents the actual viewing direction is then used to render the tree. It is now possible to allocate a rendering budget for rendering this tree, by specifying the number of points that should be rendered. Due to the sorting of the point-list according to importance, the most important points are rendered as a representation of the tree.

This tree-rendering algorithm is adequate for rendering a fair number of trees (a few hundred to a few thousand) at medium to far distance as can be seen in figure 2 and 3. Due to the preprcessing, the actual number of points that needs to be rendered is significantly smaller than the total number of points in the tree resulting in a significant speed up compared to standard point-based trees. In our tests the speed-ups were in the range between 10 times and 20 times.

A drawback of point-based trees is their poor visual appearance when they are viewed from close up: they split up into individual points and lose the appearance of a tree. In an urban setting they can thus only be used for trees that are not viewed from close up.

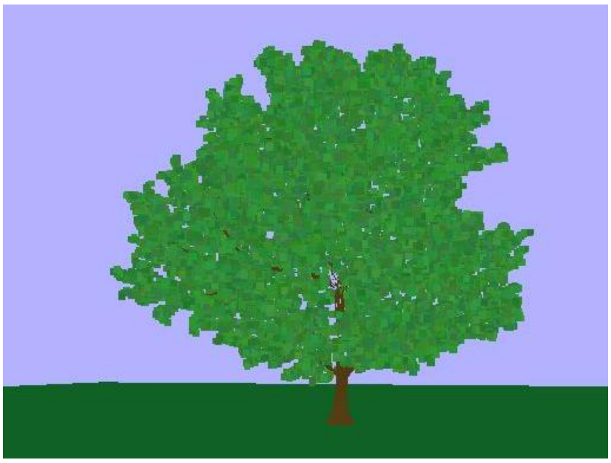

Figure 2: A single point-based tree.

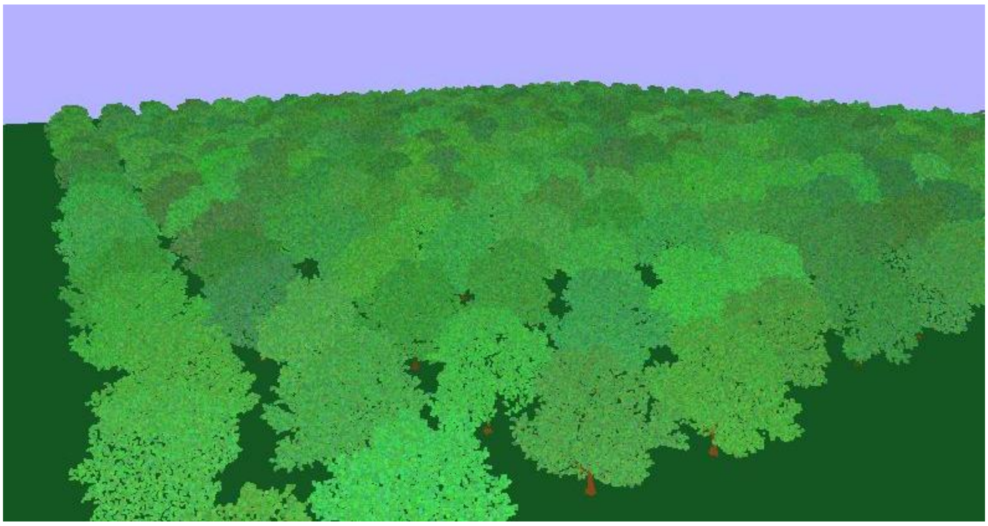

Figure 3: 250 Point-based trees rendered in real-time.

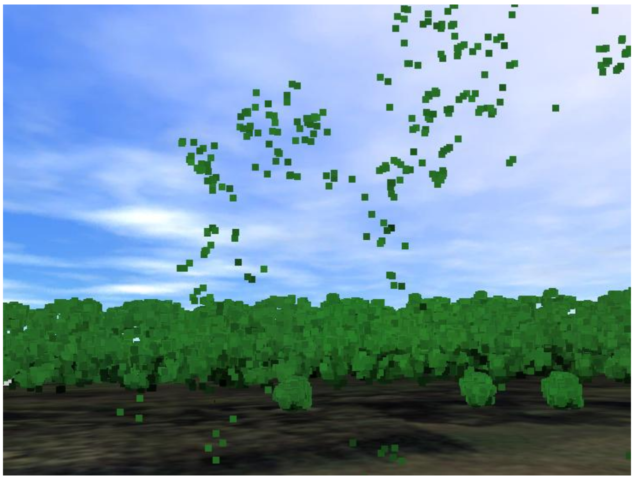

Figure 4: A point-based tree falls apart when viewed from to close-up.

4.2 Improved billboard trees

Billboard trees, although based on a simple algorithm are complicated by one fact: choosing adequate quadrilaterals for representing an operation that cannot be easily automated. Therefore these types of trees were often used with representation quadrilaterals specified by hand. Recently a general algorithm for automatically generating billboard representations of arbitrary objects has been introduced by Decoret et al. [DECORET et al.]: the object is transformed into a dual space where each plane is represented by a single point. Clusters in this dual space are then successively represented by a single quadrilateral until the complete object has been covered.

Directly applying this algorithm to trees results in inadequate representations, as the visual importance of the different features of a tree is not evident in the geometry: a trunk is visually significantly more important than a few branches that are hidden by leaves although these leaves might be larger than the trunk in total.

In order to overcome these problems we introduced a number of heuristics for placing the quads for representing the whole tree. This includes special treatment of the trunk, post-optimization of the set of quadrilaterals for representing the tree, as well as preference for vertically oriented quads in order to get good representations for walk-throughs.

Figure 5: Walkthrough scenario with improved billboard trees.

The improved billboard trees are still very quick to render, as they require only 10 to 40 textured triangles per tree, but avoid the extreme problems of point based trees when viewed from close-up. There are still visible problems when the textured triangles that represent a tree are viewed edge on as seen in some examples in figure 5, but overall the visual impression of these trees is adequate for both fly-overs and walk throughs (figure 1 and 5).

5 CONCLUSION AND FUTURE WORK

We demonstrated the use of different rendering methods in order to improve rendering speeds and rendering quality for rendering of vegetation and trees for urban environments. Based on different requirements these methods can be used to achieve adequate quality in a variety of cases.

Nevertheless, there are still a huge number of cases where the realism of the presented rendering methods is inadequate. Specifically if any of the rendered tree or vegetation models is viewed at a close distance a variety of artefacts become obvious. In order to overcome these problems we are currently developing a new multiresolution representation of vegetation for rendering vegetation and trees at any resolution and distance.

6 ACKNOWLEDGEMENTS

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MetropoVis: Time-Dependent Real-Time Rendering of Large and Photorealistic Virtual Cities

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ABSTRACT

A high quality visualization system for changing urban environments is a powerful tool for city planners. In order to accommodate the time-dependent nature of a city in such a system, we have built a four dimensional information space which facilitates both real-time rendering and database management. Our system consists of a Database Server, which solves GIS-related problems, and a fast visualization tool called AveViewer based on the Advance Visualization Engine (AVE) developed at the VRVis Research Center.

As a basis for data exchange between the viewer and the database, as well as for importing data, we chose VRML – an open 3D graphics format. The database server, utilizing MySQL 4.1 satisfies the OpenGIS standards, and facilitates the management of large amounts of structured geometric, raster and metadata content extended by timestamps. AveViewer uses this time-dependent information for a number of unique visualization methods, which are especially suited for urban planning.

Our system was tested on the very first 3D model of the Bratislava historical city centre (result of the MetropoVis data case study), as well as on other valuable datasets of Graz and Vienna.

Figure 1: Coarse-detail modeling example – Bratislava Castle and nearby Old Town textured from aerial images.

1 PROBLEM STATEMENT

Recent advances in the rendering speed of commercially available graphics cards make it possible to render large photorealistic models on commodity hardware. Hence, mechanisms for storing large models are required. This paper describes our efforts to build a database server which is optimized for storing GIS related data and meets general requirements for storing the kind of time-dependent data that is present in data bases used for urban planning.

2 FROM RAW DATA TO VIRTUAL MODELS

A variety of different modeling techniques is used for assembling a virtual city. The majority of these techniques deal with processing digital terrain models (DTM), aerial images, laser-scanned data, digital photographs, cadastral or other ad-hoc quantitative information. For an overview of a low-cost data acquisition and modeling techniques that maintain high-quality results we refer the reader to the overview by Ftacnik et al. [FTACNIK04]. High-quality modeling software for creating the city models has been described by Karner [KARNER04]. Dudek and Blaise [DUDEK03] demonstrate the importance of data time classification and show appropriate visualization solution.

This paper is not concerned with the analysis of the modeling methods used in urban planning, but demonstrates a system for fast and visually valuable interaction between the user and a large virtual space. Nevertheless, any meaningful information visualization system strongly depends on the quality of the input data, which leads us naturally to a rough taxonomy of available virtual urban models, based on their applicability in a photorealistic rendering system. Figures 1 - 3 illustrate three photorealistic categories we recognize: coarse, medium and fine-detail. They differ in the highest possible visual detail, the human effort to build them and the

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amount of data they allocate (and thus the visualization speed complexity as a trade-off based on the amount of detail that is present in the model).

Large-scale models are sufficient for data-load demanding flythroughs, where an observer is expected to view the objects from farther than about 30 meters. One typical application for such model is a city web presentation, limited by the low network traffic requirements. A large-scale web presentation gives virtual visitors the most attractive view to the city – the bird eye's perspective, but does not allow them to access resources that are too detailed (i.e. costly to retrieve).

Figure 1 shows a photogrammetrically constructed model, textured by a quick ray-casting method (described by Ftacnik et al. [FTACNIK04]). Aerial image resolution is 10 cm, sufficient for 30 m close-up in virtual space (at a field of view of 90 degrees).

While there are many automation techniques known for coarse-detail city modeling, fine-detail models require a lot of effort to create (essentially these models are mostly hand-made). They have to include all features the viewer can notice in the real object, allowing him/her to view them from the closest possible distance in the virtual space. Full-feature requirement prohibits to use the aerial data as an only data source (problems with overlapping roofs, etc.). Fine-detail methods are mostly restricted to one or a limited cluster of buildings, since the creator has to capture particular information directly from the physical object location. Figure 2 shows the model of the St. Martin's Cathedral in Bratislava, assembled from high-quality digital photographs.

Figure 2: Fine-detail modeling example – St. Martin's Cathedral in Bratislava created in Caligari trueSpace 6.5 by Marek Zimányi.

Compromises of the coarse and fine-detail approaches with both huge domains and acceptable details are often found in many virtual city projects. Typical usage of the medium-detail model is a virtual walkthrough [VOP01] – the user is allowed to move freely even in the narrow streets, but must not expect very smooth details in close-ups smaller than couple of meters (unless there is a model substitution in a higher level of detail).

Figure 3: Medium-detail modeling example – French Institute in Bratislava textured by Ján Lacko.

3 METROPOVIS DATA CASE STUDY – OLD TOWN IN BRATISLAVA

In the MetropoVis project, we have developed the software solutions capable of dealing with large amount of very detailed geometrical and non-geometrical resources. For testing purposes, we needed to have much finer than just low-cost and coarse-detail models accessible, thus we have established a team of creatives, assembling an original virtual city model. Due to the lack of such models in Slovakia, we have chosen its Capital and set a goal to virtually reconstruct the current historical centre of the Bratislava Old Town. Limited in time and human resources available, we decided to produce a medium-detail model (Figure 3 displays a fragment), enriched with a couple of selected buildings in fine-detail versions (Figure 2).

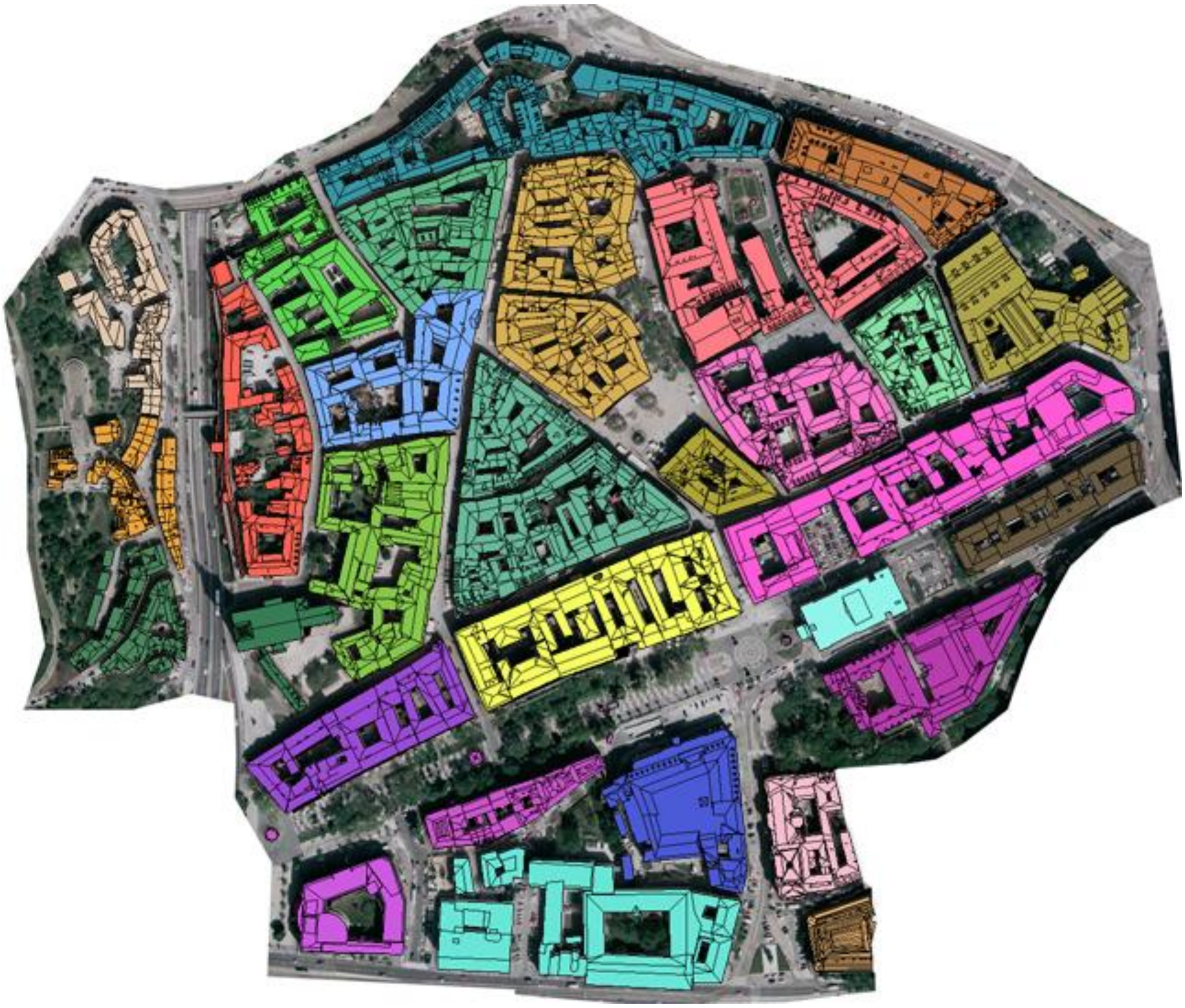

Figure 4: MetropoVis Case Study domain – historical centre of Bratislava Old Town.

36.5 hectares of historical buildings were photogrammetrically processed from aerial images by the Eurosense company. Roofline vectors of hundreds of objects together with a detailed terrain model formed the basis for further improvements. We found out that geometry of a roofline box model, as demonstrated in Figure 6, is almost satisfactory for the medium-detail presentation. Most complex wall formations can be incorporated into textures, saving several hours of geometry refinement and texture mapping per building (e.g. the flattened porch entry to the French Institute in the Figure 3). The only exceptions are some essential structures bulging out of flat façades thereby preventing the virtual user to see them from a side. The biggest possible model improvements are thus concerned with obtaining adequate textures. In our case study, we are investigating some of the known texturing methods (the ultimate method is a combination of multiple approaches). Final results including a cost and quality analysis can be found in the reports published on our project web page [MetropoVis].

4 VRML AS A COMMUNICATION MEDIUM

Obviously, any software modules of a larger system handling large amounts of data need to cooperate with each other and the outer environment via reasonably standardized means. From a lot of 3D file format specifications contemporarily available, we chose the best known and accepted open standard for scene description – the Virtual Modeling Language [VRML97]. Our proposed system accepts new models as the VRML scenes, which are loaded by and transferred into the inner format of the Database Server. Next, the Database Server replies to the AveViewer geometry queries in the VRML as illustrated in the simplified dataflow diagram below. The rest of the paper shows our proposals for each part of the dataflow, subsequent to the modeling phase.

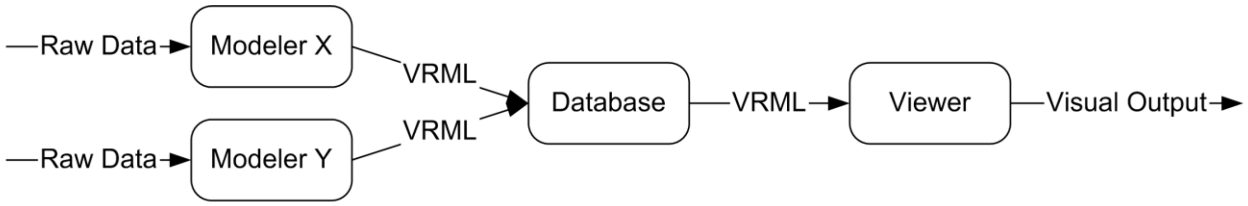

Figure 5: Basic MetropoVis data flow.

The big advantage of the VRML is its wide internet usage and the support of plugins available for common web browsers. Figure 6 demonstrates a part of the MetropoVis case study geometry rendered with the Cortona VRML viewer [Cortona]. A number of drawbacks associated with such plugins prevent them from being a viable choice for coarse-detail or large-scene visualization. This is one of the reasons, why we are developing our own tool capable of fine real-time visualization of huge amounts of data. Nevertheless it is possible to use Cortona and other similar software to render large virtual cities, though not in real-time and lacking the advanced rendering optimizations and interactive features of the AVE (Advanced Visualization Engine) Viewer developed at the VRVis Research Center.

Figure 6: St. Martin's Cathedral surroundings rendered without textures in the Cortona viewer.

5 PUTTING DIVERSE DATA INTO ONE PIECE

Our system specification proposal naturally follows the modeling database ↔ rendering software division, relieving the database from the real-time visualization and the renderer from the modeling complexity affairs. A simple HTTP protocol was chosen as a communication link between the two subsystems, leading to a particular tradeoff of advantages and drawbacks. The AveViewer acts as an internet application, giving the user a freedom of physical location. Multiple program instances can run simultaneously with one Database Server. On the other hand, HTTP does not guarantee any bandwidth or roundtrip time. Therefore, the AveViewer must be independent from the Database Server, to some extent. In a real traffic, the AveViewer tries to load as much data as possible after the connection was established (vital connection persistence is generally not assured over the internet) and after the most crucial data are delivered, less important information is requested in smaller chunks.

The main goal of the Database Server regarding its inputs is to unify the data formats provided by the various sources of geometrical models, textures, metadata and non-geometrical information. For this purpose we have developed a standalone application for importing VRML scenes into our database. Due to the versatility of VRML, all of the currently available wide-spread modeling software packages offer an option to export virtual scenes into this format. However, there are some reasons for choosing other data formats than VRML if some modeling software provides additional features (non-standard object representation, complicated multitexturing, etc.). In this case, we let other developers write their own software for importing data into the Database Servers internal structure, which is published in the interface specification document [MetropoVis]. At present, we provide additional importer programs for ESRI shapefiles and digital terrain maps.

ESRI files usually serve as a repository for GIS systems, full of data suitable for fast visualization of complex urban scenes. Nevertheless, they often miss one property crucial to the photorealistic rendering: color textures. We discovered that software system natively handling with ESRI formats commonly does not allow to store scenes in VRML and hence we introduced our own software solution called Piecer. It is an application capable of combining various vector formats into one VRML scene (prepared for further refinement and texturing in conventional modelers). Additionally, it allows to quickly break a large city geometry into small pieces (general-purpose modelers are rather awkward in this task), which is very helpful for modeling a large city by a team of modelers (Figure 4 was generated in Piecer as a scene composed of standalone building blocks).

One obvious problem arises when different geometry sources are combined: coordinate systems compatibility. VRML scenes are specified in the well-known 3D orthogonal system, but can differ in orientation, scale and position of the central point. Instead of storing some extra information about the coordinate system for each object, we developed a command-line converter of VRML file coordinates, that makes it possible to transfer them into a unified system specified by the database administrator and to store the transformation in a 4×4 numerical matrix (this is useful for transferring the whole database content into the coordinate system of the original VRML scene).

6 DATABASE SERVER OPERATION

The Database Server should store the content intended to fast rendering in the arrangement most appropriate for instant reaction to the AveViewer demands. On the other hand, it should organize data transparently in order to provide multipurpose interface for common GIS analysis. Core of the Server thus should be a well-arranged spatial database accessible by geometrical, quantitative, metadata and other SQL queries (most common query language). Main dataflow diagram of our solution is shown in the next figure.

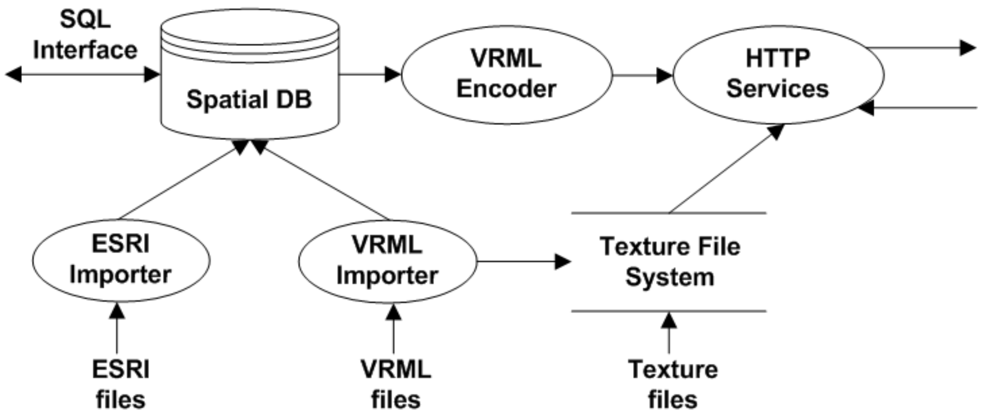

Figure 7: Main context of the MetropoVis Database Server dataflow.

On the input side, the spatial database is fed by the VRML, ESRI or potentially other importing software. As customary in a number of applications, all the texture images are held separately from the database files, which is especially suitable for VRML scenes, since a VRML viewer (not necessarily the AveViewer in this case) primarily loads the VRML geometry file, which refers to the textures by URL strings (www addresses). Thus the textures can be loaded on demand, partially, or not at all, depending on other constraints.

The spatial database design (specified in [MetropoVis]) follows the necessary GIS standards and recommendations for developers (which were summarized in a consistent manner by Rigaux et al. [RIGAUX01]). Geometrical structures are stored in hierarchical order (scene → layer → object → material → face → vertex → coordinates) with the single point as the lowest atomical entity. Therefore the objects originally delivered in one piece may be split into separate fragments, if demanded from AveViewer. We have achieved smaller information redundancy in our spatial tables compared to the plain VRML file (where one point joining different materials is divided into more vertices).

Apart from the geometrical and textural information, each object refers to its own metadata record. The most important non-visual metadata item is a timestamp of the (real-world) object creation and possibly its termination (end of existence). Thus it is possible to retrieve the state of each part of the city as it looked at a specific time. By loading the data available for whole time intervals (requesting an interval in both time and space), it is possible to visualize the changes in the buildings of a city as they happened over time. This time-dependency of the city data is essential for the long-term viability of a city data base.

Other metadata include object specific information (e.g. location name) and author specific information (e.g. name, time of the model creation) information. The same meta data is available for object layers as well (buildings, traffic signs, vegetations, civic networks, etc.). The metadata record specification is open to additions, and a tool for quick specification of a new item has been implemented for simplifying further extensions.

We have already mentioned the time constraint AveViewer can use for specifying the demanded data. Other natural constraint is the space to load geometry from. Apart from the time and layer specification, no other metadata restrictions were incorporated into the DB Server ↔ AveViewer protocol (detailed protocol description can be found on the project web page [MetropoVis]). Our motive was to achieve a fast communication, which exploit the static query format (i.e. the query structure is fixed and the only variable part is the data content) rather than the dynamic queries that would lead to additional time overhead during message parsing and particularly during the result composition on the DB Server side.

In order to avoid geometry redundancy, we introduced so-called prototyped objects into the network protocol. Prototyped objects (traffic signs, trees,…) are geometry entities with multiple occurrences of one same (or proportionally changed) instance. Prototyping is also possible in VRML, but the prototyped object cannot be shared by two separate VRML files, which is not a case of our system. Each prototype has a unique identifier associated and once the AveViewer loads the prototyped geometry, only the instance properties like position and height are transferred with the prototype identifier through the network. Having reasonable classes of trees (oak, pine, maple,…) prototyped, a virtual city creator can save huge amounts of data when supplying models for parks, orchards or woods, for example.

From wide contemporary offer of a spatial DBMS (database management systems), the famous open-source MySQL in its 4.1 version was chosen as a solution for our Database Server. This version of MySQL is the first one to support spatial tables exactly in the OpenGIS SFS style (defined in [OpenGIS]). MySQL user can now formulate structured geometrical queries for the database, which made it possible to reserve the database connections for non-visual SQL analysis, as illustrated in the Figure 7. An additional advantage of the OpenGIS spatial tables is the ease of porting the DB Server source code to any other OpenGIS-based DBMS. Due to performance considerations, we are using the C API for interfacing MySQL, rather than ODBC or other slower but DBMS-independent connection.

From the point of view of a computer graphics developer, OpenGIS has one major drawback – it only operates in a 2-dimensional space. The third dimension has to be an attribute of a 2 dimensional object. We overcome this limitation by restricting the AveViewer queries to two dimensions, which is sufficient for queries in a city model. The query results come out as fully 3D files, thus the AveViewer user can freely operate in all three dimensions, as well as the time dimension.

7 THE VIEWER

The final, and most visible part of our system is the viewer application that can be used to navigate cities in both space and time. It acts as a client to the Database Server and requests geometry and metadata on demand. In order to reduce communication overhead it also incorporates a cache that is slowly filled with the results of all geometry requests. Thus the network time delay only appears the first time a specific building or object in the database is requested for viewing.

The actual management of geometry inside the viewer is based on a two-dimensional grid: the geometry inside each grid-cell is requested using the corresponding query. The ordering of the requests is based on the current visibility of the cell in question: the cells touching the viewing cell are retrieved first, and within these, cells closer to the viewpoint get higher priority than cells that are farther away. Within each cell multiple versions of all geometry can be available, sorted by the time for which they are valid. The time, which is chosen for viewing, can be changed and is used to the selecting the actual geometry that is to be displayed.

The viewer we implemented for this project is based on the Advanced Visualization Engine, and provides real-time rendering functionality for walk-throughs and fly-overs of complete cities modeled at the medium-detail level including the typical few instances of fine-detail models. It serves as a test-bed for implementing different functionality based on the desired application area. Thus various visualization tools can be integrated into this viewer so that it can be tailored to specific users of a city model. Examples of such tools are measurement of distances and lines of sight, placement of prototyped objects (e.g. traffic signs and plants) and comparison between version of a city as it existed at various times.

The new functionality of the viewer has been built upon a basis that incorporates a sound visualization kernel with other features that are important for city modeling, such as secure transmission [HESINA03] and optimized texture management [HESINA04].

8 RESULTS AND CONCLUSION

We have developed a general system for rendering a time-dependent urban data that can easily be extended for visualizing a number of aspects of urban development. The use of standards at various interfaces in our system makes it possible to replace a number of components without a huge effort (i.e. the modeler, database, viewer subsystems and even their modules). Our in-house viewer facilitates viewing large city spaces in real-time in a very high, near photorealistic quality. In the future we will extend the database side to handle more available metadata, to facilitate the work of urban planners, and provide non-photorealistic data-views that visualize various aspects of the data available in city models.

9 ACKNOWLEDGEMENTS

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Using Visualisation Techniques In Planning To Improve Collaborative Governance in Ireland

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Abstract: *Public participation in planning is gradually being adopted as an established component of both local and national Irish governance strategies. However, facilitating public participation in planning is not based on a simple set of ingredients that can be mixed according to a set recipe. Rather, it is a complex process that requires consolidated co-operation between a variety of players, changes in existing organisational processes, the adoption of innovative technological tools, and the re-engineering of services and data to provide them to the public in a more user-friendly manner.*

Environmental Impact Statements (EISs) are just one example of environmental information that is important in a participatory context. Currently the mechanism for accessing these and the requirements for producing these are not conducive to participatory planning. EISs are rarely accompanied by any widely available metadata, they are rarely digital; in fact they only become catalogued and available in a central repository in Ireland after decisions have been taken. Furthermore, the statements themselves are not as effective as they might be in conveying the information they contain to planners and the general public. One particular issue for which EPA (Environmental Protection Agency) guidelines exist but which is rarely addressed comprehensively, is that of visual impact assessment (VIA) used to predict, visualise and evaluate the impact of proposed developments on the landscape.

This research paper examines the various visualisation techniques utilised within VIAs prepared by consultants as part of the environmental impact assessment (EIA) process in Ireland and assesses their potential use in participatory planning. It also assesses possible improvements and suggests recommendations for the future.

1 INTRODUCTION

This paper is based on the results of two surveys conducted to investigate how the planning and development system manages the visual amenity in Ireland. A quantitative survey examined the quality of visual impact assessments (VIA) carried out within environmental impact assessment (EIA) for the development control process. These results supply evidence on the nature, techniques used, and quality of visual impact assessment practice from a sample of 164 EISs submitted between 1997 and 1999 (Prendergast & Rybaczuk, 2004). A second qualitative survey examined planning policies used to protect and enhance the visual amenity. Four stakerholder groups were interviewed including planners, design professionals, environmental organisations and the environmental spokespersons for the political parties. These results supply information on the development pressures impacting most significantly on the visual amenity, policies protecting the visual amenity within County and City Development Plans, other development policies impacting on the visual amenity, and methods used to enhance the visual amenity.

The inclusion of sustainable development in 2000 as one of the criteria against which planning applications are assessed by planning authorities has emphasised the role of public participation within the planning and development system. However, public participation in planning in Ireland is not as well developed as it could be, and initiatives to improve participation have not always been successful. The utilisation of the visualisation techniques used for VIA as potential communication formats is investigated to assist public participation.

2 ENVIRONMENTAL IMPACT ASSESSMENT INFORMATION

Ireland's planning system is based on the Local Government (Planning and Development) Act, 1963 (Oireachtas, 1963), which introduced Ireland’s first statutory development control system. Much legislation and regulations have been enacted since, including a statutory independent planning appeals system (Oireachtas, 1976), an environmental control system (DoE, 1989), expanded functions to meet the demands of increased economic growth and a growing European dimension from Ireland’s membership of the European Union. The Planning and Development Act 2000 (Oireachtas, 2000) recently introduced radical changes in the areas of protection of architectural heritage, increasing residential densities in urban areas, and requiring developers to commit a percentage of residential development sites for social housing.

The planning departments of Ireland’s 88 local authorities (29 county councils and 59 municipal authorities) operate Ireland’s planning system. The system includes a forward planning process which publishes Development Plans and land-use maps every five to six years, a development control process to adjudicate applications for development rights which includes a facilitity to appeal decisions to An Bord Pleanála (the Planning Appeals Board), and an enforcement process to monitor land-use and conditions applied to development decisions.

Planning permission for certain categories of major developments cannot be assessed on the basis of the planning application and the County/City Development Plan (CDP) alone (DoE, 1989). These categories also require environmental impact assessment (EIA) to be carried out and an environmental impact ststement (EIS) to be prepared and submitted with the planning application. EIA examines the existing environment and potential impacts resulting from the proposed development on human beings, flora, fauna, soils, water, air, climate, the landscape, material assets, and cultural heritage. None of these environmental factors should be omitted at risk of invalidating the planning application, but their level of treatment may differ depending on the likelihood of impacts resulting from the specific project proposal (CAAS, 1995a). There has been a perception to date that environmental factors, which can be assessed by quantitative scientific analysis such as water, air, and noise, are more important than factors, such as landscape, which use more subjective evaluations (European Environment Agency, 1998).

EIA is a process for anticipating the potential effects on the environment caused by a proposed development, and where effects are identified that are unacceptable, these can be then be avoided or reduced during the design process (CAAS, 2002). Landscape Impact Assessment (LIA) examines two aspects of the landscape, impacts on landscape character and impacts on the visual amenity. Visual

Impact Assessment (VIA) is defined as an estimation of the likelihood of changes to the visual amenity of the landscape resulting from a proposed development (The Landscape Institute & The Institute of Environmental Management & Assessment, 2002). Visual impacts are therefore often viewed as a subset of landscape impacts. They relate solely to changes in the visual amenity of the landscape due to obstruction or intrusion of views, and to the effects that those changes may have on the viewer. Therefore, the primary function of VIA is to predict the visual impacts of a development on the visual amenity before construction, in order to modify designs of proposed structures to eliminate or minimise these impacts.

2.1 Methodology Chosen for the Survey of Visual Practice

EISs submitted to local authorities as part of the documentation for planning permission are available for inspection at local planning authorities. Individually visiting all of the planning authorities in Ireland would be a long and arduous task. Far more convenient for a study looking at projects across several planning authorities is the collection of EISs in the ENFO (Ireland's public information service on environmental matters) library in Dublin.

When the survey was conducted the central repository contained nearly one thousand EISs submitted between 1988 and 1999. The statutory requirement for EIS content (DoE, 1989), the EPA guidelines on EIS content (CAAS, 1995a) and the EPA advice notes on EIS preparation (CAAS, 1995b) would not have taken effect until 1996 at least. Furthermore, it was assumed that after the introduction of EIA professionals would have undergone a steep learning curve of the concepts, methodologies and techniques necessary. Therefore the selected sample was chosen from the later years of the total EIS population to ensure those examined post-dated the learning curve of professionals conducting EIA as well as post-dating the implementation of the guidelines.

A pro-forma initially developed to systematically collect LIA and VIA data was piloted to ensure that it was comprehensive, easy to conduct, and that the data collected were in a format suitable for subsequent analysis. On the basis of these results, the sample population was stratified into separate development categories for ease of comparison within each category. The only three development categories which had sample sizes sufficiently large enough to justify their selection were piggery developments quarry developments and urban developments, so these were duly chosen and the pro-forma was reformatted to concentrate exclusively on VIA. Development categories more likely to conduct VIA (wind-farms, afforestation) were purposely not selected, so that the overall survey results would be representative of the general quality of VIA practice in Ireland.

The survey examined 164 EISs in total, with the following breakdown by development category: piggery developments (35), quarry developments (42), urban developments (87). One EIS from the quarry development category was excluded from further analysis since it was an undersea development, which did not modify the existing visual amenity.

2.2 Visualisation Techniques used for Visual Impact Assessment

A range of visualisation techniques is available to present the nature and magnitude of predicted visual impacts which increase in complexity and realism from engineering elevations, to artist's impressions, to photomontages, to physical models and to virtual models. Piggery developments recorded the least use of visualisation techniques (3%), whilst quarry developments and urban developments recorded slightly higher usages, 25% and 26% respectively (Figure 1). However, only 51% of VIA used photography, which is the cheapest, simplest and most effective technique for providing information on the existing visual amenity.

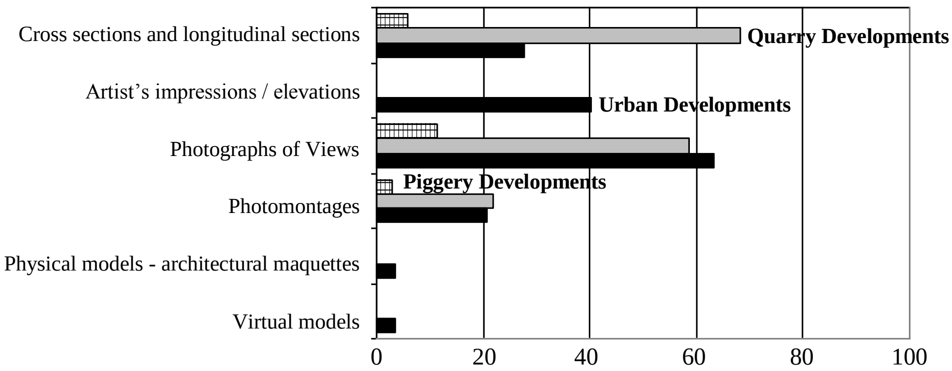

Figure 1 Incidence of use of different visualisation techniques within VIA in Ireland between 1997 and 1999.

VIA uses visualisation techniques to indicate to planners, developers and the general public what the predicted the changes to the existing visual amenity will be. Predictions need to be calculated using scientific methods to ensure they are valid and repeatable, and visualisation techniques should provide realistic predictions of the nature and magnitude of likely visual impacts. The overall use of visualisation techniques (Figure 2) was low (21%) and traditional techniques were more predominant than modern with photomontages being used less (17%) than the more conventional techniques of artist's impressions, perspective views and elevations (22%).

Physical and virtual modelling techniques can be expensive and might normally only be performed for projects involving major investments, but since EIA is only prepared for major developments, the use of modelling techniques was lower than anticipated (3%), and all of these models were only created for urban developments. However, these results refer to data produced between 1997 and 1999 which are now somewhat dated, so it would be interesting to conduct a follow-up survey to determine any improvement in use of the visualisation techniques outlined and in the adoption of modern techniques. The adoption of modern techniques is not just technologically based, and issues such as the cost and copyright of spatial data influence decisions. Many of these issues are currently being examined during the development of the Irish Spatial Data Infrastructure.

Proposed developments can be virtually modelled in three dimensions, and sophisticated tools are available to provide very advanced simulations for surface rendering, lighting and atmospheric conditions. One of the main advantages of this new technology is the high standard of realism achieved using virtual models. An orientation and latitude can be assigned to a proposed structure to permit a virtual sun to cast shadows, which are correct for the site location. The ability to model structures to this degree of realism before a sod is turned enables the designer and the developer to identify and correct design mistakes before construction begins.

Another important benefit of producing virtual models is their ability to simulate multiple scenarios of form, layout, and finishes at design stage. This examination of multiple scenarios for each development proposal facilitates the improvement of design quality. Another major advantage of virtual models is their ability to check the architectural and environmental suitability of a design to its' site and its' environs. This examination of the proposed development to ensure it strikes a balance with the receiving environment with respect to its' form, scale, colour, orientation and detailing is the essence of EIA. However, in order to accomplish this satisfactorily it is also necessary to model the receiving environment and not just the proposed development site. Ideally, a three-dimensional model of the urban environment is required in which virtual models can be placed for examination and analysis. This identifies a particular difficulty in that most mapping products currently available are two-dimensional. It would be very expensive and time consuming for project proponents to produce 3D models of the receiving environment, but many city authorities worldwide are creating 3D city models as tools to suit this planning need (http://www.casa.ucl.ac.uk/vc/cities.htm). The current absence of 3D models for urban areas in Ireland means that 3D virtual models of the proposed development if created can only be analysed against a 2D model of the surrounding environment. As a consequence, this type of analysis is not yet commonplace.

Figure 2 Examples of visualisation techniques extracted from EIS in Ireland. Anticlockwise from top left: Cross section of the National University of Ireland sports complex in Cork, Front elevation of proposed renovation of a golf club, Artist's impression of Dundrum Town Centre, Photograph of existing residence proposed for demolition, Photomontage of the Luas bridge in Ranelagh, Physical model of the National University of Ireland Sports complex at the Mardyke in Cork, and Virtual model of the Landsdown cement factory in Kinegad (EIS archive, ENFO Library, Dublin).

New visualisation techniques and methods for disseminating the information are also possible once the virtual model has been created. Visualisations techniques include perspective views, fly-throughs (using multiple perspective views), and interactive walk-throughs allowing the observer to chose their own route through the model to examine the development proposal in their own way and at their own pace. Since all of these different presentations of the virtual model are digital they are suitable for distribution and access over the Internet. This variability of presentation and increased access has the potential for making planning processes more inclusive by involving designers, developers, planners, decision makers, local communities and interested citizens (Shiffer, 2002). The visual images become the driving force and the interface to provide planning information to the end-user in a format they can understand more easily. User groups accepted the potential inherent in technological solutions, both as practical community development tools and as potential means to empower individuals, organisations and entire communities (Haughey, 2004).

The use of many intead of fewer visualisation techniques provides multiple representations of a development proposal that collectively contribute to communicate the proposed concept more effectively. Secondly, and of equal importance, is the ability to use these visualisation techniques to provide alternative development proposals to ensure inappropriate developments are minimised.

3 PUBLIC PARTICIPATION IN IRELAND'S PLANNING PROCESS

Public participation has been a feature within the forward planning and development control processes since the inception of Ireland's Planning and Development system. However public participation in the past was minimal in forward planning, because scant resources were traditionally allotted to policy formulation up to as recently as the mid to late 1990s, and County Development Plans cover relatively large areas which limits the detail possible for smaller community areas thereby mitigating against community involvement in the process.

3.1 Traditional approaches used for Public Participation

Public participation in County Development Plans is an important aspect of their preparation since local authorities must publish a notice to announce the preparation of draft Development Plans or variations to existing Plans. Once prepared, the draft goes on public display for 12 weeks to permit the public submit their observations and copies must also be sent to various statutory and voluntary organisations seeking their specialist advice. Submissions from the public and these bodies must be considered before local politicians can adopt a Development Plan.

In contrast to forward planning, public participation in the development control process is over-subscribed with multiple objections to individual development proposals being normal. Notice of submission of planning applications must be included on a site notice in a prominent position on the site boundary and published in a national newspaper to inform the public and stimulate participation. If the development proposal requires EIA then the planning authority must also publish a notice in a national newspaper that an EIS has been received with a particular development proposal. Details of applications are available for public inspection in the local authority offices for 8 weeks after submission during which time objections may be submitted. A draft decision is then published and a further 4 weeks is available where objections to the draft decision may be made to the Planning Appeals Board for adjudication.

However, public participation in the development control process is idiosyncratic and often driven by events. Knowledge of a proposed development may stem from the publicity it receives in the local media, a discussion between neighbours, or a chance observation of a planning notice while passing by. Some individuals act as local champions by taking on the role of community watchdogs and local community groups and local organisations can significantly improve participation by informing the community and stimulating opinions and observations. Government sponsored groups such as community development projects, or partnerships, can play important similar roles. However, they are not geographically uniform and tend to focus on socially excluded areas.

3.2 Sustainability highlighting the need for Public Participation

The new Planning and Development Act (Oireachtas, 2000) requires planning authorities to also consider sustainable development when evaluating planning applications for development consent. The concept of sustainable development usually cited is "development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (Brundtland et al, 1987). A glaring anomaly between this concept of sustainable development and the traditional planning and development system in Ireland was that forward planning was too short by only considering a five to six year period, so there was an urgent need to provide a national and regional planning context for medium and long terms. Another focus of this concept of sustainability was to change the perception of landscape and environment from being a resource for life, to being a delicate resource with the ability to positively contribute to quality of life.

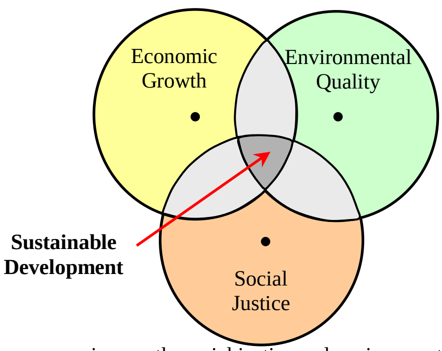

Figure 3 Relationship between economic growth, social justice and environmental quality to achieve sustainable development.

A national sustainable development partnership was established in 1999 with the aim of encouraging sustainable development across the Irish economy and society, and to advise government on policies to support and promote it. The partnership included a wide range of stakeholders from environmental, community, statutory, professional and economic sectors and they developed an agreed view on what sustainable development means in an Irish context (Comhar, 2002). Twelve principles for sustainable development were recommended as a benchmark to comprehensively test the sustainability of existing and proposed plans and programmes. A more simplified concept was also provided which is more suitable for use by developers and professionals within the design process and for planners within the development control process. It states that the three objectives of economic growth, social justice and environmental quality should be addressed equally in an integrated manner in order to achieve sustainable development (Figure 3).

The concept of sustainable development is nothing new to planners, but it has consistently been relegated by the pursuit of economic development (ENER-IURE, 2002). However, economic growth need not be at the expense of social development or maintaining a healthy physical environment, so these three objectives need not be mutually exclusive. Sustainable development requires compromise between the three competing interests, and citizen participation is identified as key to the attainment of sustainable development (Comhar, 2002).

County Development Boards were established with representation from the local government, state agencies, local development sectors and social partners to develop local strategies to implement sustainable development, and local authority's operations are now required to be consistent with these strategies (DoELG, 2001). Local authorities have also undertaken a range of initiatives to promote sustainable development both within the authorities and within local communities. Strategic Policy Committees have been established within local authorities to ensure that:

- The objectives of sustainable development are integrated into Development Plan policies.
- The performance of local authorities is evaluated and managed in a more environmentally friendly manner.
- Local agenda 21 initiatives are taken to formulate partnerships with local communities to promote awareness and educate about sustainable development issues in order to develop joint solutions.

All these initiatives have led to an increasing awareness that protecting the environment is an important national goal, and that the participation of local communities is a key requirement in this regard to ensure sustainable development is achieved.

4 SURVEY OF POLICIES USED TO MANAGE THE VISUAL AMENITY

4.1 Methodology chosen for the survey

A second qualitative survey examined policies within Ireland's County and City Development Plans (CDPs) used to protect and enhance the visual amenity. A sample was selected from the 29 County and 5 City administrations in Ireland that contain major planning departments and senior planners from the selected local authorities were contacted requesting their participation in the study. Although the initial intention was to include planners only, it was subsequently decided to include the other stakeholders of the visual environment; associations of design professionals creating the development proposals, community and environmental groups with environmental interests, and the environmental spokespersons of the political parties. The survey conducted 42 structured interviews during the summers of 2001 and 2002, which included design professional associations (6), environmental groups (12), planners (18) and political parties (6). Although the results of this survey primarily provides information on the development pressures impacting most significantly on the visual amenity, policies protecting the visual amenity within CDPs, other development policies impacting on the visual amenity, and methods used to enhance the visual amenity, it also provides much valuable information on local initiatives being taken to improve public participation.

4.2 Initiatives to improve Public Participation

The inclusion of sustainable development by the new planning and development Act (Oireachtas, 2000) as one of the criteria against which development proposals should be evaluated and the identification that public participation is key to the attainment of sustainability have highlighted the need to improve public participation in planning. However, facilitating participation in planning is not based on a simple set of ingredients that can be mixed according to a set recipe. The lack of formal structures to involve community groups in planning in the past has resulted in a shortage of existing groups and structures to take on this new role.

A statutory requirement within the new planning and development Act (Oireachtas, 2000) to prepare Local Area Plans (LAP) for local communities has rejuvenated local authority initiatives to facilitate public participation in planning. Many of the groups interviewed in the policy survey conducted felt that the preparation of LAPs would significantly help public participation by involving local communities in preparing draft LAPs for their localities. Different methodologies have been tested to develop participatory models suitable for the Irish situation with varying results. Some of the methodologies employed were:

- The Suburban Environmental Management Participatory Approach (SEMPA) project was a participatory approach designed to achieve more sustainable methods for planning and development. The local authorities and stakeholders shared responsibility for preparation of Development Plans using a SEMPA model. The model contained two aspects: an environmental forum for resolving conflicts, and local planning groups tasked with finding local solutions. A number of plans were produced including a Management Plan for the Howth Peninsula, a Recreation and Tourism Plan, a Public Transport Plan, an Environmental Plan for commercial enterprises, and a Management Plan for the use of public open space. The project proved successful in raising awareness of environmental issues, breaking down adversarial attitudes between local authorities and communities, and developing a local planning model based on partnership (Planning Authority A[#]).

[#] For reasons of confidentiality the planning authorities cannot be named.

- An experimental method was adopted by another local authority where the planners acted as facilitators and a steering group was established in a village by inviting locals to represent each sector of the community (farming, fishing, rural coastal area, tourism, commercial, residential, etc) and to prepare their own Local Area Plan. However, this methodology proved to be problematical because planners (historically under-staffed) have insufficient resources to commit to similar projects for the other villages (Planning Authority B[#]).
- An LAP for a rural town was prepared where public participation was limited. The advertisment of the Plan preparation was published before research or data collection began so the complete process to prepare the draft Plan was squeezed into statutory period of 6 to 8 weeks. Initially it was not intended to hold public meetings, however, one was held, but it did not address the hopes or aspirations of the local community so the Plan may not be representative of the views of the community (Planning Authoriy C[#]).

4.3 Difficulties encountered when encouraging Participation

There was a wide acceptance by all the groups interviewed during the policy survey of a historical lack of public participation in the forward planning process in Ireland. From the local authority's perspective, processes and attitudes need to be changed to stimulate and encourage participation. The words 'public participation' are not mentioned in any of the legislation or regulations dealing with the planning and development system. 'Public consultation' is used instead. The use of the word 'consultation' permits a less than enthusiastic support for participation if those driving the process wish to retain control, so consultation processes can be held to satisfy a statutory duty rather than engage with the public in a spirit of partnership. Arnstein viewed consultation as one of the degrees of tokenism (Figure 4), so would attitudes to participation improve if 'participation' was used instead of 'consultation'?

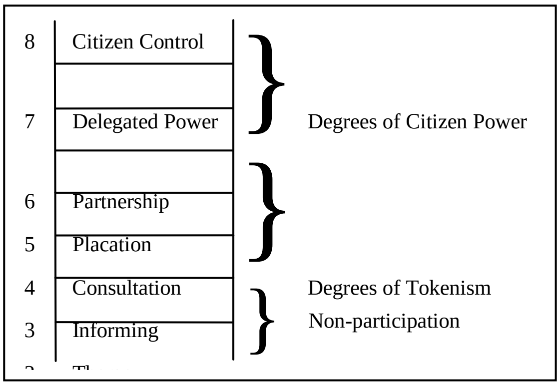

Figure 4 – Ladder of Participation (Arnstein, 1969).

Results from the policy survey indicate that some local authorities have difficulties engaging the public at times. Much money is spent putting adverts in newspapers, on local radio, and holding meetings in the local area, but local authorities do not get responses until draft Plans are published. The concept of public participation is to get people's views at the start to direct the planning process, rather than when concepts have been solidified in the minds of the gatekeepers.

Participation can be very resource-intensive for planners who need to educate, encourage, facilitate and manage participation projects. Due to the historical understaffing of planning authorities where inadequate resources were traditionally assigned to forward planning (ENER-IURE, 2002), the numbers of planners required for participation are still well below what is required even though the staffing situation has significantly improved during the last decade.

The access mechanisms currently in place to permit inspection of documents at the planning authority offices operate at only 18% of capacity from the time perspective (30 hours in a 24/7 week) due to staffing shortages within planning authorities, thereby severely constraining public participation. Although access to planning information is provided within these limited hours, the travel distance to the local planning authority and the availability of public transport for citizens can be an issue especially in larger rural counties.

Public participation in the forward planning and development control processes is somewhat compromised by procedural rules. All local authorities apply a charge (to cover the cost of production) to purchase paper copies of Development Plans and their associated land-use maps, although many local authorities now publish both of these documents on their websites. Local authorities also charge citizens to make objections to planning applications at the application stage and during appeals(currently €20), and appeals are only accepted if the same person previously submitted an objection at the application stage. All of these rules contrive to limit public participation and some expressly prohibit social inclusion by applying a charge to participate.

It is recognised that there is a major educational issue to inform the public how and why to participate in the forward planning and development control processes (Ryser, 2003). The implementation of ICTs would permit the adoption of a direct democracy model in which the opinions and preferences of the public could have a significant impact on decision making (McDonagh, 2001).

5 USE OF ICTs IN PLANNING

ICTs provide a range of new possibilities to compliment traditional ways of employment and of interacting with others and what is evolving via information society initiatives is a fundamental change in service provision. The Irish governments' first action plan on the information society (DoT, 1999) used a three-stranded e-government approach for online delivery of public services: (a)

[#] For reasons of confidentiality the planning authorities cannot be named.

information services - ensuring all public service information was available online via Department & Agency websites, as well as being delivered through traditional channels, (b) interactive services - enabling complete transactions to be conducted through electronic channels and (c) integrated services - re-engineering information and service delivery to suit user needs and developing a public services broker to supply government services through a single point of contact (www.reach.ie).

Although the implementation of the first plan was successful, rising standards elsewhere provide challenges to continually innovate, so the initial plan was superseded with a new action plan in 2002 (DoT, 2002). The new plan focuses on three key infrastructures: (a) developing the capacity necessary for delivery of advanced telecommunications services; (b) providing a secure legal framework for electronic transactions that businesses and consumers can use with confidence and (c) government playing a key leadership role in encouraging wider engagement with ICTs through its own business processes and service delivery arrangements. The new plan also containes a list of flagship projects, two of which directly relate to the planning and development system. The first project due for release early in 2005 includes an online facility providing access to the forward planning process to permit citizen interaction with the draft Development Plan, and development control process by supplying planning application forms on-line and to permit registering of unauthorised developments, commencement notices, and objections to planning applications by citizens on-line.

The second project named gPlan (GIS Planning) uses an integrated intranet/internet planning GIS (geographic information system) to provide documents and graphics relating to the planning register, Development Plans, and the forward planning and development control processes to remote users to view, analyse and make submissions via the system (www.proteus.ie). This project developed for the local authorities of Meath, Kildare and Donegal and the Local Government Computer Services Board is currently at proof of concept stage and key aspects are:

- To provide automatic display of appropriate Ordnance Survey Ireland mapping;
- To provide full access to the full text of the Development Plan for any policy objective or land-use zoning selected on the map;
- On-line submission of input by interested parties on any Development Plan policy objectives;
- To view full details of planning applications selected on the map, including a history of planning decisions in the area;
- To produce a notification report of overlaps of planning applications with Development Plan zonings, National Heritage Areas (NHAs), Special Areas of Conservation (SACs), Special Protection Areas (SPAs,) and Sites and Monuments.

5.1 Physical Access to Information for Public Participation in Planning

Physical access to information is the first key component necessary for public participation, which was identified as a right in the Freedom of Information Act (Oireachtas, 1997). The on-line ePlanning facility via the Public Service Broker portal should significantly improve the period of access by providing a 24/7 service, and should also permit access from remote locations over the internet. Many thousands of personal computers (PC) have been installed in public libraries during phase one of the Information Society Action Plan, trying to minimise the digital divide by providing access to the internet to those who do not have PCs at home.

Since the forward planning and development control processes both operate within statutory time periods, it is not only necessary to provide access, but access must be permitted within the statutory time period. If the process operates within an 8-week period and the information is not available until the start of week 2 (12.5% loss) or week 3 (25% loss), this loss of access hinders participation. This loss of access would be an ideal indicator of the success or otherwise of the new online access mechanisms and planning authorities should be required to maintain their loss below target values and publish information quarterly on whether targets are being achieved.

It is clear that improving public participation will not thrive unless the employment of ICTs in the interaction between government and citizens is at a sophisticated level. However, the existence of websites merely providing access to information about government services does little to change this manner of interaction between government and the citizen (McDonagh, 2001).

5.2 Intellectual Access to Information for Public Participation in Planning

The development control process requires a diverse range of planners, architects, engineers, project proponents, local politicians and the public to be able to conceptualise development proposals from documents supplied with planning applications. This necessitates reading maps, trying to visualise ideas in 3D from 2D schematic drawings and plans, and also understanding scientific evidence supplied in environmental impact statements (EISs) on impacts on water, fauna, traffic flows, and landscape. Therefore, intellectual access to information is the second key component necessary for participation, and how the information is presented can either impede or facilitate its understanding. Consequently, there is a need to examine the way information is currently presented in order to develop new paradigms to maximise communication, understanding and participation for all involved.

5.2.1 Capacity Building

The current process demands that individuals and community groups are aware of how the planning processes operate in order to allow them participate. This could be a dangerous assumption, which may divorce many citizens from the planning and development system and highlights a need to educate the public on how to participate and the need for participation by developing a sense of community ownership. Since public participation should be inclusive and not marginalize any social groups, this capacity building might best be provided during the mandatory schooling period before the age of 16. A planning and development module in the Civil Social and Political Education (CSPE) curriculum in second level could satisfy this need. The module would be specifically designed to educate how these processes operate and what role the public is expected to play in a democratic society. A second module should also be developed to educate existing adults how to participate and encourage them to become involved in their local communities.

5.2.2 Presentation of information

There is a need to examine the way information is currently presented in order to develop new paradigms to maximise communication, understanding and participation for all involved. Technical and scientific information can be difficult to grasp in text or in tabular form. Planning authorities are statutorily obliged to publish planning lists of applications received, decisions made, appeals received, and appeals decisions, and most do so via their websites. However, the lists are supplied in a format, which makes it difficult to find the information required, by having to read through page after page of textual data. This type of information needs to be re-engineered and supplied in a format, which assists rather than confuses knowledge.

Concepts can also be grasped much more quickly if presented graphically. Graphics not only disseminate the basic information but they can also indicate how elements are linked and how processes operate chronologically. One of the aims of the Information Society policy is to re-engineer existing processes to ensure government services are client focussed. This was successfully achieved in providing government information using a concept of lifecycles for citizens (www.oasis.gov.ie) and for businesses (www.basis.ie).

Changes in the landscape arising from new developments have a direct, immediate and visible effect upon people's surroundings, thereby arousing strong feelings. Immediate opinions are stimulated when people are visually confronted with a constructed development. Using visualisation techniques within the development control process is an important way of stimulating the public into vocalising opinions at a stage when the development is not yet built and their opinions can make a difference (Bell, 1999).

Many examples exist where geographic information system (GIS) technology has been successfully applied to improve existing planning processes, but radical changes are required to examine development proposals visually and optimise public participation in the process using visualisation techniques. Geo-visualisation is a relatively new area of geographic information research that integrates approaches from visualisation in scientific computing (ViSC), cartography, image analysis, information visualisation, exploratory data analysis (EDA) and GIS to provide the theory, methods and tools for visual exploration, analysis, synthesis and presentation of geographic information (MacEachren & Kraak, 2000). The strength of the combination of all these disciplines is the opportunity to look at data differently and stimulate so-called visual thinking by visual exploration and analysis. Two important functions of geo-visualisation in planning are exploration and collaboration. Professionals (planners, architects and engineers) can use geovisualisation for visual thinking to explore and preview different planning scenarios. Collaboration has to do with presenting development proposals visually between the various groups (planners, architects, engineers, project proponents, local politicians and the public) at different stages of the development control process. These geo-visualisation techniques can dramatically improve understanding of the planning issues, entice wider public participation by presenting the issues in a format which is more easily understood, and lead towards improved planning decisions and a better environment. Furthermore, the internet seems to be the logical delivery mechanism for collaboration to disseminate these geo-visualisations and as a resource to provide forums, chat rooms and email for discussing development alternatives (Jiang et al, 2002).

5.3 Implications of Public Participation to Collaborative Governance

There are many examples of significant improvements in public participation when investment is committed to local community groups (Clarke, 1999; Haughey, 2004) so funding should be provided for community groups across all social classes to assist participation at community level and ensure participation is widespread both thematically and geographically.

Supplying information in current formats from websites will not in itself improve participation. The information needs to be re-engineered to suit the public and its' provision in graphical formats using visualisation techniques should assist information understanding. The new ePlanning and gPlan facilities for the forward planning and development control processes are eagerly awaited and should provide the tools necessary to significantly improve citizen interaction in the planning and development system.

The development of eDemocracy can be viewed as underpinning a new approach to democratic theory where the basis of this theory is that representational democracy has failed. The perceived weaknesses of existing democratic arrangements are that members of the representative assemblies represent partisan interests, that they tend to follow only their own partial understanding of what is good for their constituencies, and that they are more responsive to the requirements of the political party they belong to, than to the citizens whose mandate they have received. The implementation of ICT, it is argued, will allow for the adoption of the more desirable model of direct democracy in which the opinions and preferences of all members of the public can have a significant impact on decision making (McDonagh, 2001).

6 CONCLUSIONS

- The results of the survey of visual impact assessment indicate a low use (21%) of visualisation techniques for VIA in Ireland in the late 1990s, and there is a need to investigvate why this is so. Obstacles limiting the use of visualisation techniques such as availability of skilled staff or availability, suitability or cost of spatial data should be examined and eliminated to encourage improved use of visualisation techniques.
- The gPlan facility currently being piloted and tested should permit maximum use of the full range of visualisation techniques available and should examine the concepts used in geo-visualisation to explore, analyse and present data in visual formats to assist understanding and encourage public participation.
- Consideration should be given to replacing the word 'consultation' with 'participation' in planning and development regulations to minimise the use of public consultation in a closed manner and to maximise participation of local communities in planning and development processes.

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The Comparison Of Istanbul Simulation Results Of Cellular Automata Based Lucam Land Use Estimation Model With Large Scale Manufacturing Industries Using High Technology

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1 INTRODUCTION

Recently parallel to the technological developments, in the transition process from industrial community to information community, while industrial production is becoming regular and routine, new activities and productions in especially service sector occurred. While service sector is prefering urban areas in tendencies of land use preferences, ındustries using high technology especially in Istanbul tend to prefer hinterlands of metropolitan areas. Another effect of technology is that it offers advantages for freedom to land use preferences of economic activities. Technological developments strengthen connections in economic relations, remove the disadvantages of physical distance, decrease the land preference necessity in congested urban areas, offer preference freedom to workers and enterprises where they live and work.

In Turkey after the liberal economy, the diversity of production activities and the rivalry environment of open market economy have brought industrial regeneration and technological development. These developments have caused rapid expansion in metropolitan areas and variation and transformation of different functional areas.

After 1980's important tools in controlling the differentiation seen in metropolitan cities, planning of the development and transformation have been developed. One of these tools is land use simulation models which use existing relation system and reflect all the properties of development and transformation dynamics of metropolitan areas to the results.

The use of modelling and simulation techniques in getting the development schema of cities, determining of transformations in natural, physical and social environment and defining negative or positive effects of urban developments on natural and cultural heritage in long term will be one of the planning standarts in Turkey and Europa in the future. In Turkey which is in an entrance process to European Union, the use of modelling and simulation tools is an inevitable situation in planning studies, and urban development and transformation studies.

In this article, depend on the relationship system between Istanbul's micro and macroforms how can the development, size and density of the metropolitan city defined as cellular groups and the simulation of the macroform of Istanbul metropolitan area and developments and transformations in city centers by cellular automata based LUCAM model as an urban modelling tool are explained. Furthermore in this article, whether the land use preferences of industrial firms using high technology and having research-development department and industrial areas after the running of LUCAM model to metropolitan area fit into one another are tested.

2 THE CONCEPT OF CELLULAR AUTOMATA AND CELLULAR AUTOMATA BASED MODEL OF LUCAM

In many studies Cellular Automata (C.A.) is an operation system and a feedback mechanism in cellular dividing of events and described subjects and determination of future condition of every cell depend on the nearby cell. Cellular Automata is described as the multi-centered planning of traditional single centered cities in post-modern era (Wu, 1998).

A cellular automata forms from regular cell lattice. Development occurs in time steps. Every cell characterise with a situation. Every cell develop by the same rule only depend on the situation of the cell and neighbour cell number. Neighbour relationship is local and self similar. Two main concepts and their relation is important in the running system of models depend on cellular automata. These concepts are induction and deduction approaches between real world (world of observed events-events to be modelled) and certain world (modelled events world). (Colonna, Stefano, Lombardo, Papini, Rabino, 1998).

The objective of this model developed for estimations about land use in urban sites is to obtain the data, which will contribute to the formation of growth orientations, on the basis of the data about the land use and the wants of the user in the synthesis phase of planning studies. Development of this model (LUCAM) has been founded upon CA developed by G. Engelen and R. White and the simulation model for estimations about settlement land use (Engelen, White, Uljee, 1997; White, Engelen, 1997-a, White, Engelen, 1993-b). The main features and the fiction of the model is based on the method developed by Engelen and White. On the other hand original ways have been followed in data formation and assessment methods. This method has been employed to test the model in Istanbul Metropolitan Area and to evaluate the results. In this model each cell represents a kind of urban land use (residence, industry, trade, facility, vacant. The main features, the operation system and assessment system of this cellular automata based model are mentioned below.

2.1 The Operation System of the LUCAM Model

The automation is divided into 500x500 m grilled shaped cells. Each cell must be in one of the pre-determined conditions i.e. Vacant (V), Residence (R), Industry (I), Trade (T), Facility (F) . The size of the grill changes according to the size of the settlement in which the model is tested. The area size accepted as about 2,5 ha for Istanbul Metropolitan Area.

The neighbour unit of a cell is defined as all the cells that remain in the 6 cell distance from the main cell. The total number of the cells that exist in the area between the core cell and the neighbour cells in the sixth zone is 168. As the cells are in a regular order, every cell in the neighbourhood is found in a 500 meter distance band (zone 1) or 4242 meter distance band (zone 6).

Empty cells have no weight and they directly contribute to the transformation potential. The facility areas exist in the settlements as unchanging function areas. These areas are for public use and they can not be transformed into functions such as residence, trade or industrial areas unless there is an extraordinary condition. On the other hand the transformation of facility areas take place if there is a need for another facility for public use. For this reason the cells defined as facility enter the model as they are, do not have any impacts on other cells and do not have any kinds of transformation.

According to the area values and economic effects the hierarchy of the lowest and highest conditions (vacant, residential, industrial, commercial, facility area) in the land use model (White, Engelen, 1993-a, 1993-b; White, Engelen, 1997-a, 1997-b; Yüzer 2001).

In each turn, the transformation potentials are calculated for all possible transformations. For one cell the transformation potentials are calculated as a total (Formula 1).

The Calculation Method of the Cellular Transformation Potential

$$\mathbf{P_{ij} = (\sum_{k,d} m_{kd}) / \sum h} \qquad (1)$$

P_{ij} : is the transition potential from state i to state j
m_{kd} : is the weighting parameter applied cells in state k in distance zone d
$\sum h$: is the some of central cell and neigbour cells

Table 1 The Weighting Parameter to be Applied on Each Cell to Calculate the Transformation Potential (White, Engelen, 1994; Yüzer M.A., 2001).

		Vacant ↓ Commerce				Vacant ↓ Industry				Vacant ↓ Housing				Industry ↓ Commerce				Industry ↓ Industry				Industry ↓ Housing				Housing ↓ Commerce				Housing ↓ Industry				Housing ↓ Housing			
		Commerce	Industry	Housing	Facility	Commerce	Industry	Housing	Facility	Commerce	Industry	Housing	Facility	Commerce	Industry	Housing	Facility	Commerce	Industry	Housing	Facility	Commerce	Industry	Housing	Facility	Commerce	Industry	Housing	Facility	Commerce	Industry	Housing	Facility	Commerce	Industry	Housing	Facility
Distance to central cell (d)	1	0,8	0,0	0,3	-	0,0	0,8	0,0	-	0,0	0,0	0,3	-	0,2	0,0	0,0	-	0,0	0,0	0,0	-	0,0	0,0	0,0	-	0,1	0,0	0,05	-	0,0	0,05	0,0	-	0,0	0,0	0,0	-
	2	0,8	0,0	0,3	-	0,0	0,8	0,0	-	0,0	0,0	0,3	-	0,1	0,0	0,0	-	0,0	0,0	0,0	-	0,0	0,0	0,0	-	0,1	0,0	0,05	-	0,0	0,05	0,0	-	0,0	0,0	0,0	-
	3	0,8	0,0	0,3	-	0,0	0,8	0,0	-	0,0	0,0	0,3	-	0,1	0,0	0,0	-	0,0	0,0	0,0	-	0,0	0,0	0,0	-	0,1	0,0	0,02	-	0,0	0,04	0,0	-	0,0	0,0	0,0	-
	4	0,6	0,0	0,2	-	0,0	0,6	0,1	-	0,1	0,02	0,2	-	0,5	0,0	0,02	-	0,0	0,0	0,0	-	0,0	0,0	0,0	-	0,05	0,0	0,02	-	0,0	0,03	0,01	-	0,0	0,0	0,0	-
	5	0,6	0,0	0,2	-	0,0	0,6	0,2	-	0,2	0,03	0,s2	-	0,5	0,0	0,03	-	0,0	0,0	0,0	-	0,0	0,0	0,0	-	0,02	0,0	0,01	-	0,01	0,02	0,02	-	0,0	0,0	0,0	-
	6	0,4	0,0	0,1	-	0,0	0,4	0,3	-	0,3	0,05	0,1	-	0,2	0,0	0,05	-	0,0	0,0	0,0	-	0,0	0,0	0,0	-	0,02	0,0	0,01	-	0,02	0,01	0,05	-	0,0	0,0	0,0	-

In Table 1 each four-column block between the spaces comprise the parameters used in the model. In each block of the table, the first column illustrates the weights applied on trade cells at 1-6 zones, the second the weights applied on industrial cells, and the third the weights applied on residence cells.

In each turn a sufficient number of cells are transformed into all kinds of uses in accordance with the above given hierarchical order. The cell which tests all the statuses, is at the highest potential as long as the conditional hierarchy is suitable for such kind of a case. In other words the end-condition of the cell which tests all the statuses shows the highest possible potential of that cell. The operation is applied on all cells and by this way the scheme following transformation is drawn up. (White, Engelen, 1994). This scheme created by using transformation parameters is operated for the second time to form a basis for the model in case the projected population or the settlement capacity is not achieved. The model is operated until the set size is achieved.

3 ISTANBUL METROPOLITAN AREA, INDUSTRIALISATION AND THE USE OF TECHNOLOGY

The Importance Of Istanbul Metropolitan Area In Turkey:

With 5512 km^2 area, Istanbul covers nearly 0.71 % of total area of Turkey and it's the greatest province of country for population size (Figure 1). As a result of the industrialisation and engineering in agriculture in 1950's and the migration from rural to urban areas increase the proportion of Istanbul Metropolitan Area in Turkey's population from 5.6 % in 1950 to 14,8 % in 2000 (Table 2).

Table 2. Population Values Of Turkey and Istanbul

Years	Population		Istanbul/Turkey Proportion (%)
	Turkey	Istanbul	
1950	20.947.188	1.166.477	5,57
1960	27.754.820	1.882.092	6,78
1970	35.605.176	3.019.032	8,48
1980	44.736.957	4.741.890	10,60
1990	56.473.035	7.309.190	12,94
2000	67.844.903	10.033.478	14,78

Istanbul has 20% of Turkey's industrialisation labour and 38% of Turkey's industrial firms. Istanbul which contains 55% of country's trade and 45% of wholesale trade, has 21.7% of Turkey's Gross National Product. Istanbul contains 75% of Turkey's financial institutions and 50% of Turkey's universities. 42.2% of taxes are gathered from Istanbul and 20-25% of government investment encouragements are done to Istanbul. 43,4% of total exports from Turkey are done from Istanbul. 80% of textile sector and 67% of metal things are exported from Istanbul. 40,7% of Turkey's imports are done to Istanbul. In chemical sector 94,2% of Turkey's import are done to Istanbul. In the sectoral distribution of Istanbul's Gross National Product, while industrial sector proportion is 28.06%, service sector proportion is 71.40% (DİE, 2000; İBB, 2001).

As the upper data shows, Istanbul is always a center of attraction for investors.

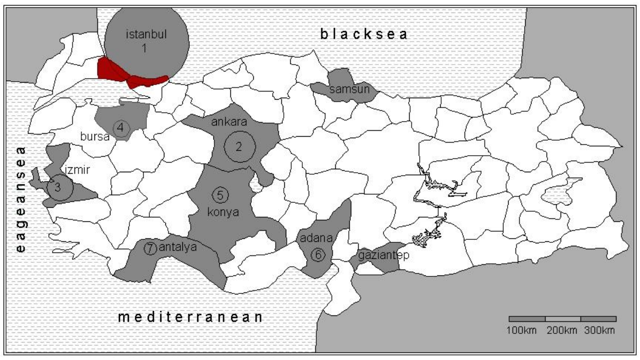

Figure 1: The Hierarchy of Metropoliten Cities in Turkey According to Population Growth (DIE, 1998, 2001)

The Reason Of Industrial Agglomeration In Metropolitan Areas;

Historically, cities have arisen and grown as centers of transactions and commerce, largely because of the need for physical proximity among firms, suppliers and customers. Agglomerations of people, commerce and industry allowed efficient production, transport and distribution of goods and services. Technology, particularly new transportation modes (cars, trains, electric trolleys etc) helped shape the first industrial cities as new technologies particularly information technologies do today. New and powerful information and telecommunications technologies continue to be developed and their impacts on industrial and residential location are still evolving. These technologies are central to the reshaping of the post-industrial metropolis. While places with the advantages - including a skilled, moderately priced labour force, low urbanization diseconomies (crime, congestion and environmental pollution etc), an industrial base of advanced innovative companies and high quality of life- will continue to do well, places without these advantages are likely to continue to lose out economically (Atkinson, R. A., etc. 1995).

As advance in technology and telecommunications have offered more freedom to economic sectors, industrial locations also changed from being dependent to natural sources to market.

As the advantages of metropolitan areas below continues, in the future most of the economy will be locating in these areas.

Metropolitan areas continue to provide advantages for industry, including large labour markets, frequent and cheap air transportation and availability of repair and technical services.

Metropolitan areas offer an environmental conducive to innovation and learning which, as technology increases the importance of continual product and service development, is an advantage to many firms.

Metropolitan economies have larger, more diverse amd more skilled labour markets, which gives firms acces to a sufficient number of qualified personnel.

Since there are more customers in larger metropolitan areas than in smaller ones, firms choose to expand in larger metropolitans to minimize distance from the customers.

Wıth the development of information technology, demography, social structure and, changing industrial organization, interaction among economic activities makes differences according to time and space, and reform metropolitan areas by the effects on industry and trade. It's an important potantial that cause the growth and diminish of some areas.

Industrial Distribution of Istanbul Metropolitan Area

When the spatial structure of Istanbul's industry is examined, it is seen that manufacturing industries are in a tendency of scattering from center and show a lineer view along transportation web (Figure 2). Manufacturing industries settled in Istanbul prefer city center because of existing labour and market possibilities. Especially untill 1990's firms connected to market as newspaper and printing prefer city center because of close relation with information and advantage of distribution. Organized and integrated industries dense along E-5 and TEM Highway axes. While high quality housing areas haven't take part near industry, labour houses lacking quality have developed near E-5 highway and close environment since past. New large scale industries settle in Gebze ve Tuzla in east part and Hoşdere, Firuzköy in west part where suburbs with cheap land and easy to get (Yüzer A.Ş,2002).

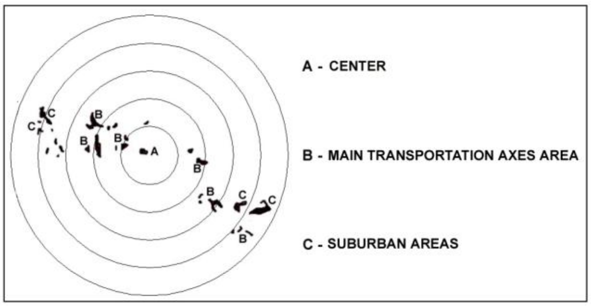

Figure 2: Industrial Distribution of Istanbul Metropolitan Area Along Highway Axes

4 THE SIMULATION OF ISTANBUL METROPOLITAN AREA BY LUCAM MODEL, INDUSTRIAL DESANTRALIZATION AND TENDENCY OF INDUSTRIAL INVESTORS

First of all existing land use data is entered to LUCAM Model (Figure 3, Table 3). Througout İstanbul Metropolitan Area at the base of year 2023 LUCAM Model is run and the figure 4 below is obtained. When the schema is examined, mostly the developments and transformations are in commerce and service sector and industrial sector area. Because of not having much vacant areas in Metropolitan area and having forest areas in the north prohibited to settlement, transformations are occurred mostly from residential areas to industrial and commercial areas or from industrial areas to commercial and service areas. As it is defined in high scale master plan, 1st, 2nd ve 3rd degree sub-centers in İstanbul metropolitan area are defined and the decentralisation in these areas are suggested. Simulation results after LUCAM Model also supports the necessity of decentralisation.

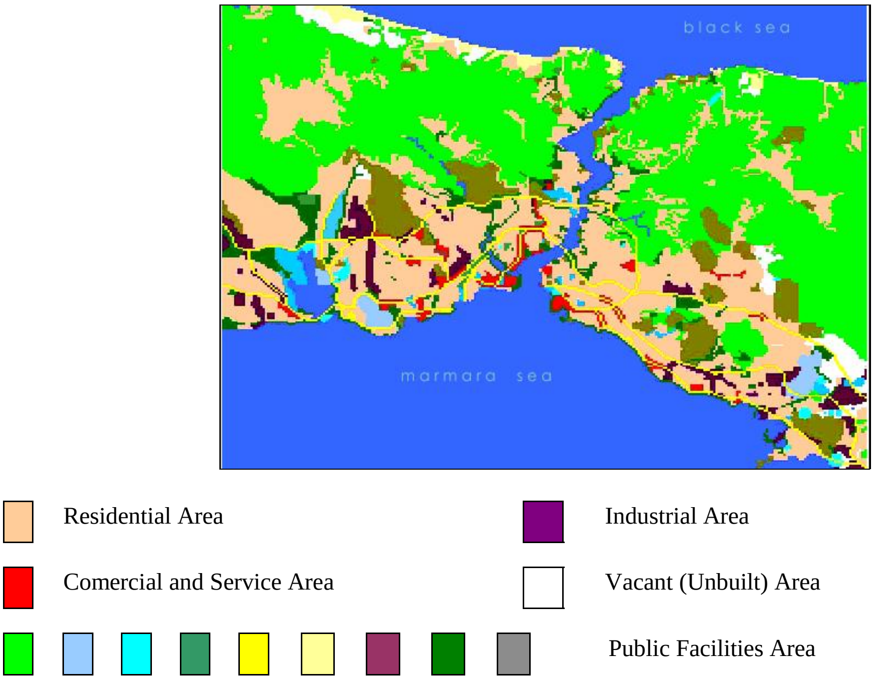

Figure 3 Existent Land Use of Istanbul Metropolitan Area

Table 3 Existent and After Simulation Land Use of Istanbul Metropolitan Area

	Area Size (Ha)	
Functions	**Land Use 2000**	**After Simulation 2023**
Vacant	2545	0
Residential Area (ha)	27917	27200
Industrial Area (ha)	2762	4060
Commercial and Service Area (ha)	1312	3277
Public Facility Area (ha)	114583	114583

After the simulation ran throughout İstanbul Metropolitan Area, transformation tendencies from industrial areas to commerce and service functions are occurred in sub centers. New industrial areas after transformation are occurred close to residential areas. Although out of metropolitan area is suggested for industrial decentralisation in master plan, when the simulation results are evaluated, it is seen that the decentralisation is still in metropolitan area.

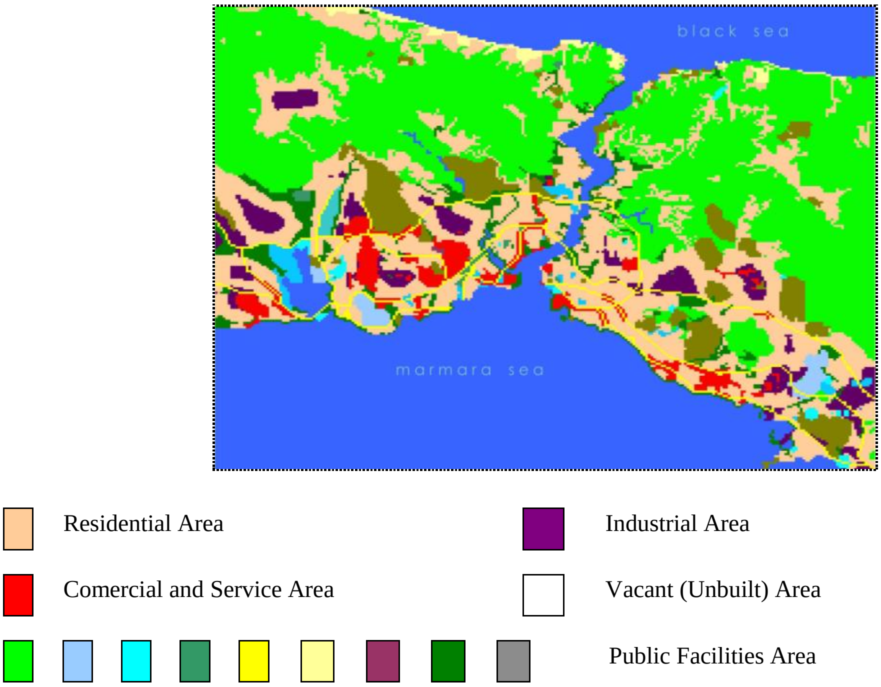

Figure 4. Istanbul Metropolitan Area Distribution After Transformation

The model is run to define the area need for 2023 and the values in Table 4 is obtained. While the residential areas don't change much, indutrial area rises to 1,5 times, commerce and service areas rises to 2,5 times. No variation happens in public facility areas as the necessity of model.

Tablo 4. The Distribution Of Functions After Simulation

Functions	**Tranformed Functions (ha)**		
	Residential Area (ha)	**Industrial Area (ha)**	**Commercial and Service Area (ha)**
Vacant	2397	147	0
Residential Area (ha)	-	2332	782
Industrial Area (ha)	-	-	1182
Total	2397	2480	1965

At the end of simulation 3, 95% of 2545 ha unsettled area is turned to residential area and 5% is turned to industrial area. 75% of the transforming 3115 ha residential area turns to industry and 25% of it turns to commercial area. 1182.5 ha industrial area turns to commercial area. Totally 2397,5 ha turns to residential area, 2480 ha turns to industrial area, 1965 ha turns to commercial area.

With these results, the decentralisation tendencies of large scale industries having research-development unit and using high technology are evaluated below:

In 18 large scale manufacturing industries of Turkey that settle in İstanbul Metropolitan Area, to determine the structural properties, technology use, Research-Development potential, factors of land preferences and to put forward the decentralization and transformation tendencies questionnaires were done.

In the prefernces of the firms, besides the properties like various area, various sector and various size, the location of the firm in İstanbul were taken into account. The main activity subjects of large scale manufacturing industries inquired almost in every sector were 33% of chemistry,17% of food, 22% of methal things, 11% of textile, 11% of paper products and 6% of methal sector.

Questions related with the firm's quality and structural properties are asked. While 94% of large scale industries stated no activity change, 4% expalined an expansion in their activities. When the qualities of investigated firms evaluated, 48% factory, 30%, headquarters, 7% branch, 7% warehouse, 4% selling area and 4% office use is determined.

The foundation year in the investigated large scale industries is 33% in between 1991-2002 years, 28% in between 1966-1970 years, 22% in between 1981-1990 years, 11% in between 1971-1980 years and 7% before 1965. 48% of the small scale manufacturing industries founded in 1990's. This shows that small scale manufacturing industries can move easier than large scale industries. 78% of firms stated no variation in branch number connected to the factory in 3 years. Firms changing branch number stated either by opening new branchs in foreign countries or closing the firm.

Land use preferences of large scale manufacturing industries are evaluated in two types:

In the first approach, the sum of preferences of all firms and the proportion of every factor in this sum are counted and ordered. In this approach the most prefered factor of firms are "economic development potential". "Cheap land supply", "skilled labour supply", "accessibility of market", "having no transportation problem", "accessibilty of good supply" factors are the other preferences.

In the second approach, the preferences are ordered according to preferences and evaluated. In this approach "accessibility to market" factor is the first prefered factor.

Large scale manufacturing industries prefer Istanbul to use the advantage of labour and market. Firms become advantageous in supply of good from domestic or foreign countries by using input-output or transportation facilities.

The advantages of İstanbul for firms are:

- The easiness of tarnsformation 31%,
- Market facility 15%,
- Skilled staff and professional manager potential 7%,
- To be an industrial area 7%,
- To have a harbour 7%,
- High consumption in İstanbul 5%,
- The existence of main sectors 5%,
- The existence of sub-industries, easy contact with other firms, prestige to foreigners, closeness to customs, to be a commerce center, financial sector gathered in this area, accessibility to goods, cheaper sale of goods, communication possibilities are the other advantages described by investors.

72% of the firms stated that they invest for the innovations in last 3 years. These investments are the formation of Research-Development, the purchasing of machine to adapt technological changes, purchasing of packaging patent rights, following all the innovations that the sector and communication technology bring.

61% of the firms don't want to move. 39% of the firms tend to move because of inadequate land, problem of transportation, staying in settlement areas and neglected environment. While half of the firms thinking to move prefer inner İstanbul, the others prefer Marmara Region (close environment of Istanbul) for the new settlement area. For example MERCEDES automative firm will move from Davutpaşa and gather bus and lorry production in it's Hoşdere factory (west side of Istanbul), FAKO chemical firm prefer Silivri (east side of Istanbul), AKSA generator firm prefer Hadımköy (west side of Istanbul), BETEK, MEGES painting firms, ALTINTEL melamine firm prefer Gebze Organized Industrial Region (east side of İstanbul), ALEMDAR chemical firm prefer İzmit Dilovası (close to Istanbul).

Questions are asked about how the firms want to move will use their area after the evacuation. The answers are 35% commercial use, 30% marketing unit connected to the firm, 15% administrative unit connected to the firm, 15% the sale of the area and gathering the firm together (Yüzer A.Ş,2002).

5 EVALUATION AND CONCLUSION

In consequently according to industrial enterprises in metropolitan and the results of simulation, some evaluations related with decentralization and development are below:
Since "transportation", "market" and "cheap land supply" factors of industrial land use prefered highly by users, in the future planning studies of Istanbul Metropolitan Area these factors and industrial allocations after simulation should be dealt with together.

While labour tendencies were in center and sub-centers dense with industry, today "easiness of transportation", "closeness to family", "cost of house" factors are important and labours tend to prefer industries in unurbanised areas.

Nowadays technological variation vawe plays an şmportant role in the development of metropolitan areas and Metropolitan cities have been keeping to be an attraction centers for industrial investors. In planning studies and big scale planning decisions developed among regions, this kind of politics should be developed and area allocations need for investments in metropolitan cities should be planned orderly.

While areas were allocating in hinterlands of metropolitan cities for industrial investments forming research-development units, as in the results of simulation, functional definitions related with administration and marketing services for centers after transformation should be done.

As it is understood from evaluations done highly in industries having research-development unit and using high technology, large scale manufacturing industries determined to move their production units in metropolitan centers to another place in Istanbul or hinterlands of metropolitan.

Simulation model done throughout Istanbul metropolitan area produced simular results. After simulation, transformations are occurred in industrial areas in 1st, 2nd and 3rd degree sub-centers and these areas are defined mostly as commerce and service sectors. If the user demands are taken in to consideration, a tendency of using production units after simulation as administration units is occurred.

After simulation new areas defined for industry shows similarities with user tendencies. Although the decentralisation of industy from metropolitan areas in high scale plans is considered, the results of simulation and user tendencies shows that the decentralisation is necessary but it has to be in metropolitan area.

LUCAM model is a model that gives important results to be used in the estimation of transformation and development of metropolitan cities. Since the user tendencies are taken into account in defining the parameters used in the model, data after simulation and the expectations of industrial investors show similarities. These results shows that the model is successful and usable.

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Prospective Enhancement of Urban Planning Methodology Based on OO Modeling and Rational Unified Process

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1 INTRO

Objective of paper is to try to define preliminary release for new urban planning methodology[24] based on strong positive knowledge and practice of Object Oriented Methodologies, particular Unified Process and Model Driven Architecture widely used in IT industry. This should be in the same time starting step for the whole process of establishing this methodology which we consider as extremely complex, extensive and long-lasting as it is described later. One of the most important and effective characteristics of Unified Process is its iterative approach resulting in incremental advancement towards targeted goals opposite to the more traditional "waterfall" approach. We suggest the same method for urban planning methodology definition process previously mentioned. Actually, this method suggests to start with simple and small models and methodology elements[25], which may not look useful at the start, and iterative improve it to the complex, strong and valuable methodology at the end. This is the way how modern IT methodology and modeling techniques are built to this level of complexity and expressiveness. Recommended method is especially important for urban planning methodology establishment process as complex and multidisciplinary research of application of formal methods, modeling methods, and theory for the solution of spatial problems including building environment, spatial city or regional structure.

Planning theory and practice currently use several different methodologies or planning techniques but most of them are typically partial, verbal and informal, restricted to the local ambient, non-automated and thus especially difficult to be established within the IT. There is reasonable advancement in the different categories like GIS, Planning Support Systems, Decision Support System, Sketch Design, Modeling and automata theory. GIS, as the most mature one, is still not solution for all and whole problem of urban planning as it is explained in the literature (L8, L18). Planning and Decision support systems are still more in the academic and discussion phase than in actual implementation and use (L11, L13). Automata theory is exceptionally good and already widely used but has very limited implementation covering only narrow problem domain subset (L1, L10). Sketch Design and Modeling are not developed to the useful level despite theirs recent resurrection (L5, L6, L16, L17).

Situation within the IT industry is opposite and we may find emerging standards for Analysis, Design, Implementation, Testing and Deployment of computer based systems which are successfully applied in many vertical industries. Results are improved controllability, quality, efficiency and accuracy of solutions, active participation of all participants, knowledge accumulation, knowledge transfer and at the end complete industry improvement.

Papers propose multidisciplinary research focused on development, advancement and application of formal computer based modeling methodologies for better understanding and improvement of urban systems. Result of this research is not new programming or software tool, ready to solve all possible problems encountered to the planners in everyday work, but it is formal and standardized planning methodology. This methodology may be later used for software tool production as it was the case in the IT industry. For this we suggest as starting point OO Modeling (L7, L16), Unified Process (L12) and Unified Modeling Language (L4, L14). It is obvious that linear and direct application of Unified Process, to the urban systems, is not appropriate therefore localization to the urban domain should occur. Once again we strongly want to recommend iterative and incremental approach to the whole process and therefore we may consider this as a process of establishment of formal planning methodology[26]. Proposed Establishment Process is extremely difficult and complex therefore all participants should take active role. Moreover, it certainly requires a strong and widely supported strategic decision within the urban industry before it even starts. Without this support the whole research is destined to fail since it can not be established properly and will not be used and further developed.

We will emphasize existence of two targeted directions of proposed research. The First considers mutation and application of Unified Process methodology and UML to the urban planning and urban systems domain and the second targets further enhancement of urban planning knowledge and techniques as the result of applied formal methodology. The First direction will question and improve Unified Process and UML completeness and universality through its further enrichment, by adding and generalize domain specific particularities. The Second direction aims to establish new planning methodology as solution for emerging problems found in contemporary urban systems.

2 PRINCIPLES AND ELEMENTS

First, we would like to emphasize several fundamental characteristics, imposed constraints and basic elements of future Planning Methodology and whole Establishment Process. This puts basic frame around future methodology and should establish its strength, usability, applicability, openness, flexibility, adaptability etc. The same characteristic must be applied to the Methodology and Establishment Process as well[27]. Next we will outline some basic elements of methodology and their mutual relationships. At this stage it is not possible to be more specific and strict in order not to close and damage the whole process. Further knowledge, expertise, experience and discussion are required to make procreative steps in this direction.

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[24] We may use phrase Planning Methodology in further text for better understanding

[25] As it is the case in this paper

[26] We may use phrase Establishment Process in further text for better understanding

[27] This is usual approach in IT to use discourse to improve and further develop the very same discourse (Java, UML etc…)

2.1 Methodology and Process Principle

Here we would like here to recommend several fundamental principles of the future Planning Methodology applicable to the Establishment Process as well. We will also outline possible benefits of every proposed aspect.

First the **Incremental and Iterative** approach is to be used equally within the Planning Methodology and Establishment Process. This approach suggests decomposition of a whole, huge and complex problem to smaller and manageable units. Every such unit is then solved within iteration resulting in increment, as advancement of a whole solution toward targeted objectives. This allows slow but constant progression in intended direction and further direction adjustment after every step making it extremely adaptive and precise. The same method is used within the IT industry in order to cope with extremely complex and unknown problems with extensive success. Incremental and Iterative approach is the first corner stone of Unified Process.

The second is to make Planning Methodology and Establishment Process strongly **Collaborative and Cooperative** (participating) therefore opened to all and every possible actor participation. There is a substantial number of research reasoning on possible benefits of this approach (L13, L15). Once more we should look at the IT counter side. Unified Process is open to all participants especially to non-IT personnel and this is the second corner stone of its success and effectiveness. Considering broad audience of different actors, their divergence of interests and planning objective, if we want to succeed to harmonize this to working and sustainable system we practically do not have alternative.

Collaborative and Cooperative approach has its drawbacks and problems. One of the most widely used may be the question "How?". How it is possible to open planning process to all and everyone and still stay in the control, manage all the participants' contribution, huge amount of gathered data, ensure acceptable quality etc. IT Technology, by itself, has all the power needed for this but this is not sufficient to solve the problem. We would suggest here **Role Based Access** where every participant has appropriate aspect and properly sized presentation of planning artifacts depending on its role, interests and capabilities. In the same time all planning artifacts exist in whole, containing all their richness, on the model **Meta Level**. User will then access only particular aspect of this planning artifact depending on its role. Meta level therefore divides existence and structure of planning artifact from its presentation to the particular participant. This decreases the complexity and makes Collaboration and Cooperation feasible.

Planning Methodology should never be considered to be closed and finished thanks to the general domain complexity and complexity inherited from constant changes within it. Therefore one of its fundamental principles must be **Adaptability to the changes** either because of further advancement of planning techniques, based on experience and knowledge, or on changes in urban systems and human society. Planning Methodology therefore must have built-in techniques and activities for its improvements and enhancement.

Urban system is exceptionally heterogeneous ambient i.e. Planning Methodology has to include a vast number of different specialties and expertise within one working framework in order to gain control over the whole process. That is the reason of making Methodology as an **Integrative platform** for all other tools, techniques, activities including existing ones like GIS, AutoCAD, Automata Simulators etc… This principle should open Meta Model level to all external tools, knowledge and techniques enabling easy information exchange. This is the only way to harmonize all existing and future solutions, to make them to work together and not against[28] as it is the case now.

2.2 Methodology Elements

Methodology in general should answer the following questions: Who, What, When and How. To establish the methodology means to answer every question at every given point of time for every possible actor. Complex project should be divided into phases to manage complexity. Within the phases Actors will conduct particular activities in the particular workflow in order to establish particular artifacts. Therefore basic Planning Methodology elements are Planning Phases, Planning Workflows and Activities, Planning Actors and Planning Artifacts. The latest two are covered in the following chapter. We will try here to establish Phases, Workflows and Actors leaving further detailed development of activities for near future. Once more this is just an outline and suggestion, to start discussion about the matter, and not a final and fixed proposal.

2.2.1 Phases

Every complex problem should be solved and treated through phases in order to decrease complexity level to manageable level. Moreover phases should be repeated if substantial changes, which are inevitable for dynamic complex system, have happened in order to adjust the solution to those changes. This process progresses in repetitions and therefore may be called Cycle. Since they are constant through the system Life we may call them Life Cycle. Unified Process suggests four phases for software development process named: **Inception, Elaboration, Construction and Transition** (L12). IT Development process recognizes construction and transition as separate phases because it is possible to produce solution and then to install it and use it. Planning problem is somehow different as it is not possible to separate the last two in separate phases. To be exact, result of planning is not a tool or software component which may be used, but it is a set of Criteria, Policy, Regulations, Procedure, Legislation and Descriptions to be continually and consistently applied to urban system. Moreover, IT considers any adjustment, within the Transition phase, as reparation of an error, established either during the analysis and design or implementation. Adjustment is then exceptional in nature. Planning, on the other side, will consider any correction, to the changing environment, as natural and immanent to the domain and therefore regular. Accordingly to the previous we will suggest three phases for Urban Methodology named as: Inception, Elaboration and Implementation.

Inception[29] is a phase aimed to establish the clear vision of problems within the domain, to gather main requirements from the Actors, to establish starting set of Goals to fulfill, starting and basic Policy and Criteria. This should answer to the question like: what

[28] UML established as good mixture of three different methodologies: OMT, Booch and Objectory

[29] more or less same as within the Unified Process with few different verbs and/or nouns

are current problems within the urban systems, how difficult are those problems for particular actors, how difficult are those problems to solve at this level of knowledge, what we can propose to solve it, is this feasible, what are basic time constraints etc. This phase should firmly establish “the case” in all aspects including commercial, social, urban, construction, legislative etc. At the end all major problems are recognized and directions to the solution of those problems are outlined. This phase should consider all higher level policies and regulations, national level and upper, in order to comply with them and suggest compatible directions.

Elaboration is phase of establishing a detailed and deeper knowledge about the problem domain and of production of planning artifacts aimed to solve those problems. Deeper understanding should include deeper and wider knowledge about the problems, actors and theirs requirements, actors’ interests and everything significant regarding the problem domain. This phase is used also to produce Plan with all its artifacts like, Vision, Goals, Policy, Criteria, suggested implementation Activities, further map-like and verbal descriptions of plan aspects etc. Plan is established through set of alternatives which are evaluated using Evaluation Criteria, established and corrected within the same phase, with active participation of all Actors. At the end one of the presented Alternatives, improved through several iterations, is adopted as a Plan.

Implementation is a phase of putting into the practice previously adopted as a Plan, conducting suggested implementation activities, considering all planning description, procedures, regulations, legislation, policy etc. This is ongoing phase where all changes in real space (ideally) should comply with planned constraints and procedures. Nevertheless, the real ambient is changing all the time and the Plan should face reasonable corrections to manage those changes. Constant monitoring of real ambient and evaluation of changes, within it, should be conducted, during this phase, in order to evaluate actual Plan results. This also may require Plan correction to improve its impact to the real problems. However correction should not be substantially and fundamentally different from the Plan starting version or, if this is the case, new Life Cycle should be started.

2.2.2 Workflows

All previously described phases are executed through set of activities suited to particular phase inputs and required outcome. Same activity may be repeated within different phases and actually all activities may be repeated with every phase if it is suitable. Activities are executed by particular Actors, in order to develop and establish particular planning artifact. Artifact may differ in complexity, importance, quantity etc. Set of related activities is usually called workflow. Unified Process recognizes five workflows: requirements, analysis, design, implementation and testing. Urban environment is considerably different than computer based system where for example it is not possible to have requirements before the analysis of urban situation as it is possible to have all future user requirements before full analysis of the domain. We can name even more differences but this is out of the scope of this document. This difference forces us to change workflows and order of execution. Proposed workflows should be matter of careful revision of industry professionals and authorities in order to check completeness and correctness of proposed workflows and activities. This is also main reason why we could not propose, at the moment and with current knowledge, detailed list of activities for the whole process.

We will propose, at this moment, following workflows: Urban and Spatial Analysis, Requirements Analysis, Plan Design and Plan Execution and Evaluation.

Urban and Spatial Analysis establishes full and precise description and specification of all important aspect of treated urban system including: spatial[30], social, economical, legislative and other aspects and elements etc. Result of the analysis is a set of models, maps, sketches and other descriptive forms describing the urban system in all important details and aspects. Analysis should recognize and specify basic problems in treated urban system using modeling, simulations, external data sources and tools and other useful techniques and tools to reveal hidden elements, theirs structure, behavior, mutual and possible complex relationship etc.

Requirements Analysis establishes full collection of all Actors’ requirements including citizens, experts, government, investors etc… Requirements must include Regulations and Policies established on higher level in order to make final outcome compatible with them. Requirements analysis then recognizes and specifies the Actors’ interests, for every Actor group, and how different interests forced by different actors are related (conflicted, compatible or inert) trying to establish minimal set of requirements accepted, or at least not opposite, to every Actor group. Identified minimal set is then promoted to the Planning Goals and should be targeted in the following Workflow. Requirements Analysis workflow may also include verification of promoted Goals through public debate. Defined set of Goals is then followed with related set of Criteria used to evaluate fulfillment of particular Goal or set of Goals used later within the last workflow to calculate the level of Plan accomplishment. All artifacts should be result of partial or full cooperation and participation of all the Actors accordingly to the Cooperative and Collaborative principle defined above.

Design establishes the Plan with all its details through set of Alternatives. Every Alternative works with result of previous workflows since it is situated within the problem domain trying to solve specified problems, defined in the first workflow, complying with Goals, Policies and Regulations defined in the second workflow. Every Alternative is actual Plan sketch developed to the level sufficient to understand basic idea and outcome of planned solution. This is the moment where all the Actors should participate in and where their participation makes substantially impact on the final solution. When consensus is established chosen Alternative is further developed into the Plan. During this workflow some of previous elements may be improved and slightly changed according to the new knowledge and experience collected within the Design workflow, Actors’ interactions and discussions.

Execution and Evaluation uses previously defined Plan and executes all its implementation activities like Procedures, Regulations, Policies, Legislation using defined Goals, Map-like or verbal descriptions of particular Plan aspects etc… The plan is here more like Expert Knowledge Base used for consulting purposes than a predefined description and specification of everything and everywhere. Nevertheless, every activity within the urban system may not violate clearly and precisely defined Plan Policy, Goal or Regulation or may not disobey clearly defined Procedure, Regulative and/or Legislative rules. This workflow includes constant monitoring over

[30] We use this word to cover everything in real tangible world like buildings, infrastructure, natural resources etc…

predefined set of urban system variables and evolution of measured changes against predefined Plan Set of Criteria. This evaluation process will reveal the Plan impact on targeted problems and may require Plan corrections. In normal situation those corrections are not extensive but may improve real impact of Plan implementation. In other case, if substantial correction is needed, this workflow signalizes “major flaw” resulting in next Phase or even next Life Cycle starting.

It is essential not to relate proposed workflows within with only one of the previously described phases, like for example Urban and Spatial Analysis with the Inception phase, but to understand that every workflow has to be used to particular extent within every phase[31]. Although, it is most likely that particular workflows are used mostly with particular phases this should not be always the case and certainly should not prevent use of particular workflow within the particular phase. Later, after new knowledge and experiments arrive, we may reconsider this decision and then we may suggest constraints over relationships between phases and workflows.

2.2.3 Actors

This is the least known element of the whole Planning Methodology but we should still offer starting set and therefore we will define a very simple set of Actors’ classes named: Experts, Government, Investors and Citizens (L15). All the Actors are participating in “real life” and in the same time they are participating in the Planning Process. This is a direct consequence of Collaborative and Cooperative principle we established above. What we see in near future is further decomposition of Experts group because its importance for Planning Methodology improvement. Other Actor classes may be further decomposed but in not more then two or three levels just to accomplish better Planning Methodology and Model granularity.

Citizens are main sources of requirements and also a main supporting force. They will identify the main subjects within the problem domain together with the Investors and will improve understanding of planning and its frame together with government. Citizens will therefore intensively participate within the Requirements Analysis workflow but may make substantial contribution to the Urban and Spatial Analysis workflow. They certainly may participate in Design workflow and therefore help to find the best Alternative.

Investors are main developers with necessary power to make changes in real space. Investors Actor includes almost certainly two subclasses named: Pure Investors and Developers, but this distinction is not considered as important on this level. Investors will identify the main subjects within the problem domain together with the Citizens and will establish strategic framework necessary to reach agreements together with Experts. Investors will also intensively participate within the Requirements Analysis workflow trying to promote their interest. They will also intensively participate within the Execution and Evaluation Workflow during their construction activities. They may participate in Design workflow but more as Citizens then Investors.

Government represents management and decision force capable to administer and supervise the whole process which is authorized, by election, to make decisions. They will improve understanding of planning and its frame together with Citizens and will define all conditions, constraints, policy and regulations with Experts. They will participate intensively within Requirements Analysis, to define Policy, Design workflow, to make final decision over the best alternative, and certainly as authorization authority within Execution and Evaluation workflow.

Experts are the most interesting group of players, from the Methodological point of view, and should be developed and decomposed in near future in order to specify activities and workflows in all details. Experts are, currently, covering all workflows and all consulting and know-how activities within the workflows.

Please be aware that **one individual may play several Roles** over the time like for example one may own construction company and may play Role Investor, on the professional basis, but may also live in same zone and play Role Citizen on private basis. You should take this into the account while reading the previous definitions.

3 LANGUAGE AND META-MODEL ELEMENTS

Above are listed Phases, Workflows and Actors. Actors are executing activities[32] within the Workflows, during the Phases, in order to produce Planning Artifacts. Every Artifact will define, explain or specify particular aspect or element either from problem or solution domain. Although those aspects, elements and models differ substantially in nature, structure, semantics, syntax, behavior and many other qualities we should try to establish unified language to be used in their description and specification. This language must be standardized and opened to the public. Moreover this language must be well suited to the problem domain in order to grasp strength, preciseness and effectiveness required to manage complex domain of urban phenomenon.

3.1 Language

Complexity of Urban Phenomenon is substantial and therefore we are not capable to establish proper and useful language at this time and with this level of knowledge. What we could suggest at the moment is to use OO approach for the Language, to try to establish it as graphical language and to use UML for the description of its starting elements.

We should always keep in mind Iterative and Incremental approach which is especially useful in this situation. What we have to do, since complexity is substantial, is to try to make a simple starting version and then to improve it in several iterations. Even if first release is not expressive and of any use, we may in subsequent iteration establish first practical version of it, and then we can work on its constant improvement in the following iteration.

[31] Same approach is used in Unified Process and it becomes one of the main drivers of whole process.

[32] Still not defined

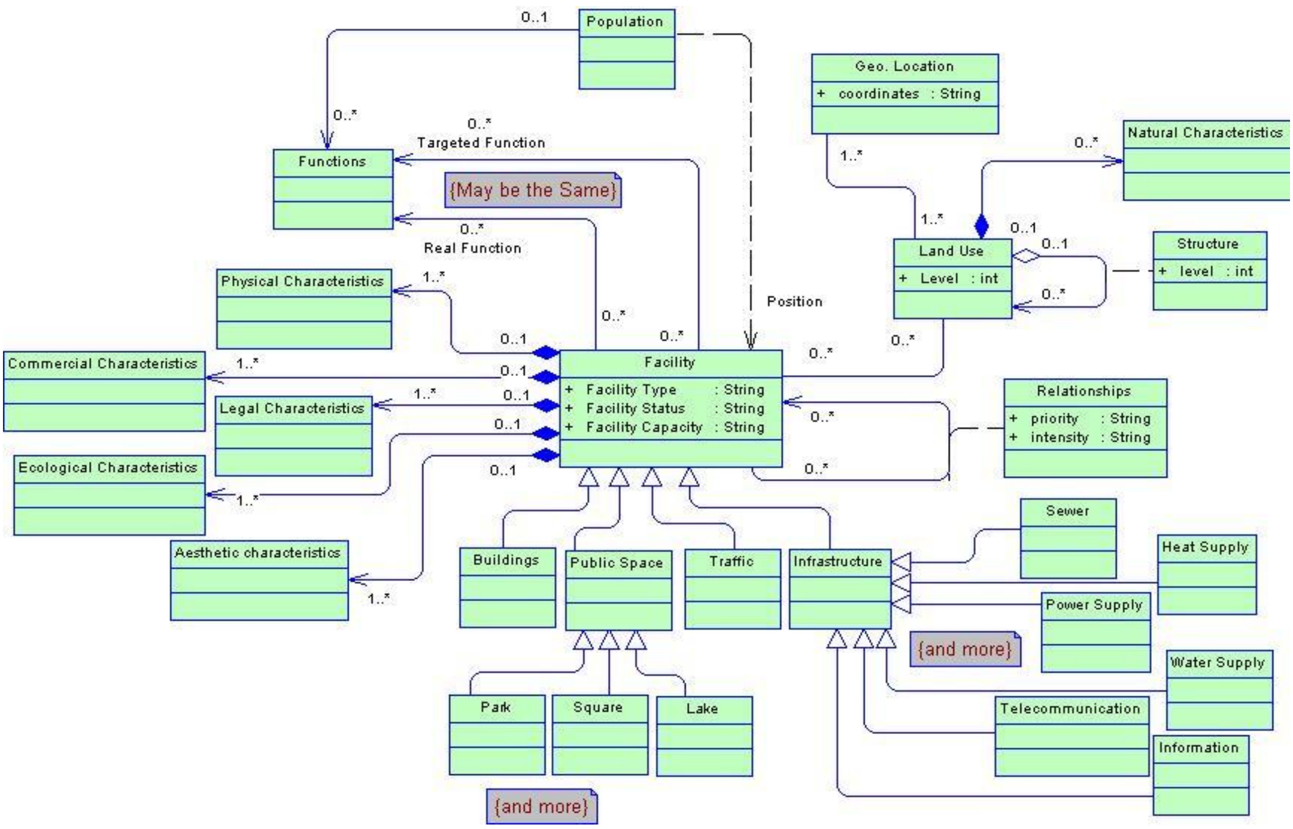

Figure 1 Outline of possible OO Meta model language elements for Urban Planning Methodology – Spatial Elements

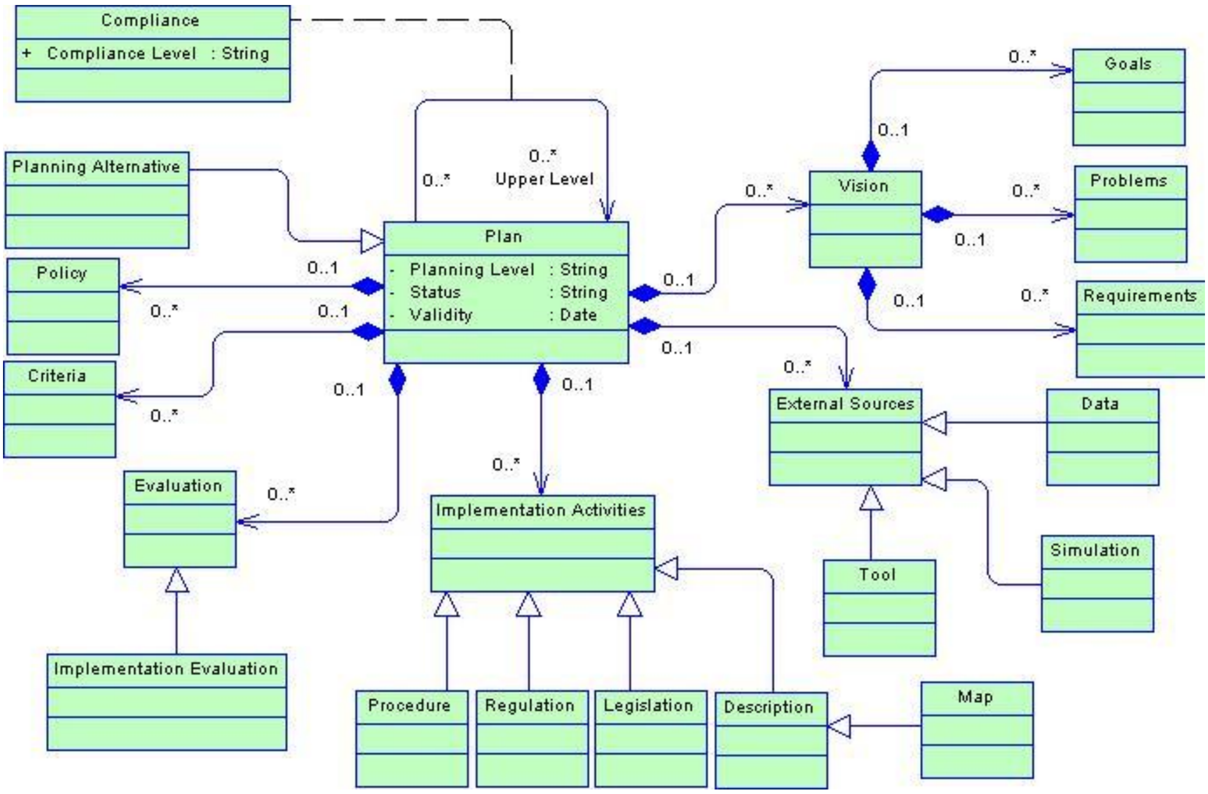

Figure 2 Outline of possible OO Meta model language elements for Urban Planning Methodology – Planning Artifacts

After Language Verbs and Nouns have bee established and approved in several iterations and projects we may consider moving it to the Meta model level (L7, L14, L17). Meta model level contains Language constructs, their mutual relationships, syntax and semantics, constraints, visual characteristics etc. This will be opening point for a planning tool development.

To illustrate the whole process and problem, and only in that purposes, we are presenting above, on Figure 1 and Figure 2, a simple sketch of probable language elements regarding Spatial Elements and Planning Artifacts. These two diagrams are presented only to demonstrate OO approach to the domain and will express only main verbs and their relationships. Attribute and other endorsement are deliberately avoided for simplification, readability and descriptiveness purposes.

3.1.1 Spatial Phenomenon

We will explain just in few sentences elements and relationships presented as first outline of possible language elements to manage and describe spatial phenomenon.

The main entity is **Facility** which represents any object, natural or constructed, within the urban space including, buildings, public space, roads, transportation[33] and infrastructure[34]. Facility is then specialized into four general subtypes named **Buildings, Traffic, Infrastructure** and **Public Space**.

Building represent any kind of constructed object used for various purposes including industrial buildings, housing, schools, medical posts etc… We also recommend distinction of facilities used for **Traffic and transportation** purposes because of their special characteristics, features and substantial importance. Other **Infrastructure** elements are put together since they have many common characteristics, given that they are used for supply of some goods like electrical power, water, information, communication, heat etc. At the end **Public spaces** are important and inevitable elements of any urban space and therefore have to be identified as a separate entity. We presented few possible elements of Public Space and Infrastructure just to explain an idea better. All relationships between Facility, Buildings, Public Space, Traffic, Infrastructure and others, relationships with closed arrow, are represent "kind of" or inheritance relationship (L3). Facility then represents more general class and Buildings specialized version of it inheriting all features of Facility and adding few more (L4).

Facility is related with other facility through their **Relationships** like for example instance of Building (Office) is related with instance of Traffic (Road) which is related then with another instance of Building (House) to represent Office-Road-House path. This is usual graph approach where nodes are instance of Facility and lines are instance of Relationships. On this way we move richness and complexity of real traffic to Facility and enable easy Path analysis, simulation etc. Relationships are endorsed with priority and intensity and may be later endorsed with Path name etc…This generalization may, from our point of view, considerably simplify analysis, sketch planning and simulation. Simple arrow used in this case represents only dependency of any kind (L4).

Every **Facility** is characterized with the number of different characteristics where we listed just a limited number like **Physical** (Height, Width, Number of…), **Commercial** (Building Value, Expected Rate…), **Aesthetic**, **Ecological**, and **Legal** (Ownership) etc. We postpone further generalization for following iterations. Line with the full diamond on one end represents composition of Facility from available full set of characteristics (L4).

Facility, and therefore all descendants, is represented as object without **any function** and any **real geographical attribute** built within it. Those two qualities are extracted in separated entities to enable management over the Facility, Functions and Land Use independently and on different stages and phases of modeling. Functions are separated from Facility to model real situation where particular Facility (Building) may be used for different purposes, like for example an old warehouse for fancy apartment etc. Actually Functions of the Facility are separated from it and may be changed during its life cycle. Separation of geographical domain is more serious and has to introduce complete separation of Urban System from its geographical representation. Planner will decide, using this approach, where and when to interfere with the geography and where and when to stay out of it. Consequently Facility may be situated in one or more element of Land Use, like for example Parcel, and one element of Land Use may hold none, one or more Facilities. On the other hand every Facility is associated with none, one or more Targeted Function (planned) and with none, one or more Real Function (real use). Those two sets may differ, this difference may be established during Facility Life Cycle, or may be the same.

Different configurations of **Land Use** are represented with the association class **Structure** where level represents actual granularity. Land Use element may have Natural characteristics like Height, Quality of land, rivers, mountains etc. Finally Land Use Element is associated with actual geographical coordinates to link modeling with the actual geography.

At the end we present general entity for **Population** just to outline their use of Functions, associated with the Facility, to fulfill their needs. Population has to be actually within particular Facility, at given Position, to use its Function but this location may change over the time either within the same Function, traveling for example, or with change of Function like Shopping at Mall and Resting at Home.

We want to emphasize fact that this is only one expressive example for prosper use of OO within the urban systems domain.

3.1.2 Planning Artifacts

Second Diagram outlines structure of Plan as general OO entity. Presented Plan does not actually represent any real plan, well known from planning practice, and certainly does not suggest this structure to any real plan as well. This is represented just for the purposes of this paper as general structure of possible Plan elements which are then used through text especially within Workflow description section. Therefore this is Dictionary-Like explanatory Diagram.

The Plan is composed (diamond arrow (L4)) of sets of statements of different kind Policy, Goals, Evaluations, Implementation Activities and Visions. All this different elements are used to describe Workflows. Planning Alternatives are a "kind of" Plan but with reduced level of details and expressiveness. The Alternative Plan becomes Plan after the adoption process. The Plan may form

[33] of any kind

[34] of any kind

Hierarchical structure where higher level Plan imposes set of Constraints, in form or Policy, to which lower level Plan has to comply with certain level of compliance. We presented on the diagram few "kinds of" Implementation activities like for example Procedure, Regulation rules, Legislation Rules and general kind of Description to express the Plan in more details. Maps are only one kind of possible Plan Descriptions. At the end we suggest use of External Data Source to comply with Integration principle presented above where the Plan has to include all the data used within the Plan, for Alternatives and especially used to make good decisions, like External Data, Simulation Results and External Tools. This may be the start of using this methodology as Integration Platform.

4 VISION AND BENEFITS

We tried to reason, in this paper, about two different but related matters. First is how to start and manage process of establishing starting, and subsequent iterations, for Planning Methodology. Second is what might be the basic elements of future Planning Methodology itself. For this purposes we use positive experience found in IT like OO/UML and Unified Process as starting point.

What we suggest is to use Iterative and Incremental method for the mentioned process and to start building Planning Methodology from simple and understandable elements toward more complex, effective, descriptive and usable version of it with active participation of all relevant and interested domain players.

At the same time we put some basic principles and elements of future Planning Methodology in place for discussion purposes. We find Iterative and Incremental method equally important for Methodology itself as it is important for the process. At the same time this methodology must enable strong Collaborative and Cooperative environment for all and every actor within the domain, based on separation of Roles and concerns, adaptive to constant changes within the domain. At the end this methodology has to establish Integrative platform for already existing efforts, researches and results.

Finally we identify three phases, Inception, Elaboration and Implementation, with four workflows, Urban and Spatial Analysis, Requirements Analysis, Design and Execution and Evaluation, four basic classes of Actors, Citizens, Investors, Government and Experts. We presented here OO approach and outlined basic entities of future Unified Language and basic structure of Plan as one of the main Artifacts within the Planning Methodology.

What we suggest is to establish usable version of Planning Methodology with reasonable detailed definition of Phases, Workflows, Activities, Artifacts and Actors described with unified and standardized spatial language, with clean and strong Meta model definition, accordingly to the proposed, and possibly extended, principles in open, public and broad discussion through subsequent iterations.

Along the path of this complex, difficult, heterogeneous and never-ending research we perceive promising set of improvements of the industry from which we will list just few:

- Improved **controllability** over the planning process and certainly over the implementation of Plan as a result of carefully developed Phases, Workflows and Activities,
- Enhanced **adaptability** to the changes in the domain either for implementation or for planning activities based on built-in methodology adaptability and evaluation activities,
- Increased **descriptiveness, expressiveness and preciseness** of all planning artifacts especially for implementation activities because of use of standardized and unified language,
- Robust and strong tool/methodology capable to **manage complexity** of urban system based on OO approach and standard planning techniques,
- Better **level of integration** capable to include virtually every external data source, simulation or tool and to pro-actively use this for planning and decision purposes as a result of OO technology, public and opened standards,
- Substantially better **knowledge accumulation and transfer** based on used unified language, clearly defined methodology, and used public and opened standards,
- Support for Planning Methodology by (Semi) **Automated Tools** developed over and on account of unified language, its Meta Model definition and standardized Methodology elements and
- Significant **improvement** of the whole industry as a final result as it has been the case with IT industry[35].

Proposed Process as well as the Planning Methodology is extremely difficult and complex therefore all participants should take active role within it. This process certainly requires strong and widely supported strategic decision within the industry before it even starts. Without this support the whole research is destined to fail since it can not be established properly and will not be used and further developed. Only widely used solution will survive and grow.

[35] Latest advancement of IT are OO DBMS and executable UML where skilled user may produce application directly from UML Diagrams

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Economic Transformation and Urban Planning in Vienna: Emergence of the Service Sector and its' Implications for Urban Regeneration

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Abstract

In light of the growing urban trends of suburbanisation, decentralisation and urban sprawl, cities are now finding strategies as to how to keep economic wealth within their own city limits. One effective strategy for city planning could include finding ways to make the best use of land parcels that have lost their traditional economic uses. The growth of the service and high-tech sectors has meant that areas once used for industry must now be transformed into office, lab and studio space that would attract emerging sectors such as high-technology, research and development, and new media development. Not only the facilities themselves but also their location in areas that are accessible and near vital urban centres play an important role in a firm's decision to locate or relocate to a specific site. All these issues are relevant to the case for the City of Vienna's planning of its old industrial tract, *Erdberger Mais*, which is located in the southeast section of the city between the city centre and Vienna International Airport. This article describes, in four parts, the challenges facing Vienna in the age of global and European competition and one of its efforts to concentrate its economic and population growth through the reuse of its outdated industrial areas.

I. Economic Transformation in light of de-industrialization

The emergence of the service sector as the fastest growing economic sector has created the demand for space that suits the needs of modern enterprises in this sector. Older cities in Europe and the United States have experienced rapid growth during the period of industrialization and, as a result of industrial decline, have struggled with finding new potential for industrial tracts of land that have been abandoned.

As urban areas vie to stay competitive with other regional economies, the location of service sector industries has become even more important than before since a good service sector base is critical to support major industry and centers of research and development. Most important, however, is to have a good coordination of service and industrial activities through the complex form of a regional "Cluster" (Schoon). This would include the supply of resources and specialty skills, such as research and development, production, marketing, trade and finance. In addition, the supply of public services such as education, city administration, infrastructure and its maintenance, as well as the provision of safety and cultural facilities are all important for a region's competitiveness (Mayerhaffer). On the other hand, a city or region must find a balance between its level of taxation at the extent which such public services could be provided while remaining competitive with other regions.

A locational advantage also depends in part on natural resources, public goods and given 'incentives' in order to create or attract employment to a region that would create a dense enough cluster effect. Through public-private partnerships, more capital could be infused into a project and more accountability and management of a project could be accepted by the private sector. Several methods of financing are used in public-private partnerships (NCPP). In Vienna, large scale urban projects such as Erdberger Mais and the TECHbase Technology Park have resorted to public-private partnerships in order to get developed.

To match its outer regional competition, Vienna must build new zones of development to preserve as well as attract economic activities. The city also has had to remain more flexible as far as its zoning regulations are concerned. Many large scale projects built in Vienna during the decade such as Donau City, Floridotower, Millennium City, Vienna Twin Tower, T-Center or City Tower Vienna actually were not in accordance with its official urban development plan, nevertheless these projects have had as much of a dramatic impact on Vienna's urban landscape as they had on the creation of service sector employment created within the city limits (Enichlmair & Borsdorf; Fassmann & Hatz).

Tracts of land that have become outdated due to its industrial nature needed to be considered to serve a new economic purpose. The transformation of older structure building sites, as was done with the Vienna's Gasometer site, create a sense of place and uniqueness that would give the city a comparative advantage in attracting employment over sites in newly developed areas. This can be accomplished through a combination of legal and planning led measures, including designated landmark protection as well as incentives that would encourage the regeneration of older stock buildings to ensure their continued use. As a result, this sense of uniqueness could not only help Vienna retain employment among a more competitive environment for office and facility location, but would also improve the marketing image by which most goods and services are sold.

II. Main dynamics and development of the service sector in Vienna

The following list gives insight into the changes occurring within Vienna's service sector economy:

A. Trends

As far as investigating Vienna´s service sector, there are certain trends that could be defined. In the following examples, there are different economic branches of the service sector that specify the economic and spatial processes taking place in Vienna:

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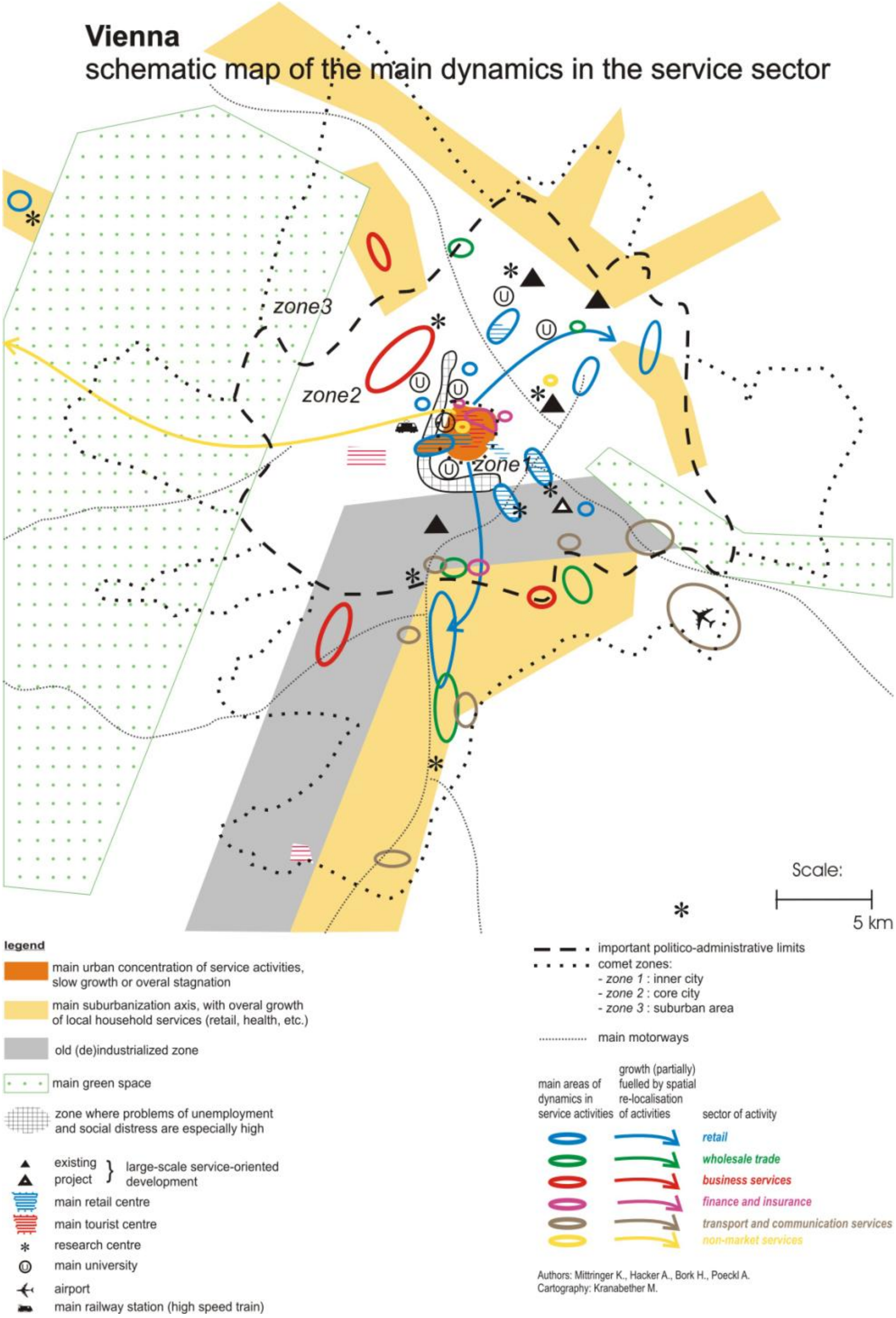
Graphic 1: Schematic Map



1. **Retail:** This sector has shown the most dramatic activity over the last three decades. Retail activity has been re-locating from the inner city districts towards the north-east edge of the city (e. g. Flugfeld Aspern) and especially out towards the suburbanisation axis just south of the city. This re-localisation is shown on the map by the blue arrows leading out from the inner parts of the city. Also, significant efforts have been made by city planners in Vienna to create new urban retail activities within the city's limits in order to minimize the loss of consumers to the suburbs. An example of these efforts is the revitalisation of the Wiener Gasometer (Chapter 3). In this context, the close proximity of research centres or universities within Vienna could lead to the growth of a young educated and urban oriented class of consumers. Despite these efforts, however, smaller and less vital shopping streets have experienced a negative development of retail activity.
2. **Wholesale trade:** Wholesale trade businesses are mostly situated in the south and south-east areas of the core city. Re-location trends in this branch are hardly noticeable. Rather than moving, nearly all existing units seem to be growing in their original established locations.
3. **Business services:** In Vienna, business service enterprises are not only located in the inner city but also in particular districts of the core city, such as, for example, in the 18th or the 19th districts and high-quality suburban locations. There are no signs of major spatial re-localisation in this sector.
4. **Finance and insurance:** Most enterprises are located in the inner city or near the inner city and tend to expand their activities without re-locating to another area of the city. The most finance and insurance businesses are located outside the inner city in office districts such as, for example, the Wienerberg-City in the 10th district.

5. **Transport and communication:** Since the fall of the Iron Curtain, this branch has been growing rapidly. All existing businesses and facilities tend to be located in the southern part of Vienna near major expressway interchange points that are ideal for quick access to other regions of Austria and neighbouring countries in the East. An example of enterprises in this branch that are expanding include the multi-facility Port of Vienna on the Danube River, the Vienna International Airport at Schwechat and freight logistic forwarders in the south suburban area.
6. **Non-marketing services:** There is not much recent activity in this branch which includes all U.N. departments that are located in Vienna. The move of the regional government of Lower Austria from Vienna to St. Poelten (see yellow arrow of above map) already took place in the 80's.

It is possible to make a relation between the different sectors of activities and their location preferences. The following table is an attempt to combine mixes of activities and types of space.

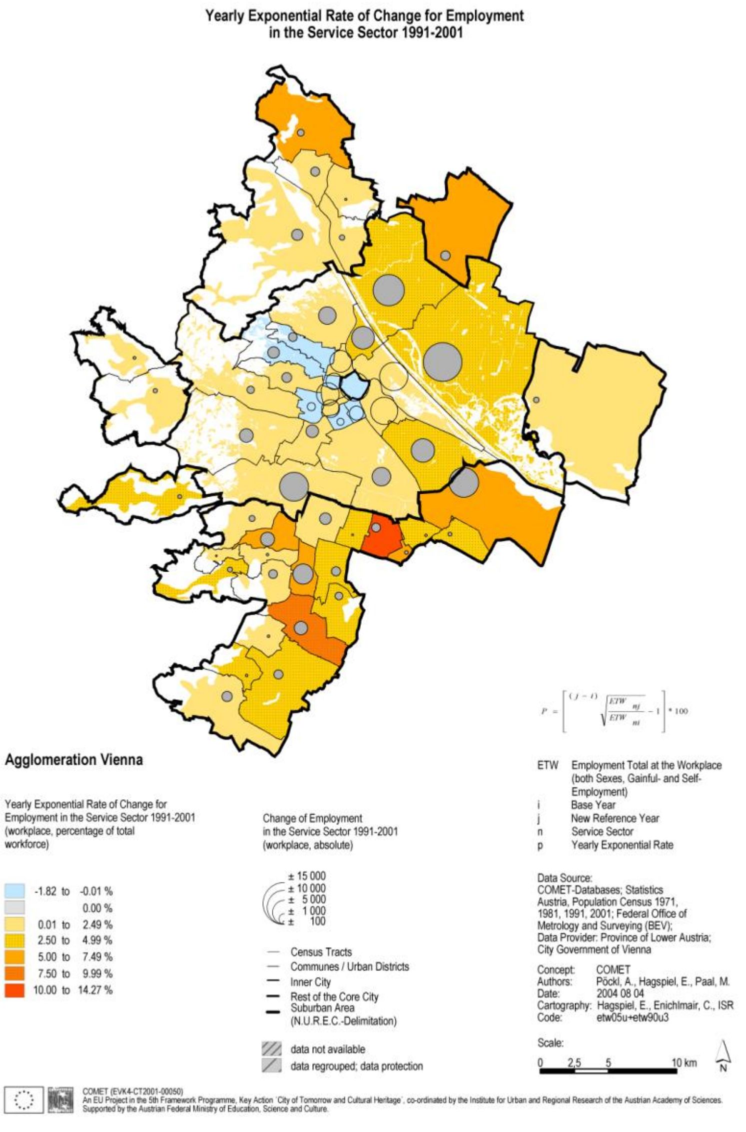
Considering the economic changes taking place in various cities, it is remarkable that many companies in Vienna have remained within the city limits rather than relocate to the suburbs as was the case in other cities (e. g. Brussels). An exception to this has been mass retail and entertainment complexes which left Vienna's core city and settled in the suburban area along road and motorway junctions.

Activities which are most important for Vienna´s competitiveness still are tourism, culture, entertainment (esp. high-end segment) but also national and international non-market services. Most of these activities take place in the city's first district or inner city.

Employment in the service sector

In the second part, we should have a look to the amount of employment in Vienna´s service sector. Regarding the map below, that shows Vienna and its surrounding region, we can isolate three important processes:

Graphic 3: Yearly Exponential Rate of Change for Service Sector Employment between 1991-2001 in the Vienna Agglomeration



There is a loss of employment in the service sector in the inner city and some districts of the core city.
Employment in the suburban area is gaining.
Nevertheless, most of the jobs have been remaining in the rest of the core city

By looking at the level of employment within economic branches of the service sector, we can find that Business Services had the highest absolute gain while employment in the branches of Research and Education, Health and Social Work and especially in. Each of these branches had experienced a relatively high rate of growth whether one considers a 10 year period between 1991 to 2001 or over a 30 year period between 1971 to 2001. On the other hand, there was a relative stagnation of employment in the Trade branch from 1991 to 2001 although Trade experienced some growth since 1971. Other branches, such as Hotels and Restaurants and Post and Telecommunications have continuously experienced a modest amount of growth since 1971. Also, certain branches such as Public Administration and Defence; Compulsory Social Security had experienced growth when comparing 1971 to 2001, although during the last 10 years this branch had actually experienced a decrease in jobs.

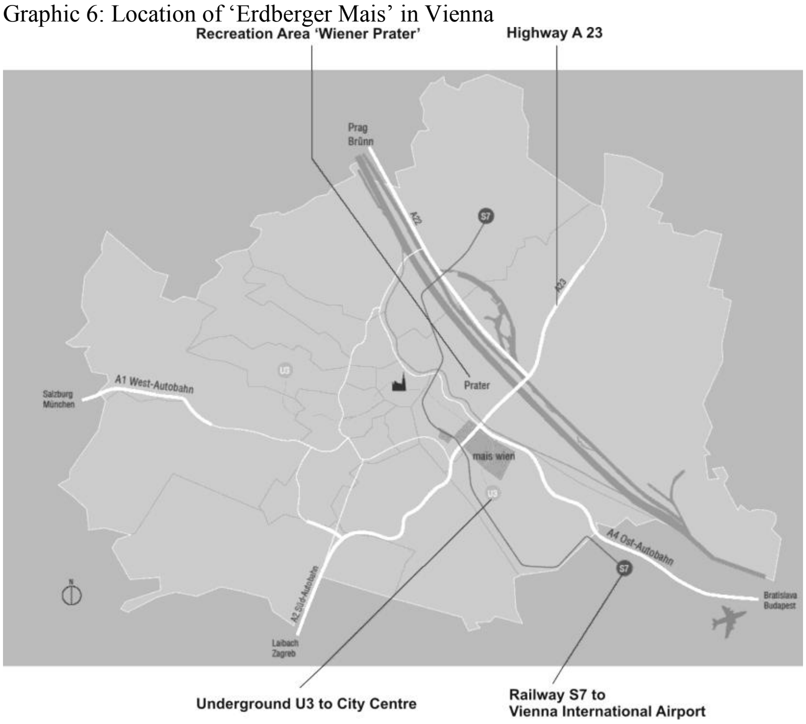
III. Urban planning Strategies in Vienna: Large-scale urban project ‘Erdberger Mais’

There have been several stages and therefore also different strategies of urban development planning in Vienna. STEP 1994 proposed the development of Donau-City (located north of Danube in a public transport axis going to the city centre) as an urban ‘countermagnet’ to the inner city (located south of the Danube) in terms of business and living. Then a master plan was created for developing a high quality office and living site nearby the city centre on the waterfront of Vienna. This was to be seen in the light of increasing importance of regions and competition among regions within the European Union as well as its forthcoming Eastern Enlargement Process (Stadtplanung Wien, 1994).

One of these strategic projects is called ‘Urban Development Zone Erdberger Mais’ (‘Stadtentwicklungszone Erdberger Mais’): The main targets of this project are to develop a high-quality business location with a mix of land-use, upgrading and appreciation of a huge, but not attractive industrial urban area by making use of new and future-oriented kinds of cooperative planning management e.g. including involvement of investors at an early stage. The project-site is located in parts of the municipal districts Landstrasse and Simmering in the traditionally industrialized south-eastern area of Vienna between its nearby city centre and Vienna International Airport. ‘Erdberger Mais’ is divided by highway A 23, which runs from the northeast to the southwest of the area. At present, the whole area covers 250 hectares and includes 5,000 inhabitants, 17,000 employees and 1,200,000 m² of housing development. The project started in 1998 after the closure of the St. Marx slaughterhouse, which dominated the St. Marx area. The extension of the underground line U 3 from the station ‘Schlachthausgasse’ to the now terminal ‘Simmering’ which leads through the project area was a precondition for the development of the ‘Erdberger Mais’ area. The goal of the project is a concentrated location appreciation that offers potential investors security and flexibility. This is to be accomplished by means of a designated mix of land-use and ecological uses of production-orientated services. The Strategy Plan of Vienna also includes strategic projects titled ‘How to turn Vienna into an attractive location for Biotechnology’ (‘Entwicklung Wiens zum Biotechnologiestandort’), which targets are overlapping with the project ‘Erdberger Mais’.

Since 1998, a planning team coordinated by the Municipal Department 21 A (Municipal Department of District Planning and Land Use – Central West) has been working on the area´s future development. In 1998 it commissioned a planning team working in the public and private sector for coordination and consisting of the relevant municipal departments and institutions related to research and planning. Their work focused on such areas as proper utilisation of land types and densities, traffic and transport, planning law, open spaces, land management, and developing infrastructure for land resources within the competence of the Vienna Public Utilities. According to the development plan a stepwise development of the area requires service-orientated management of spaces in connection with professional marketing (Magistrat der Stadt Wien, 2003a).

Graphic 6: Location of ‘Erdberger Mais’ in Vienna



Source: http://www.iemar.tuwien.ac.at/mais/, 1 June 2004

The housing development of 1,200,000 m² will be estimated to at least double in size during the process. The area will be expected to have 16,000 inhabitants and around 44,000 employees by end of the project´s scheduled completion which is presumed to be between 2010-2015 (Magistratsabteilung 21 A, 2003a). Overall, the number of jobs is estimated to triple in the development process while population will only increase by around 60% (Magistratsabteilung 21 A, 2003b).

According to Magistrat der Stadt Wien (2002), apart from its favourable situation between the city centre and the airport, the strengths of 'Erdberger Mais' consist of its accessibility in terms of public transport lines such as the railway S 7 going to and from Vienna International Airport; the underground line U 3 going from the western districts of Vienna via the City Centre to Simmering; access to highways (A 23, A 4); and the proximity to the recreation and park area 'Wiener Prater'. There are also available amount of space with high potential for development especially due to the close-down of the slaughterhouse St. Marx in 1997 that includes numerous building plots in the possession of the City of Vienna or funds related to the City of Vienna and the existence of a biotechnology cluster, the Campus Vienna Bio Center, which serves as a mainspring for establishing a high-qualified labour-intensive district.

Graphic 7: The project area 'Erdberger Mais'

Source: http://www.iemar.tuwien.ac.at/mais/Lageplan.pdf, 1 June 2004

V. Conclusion

Vienna, as a city, still maintains the highest share of service sector employment within the its own city limits, for the most part in areas outside of Vienna's historic city centre. Nevertheless, with the growth of the service sector employment, especially in such areas as business services, health care, research and education opportunities, competition for employment location and growth in areas surrounding Vienna will continue to grow. Evidence of this exists based on annual growth figures of service sector jobs occurring in areas immediately outside the city limits where good infrastructure is available (Figure 3). The planned expansion of highway networks outside the city limits is likely to, in part, help propel economic growth and the attraction of employment and services to these areas.

The present development in Erdberger Mais includes the flagship projects of Gasometer and T-Center and their surrounding areas. Apart from Gasometer, no new residential building have been built to date, although the projects Karree St. Marx and TRIPLE A are dedicated to a mixture of land-uses. The planning objectives of Erdberger Mais attempts to construct a lively multi-use facility consisting of office buildings which could attract international investors and companies as well as create residential areas and space for shopping, gastronomy and recreation. The Cattle Market Hall, with its huge dimensions, would be a perfect building for including these leisure facilities, however, due to landmark protection and the fact that potential projects may not meet the corresponding criteria that landmark designation creates, it will be difficult to determine whether a well-balanced development plan could be presented that could overcome these obstacles. Many old industrial parcels, such as the Gasometer and other buildings on the Erdberger Mais site, were purposely built in areas away from residential areas because of the nature of activities that took place there. In order to have good accessibility to the city and other areas, this site required the accessibility measures such as new underground stations and better access to local roads and motorways.

A framework of institutional and democratic decision-making processes can be carried out properly through the use of consultation, contested developers rights or a project evaluation methodology. In the case of Erdberger Mais, planning and development is made possible by means of public-private partnerships that include local and national development companies, most of whom were founded by the City of Vienna to assure that the city maintains its influence in the development process. Decisions made by the planning team in collaboration with project developers and other investors nevertheless require broad based consent

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Representation of socio-spatial processes of identification by a multiagent system model approach

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1 INTRODUCTION

With the relocation of the Munich Airport into the outer suburban fringe in May 1992, an area of 560 ha, located in Riem at the eastern edge of Munich, was available for real estate development (Fig. 1 and 2). Therewith the foundations of one of the biggest urban planning challenges in Munich's postwar era were laid. Due to several locational premises Munich city planning intended a so-called 'one-third-solution' (http://www.muenchen.de/Stadtleben/BUGA05/Historie_Hintergrund/100737/01wieallesbegann.html): One third of the area is determined for houses and flats, one third for commercial use (mainly offices, and including 440.000 square meters for the relocation of the Munich Trade Fair Center) and one third for open space. The New Munich Trade Fair Centre was inaugurated in spring 1998, and during winter the same year the first persons moved into 'Messestadt Riem'. Currently about 4.000 inhabitants are living at this new place – it will increase to 16.000 inhabitants and 13.000 employees until completion in 2013.

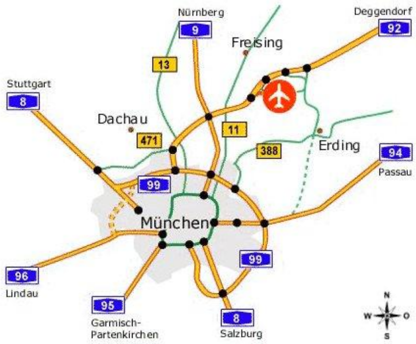

Fig. 1: The new airport location

An urban development project of this size made it necessary to improve the transport infrastructure and to generate an adequate social infrastructure. Since the area is located close to the highway A94 it was sufficient to increase the number of access possibilities. Furthermore, the network of roads to the suburban settlements in the vicinity was improved. Concerning the public transport system an existing underground line was extended to the Messestadt and the supply of bus lines has been increased. The relative high share of open space provides a sufficient value for recreation which is going to be increased due to the federal exhibition of flowers in 2005. However, this share of open space is compulsory for climatic reasons and has therefore been fixed by local planning authority. Structural relations to the vicinal settlements of Riem (the old village), Trudering, Feldkirchen, or Haar can hardly be found. Insofar, one can circumscribe this current state as a locally bounded development (Fig. 2).

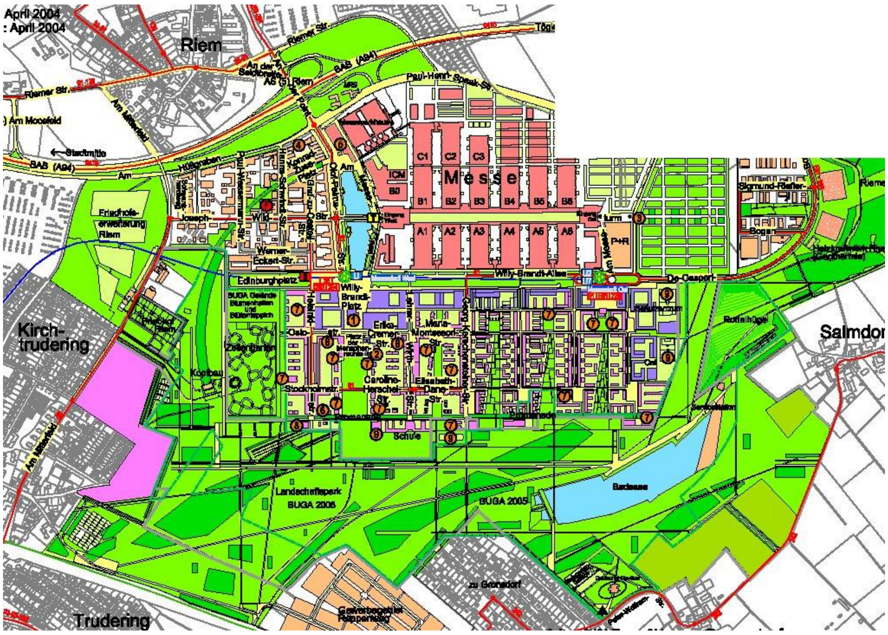

Fig. 2: The Messestadt Riem

Up to the erection of the shopping center called 'Riem Arcaden' in February 2004 the retail situation was quite bad – the provision of food and other daily things like newspapers was limited to only a few small stores. Compared to the retail situation there is an extensive supply of social institutions in the Messestadt: Besides a large elementary school and two kindergartens, a forum for citizens, a familiy centre, several meeting places, a greenery workshop, and a centre for children and teenagers, just to mention a few, serve as public institutions for interested inhabitants. These institutions are completed with printed media and virtual offers like for example a quarterly published magazine, local TV and radio programs (http://www.messestadt-tv.com/), at which inhabitants can actively participate, or the project ‘E-neighbourhood’, an online bulletin board that enables virtual contacts among neighbors (http://www.messestadt-riem.com/msr/pl_neighbors/fr_neigh.htm).

Since the question should be investigated, how social and spatial processes of identification can emerge and develop under these circumstances then the above mentioned premises and conditions are highly relevant. The Messestadt Riem is characterized by a dynamic and independent growth, there is no historical nucleus for organic development. This specific situation is responsible for a more or less identical starting point to build up social networks among the new inhabitants. There were no networks, therefore, the process of assimilation is not based on gradual adaptation to existing social structures. An influencing element of Munich urban planning is given by a different supply of property and houses to achieve a balanced social mixture. 28% of property and houses are determined for low income households, 30% for those Munich residents with an average income who want to purchase a flat or a house (the so-called Munich model), 14% are provided for non Munich residents with an average income, and 28% are privately financed. A further impressive fact is the relatively high share of foreigners (30%), mainly from Turkey, Bulgaria and the former Yugoslavia.

The conditions for the creation and development of local networks are quite similar – they too are starting at the very beginning. The mentioned social institutions serve here as appropriate local nodes, but spatial networking is not restricted to them. Local points of identification and non-identification – each case obviously gradually differentiated – emerge with the development of the city quarter and they emerge under the condition, to live temporarily with a building site. This condition has to be constantly kept in mind while studying those processes. We can, to a certain degree, compare this field study with a work in a laboratory, i.e. the empirical results we would like to obtain in our project called ‘place-making and place-relation’ are only partly generalizable.

2 THE MULTIAGENT SYSTEM MODEL APPROACH

Investigations of socio-spatial processes of identification are a complex matter and could not be elaborated sufficiently by adopting just one single method. The generation of social as well as spatial interactions depends on a variety of facts, including personal settings of attitudes, meanings, opinions towards other people and/or its build environment, but also including inter-personal aspects like norms, rules, and laws. This is the social point of view to examine interactions among individuals and between them and space. Complementary, the local settings like built space, public or open spaces are as well to include as inter-local facts like settlement structure, infrastructural networks or spatial access. This is the spatial focus on interactions among spatial objects and between them and individuals.

In trying to grasp the mutual relations between social and spatial facts different methodological approaches can be utilized. A quantitative survey, conceptualized for example as a standardized random poll, is one common possibility to receive data about demographic and economic facets of the interviewees. These data are appropriate to statistically correlate them with individual statements about identification processes. The statements itself are hardly to explore and to understand by using a standardized questionnaire. A qualitative enquiry, conducted for example as a personal interview with a coarse set of non-standardized questions in mind, is a useful approach to achieve a deeper comprehension of individual attitudes to assessing chances and hindrances of social interactions and place-making. Both approaches, however, have one disadvantage in common: They are not appropriate to observe people in action, realizing what they have expressed verbally. This disadvantage can obviously be surpassed by observing them at specific locations. Even if one has the knowledge of these specific locations (which is not always completely clear, very often one has to detect them first), it requires a great deal of time to obtain satisfying results. This is exactly the situation at which the multiagent system model approach can be brought into action.

According to Conte et al. (1998, 3) a multiagent system (MAS) can be characterized as a set of autonomous agents with the following properties: “[…] a strong emphasis on the whole agent, rather than solely on its actions; careful attention paid to the process of plan-construction, not just decision-making and choice; familiarity with […] agents mental, as well as their behavioral states; a tendency to provide the social agent with specific capacities for actions answering social requests and tasks […], rather than modelling social processes as mere emerging properties of agents’ interaction”. In spite of many important agents’ properties which are currently not completely implemented in our model, one terminological difficulty is given: a lack of any spatial context. In other disciplines like political science or sociology (Epstein & Axtell 1996), the spatial context has not to be considered as a necessary part of the model, in geography it has. The geosimulation approach of Benenson and Torrens (2004, 6) emphasises precisely this need: “Agent-based models often represent space in a cursory manner, if at all. The geosimulation paradigm demands explicit representation of space, spatial behavior of objects, and their spatial relationships”. Thus, a MAS consists of

a community of mobile social agents, representing properties of real human beings

a community of spatial agents, representing properties of real spatial facts

an environment as an abstract medium to embedding social and spatial agents

operations which enables agents to perceive, transform, and interact (Mandl 2003, 13).

The term ‘community’ doesn’t indicate that there necessarily has to be a sociality or spatiality at the very beginning of the phenomenon being modelled – it also could emerge. Our model, however, doesn’t assume a complete emergence of sociality and spatiality, the original conditions of the model include for example the fact that there already exists a plan how to develop the Messestadt Riem and also that social agents are already equipped with (currently very simple) capabilities to communicate. Provided with these capabilities, our goal is to explore where, how, and who is interacting socially and spatially – this is the emerging part of our approach.

The above given characterization of MAS is related to autonomous agents. “An autonomous agent (1) is a system [we would say ‘automata’] situated within and a part of an environment; (2) that senses that environment and acts on it, over time; (3) in pursuit of its own agenda, and (4) so as to effect what it senses in the future” (Benenson & Torrens 2004, 154; from Franklin & Graesser 1996).

This definition of agents' properties which can be further differentiated (Tab. 1) indicates that it is related to social agents, i.e. spatial agents do have other properties.

Property	Other names	Meaning
Reactive	Sensing and acting	Responds in a timely fashion to changes in the environment
Autonomous		Excercises control over its own actions
Goal-oriented	Proactive, purposeful	Does not simply act in response to the environment
Temporally continuous		Agent behavior is a continuously running process
Communicative	Socially able	Communicates with other agents, perhaps including people
Mobile		Able to transport itself from one location to another
Flexible		Agent actions are not scripted
Learning	Adaptive	Changes its behavior based on its previous experience
Character		Believable "personality" and emotional state

Tab. 1: Properties of agents in MAS (source: Benenson & Torrens 2004, 156)

The fact that we are developing a model framework with social *and* spatial agents has two reasons. The first reason is of conceptual nature: In contrast to cellular automata with its restricted neighborhood relations due to its stationarity – "[t]he position of cells and their neighborhood relations remain fixed over time" (Benenson & Torrens 2004, 6) – spatial agents are capable of generating neighborhood relations among each other being arbitrarily located (see also Parker et al. 2003). The second reason has to do with our theoretical approach. Very briefly, we conceptualize sociality and spatiality in a system theoretical manner (Koch 2004a; 2004b). Social systems are composed of communications between individuals which are structurally linked to them. And spatial systems are composed of communications (defined distinctively compared to social systems) between material and network objects which too are structurally linked to them. Both types of systems are structurally linked through mutual coding processes.

The realization of the MAS model approach which will be described in the subsequent chapter is one of four accesses to explore socio-spatial processes of identification in the Messestadt Riem. The standardized poll with a sample size of approximately the half of the inhabitants will take place in spring 2005. The qualitative enquiry with a couple of non-standardized interviews is part of a diploma thesis which will be finished soon. The fourth approach of investigation will be a participating observation at particular locations. This part will start instantaneously after a first statistical analysis of the poll results.

3 THE MULTIAGENT SYSTEM MODEL OF MESSESTADT RIEM

The MAS model of Messestadt Riem is currently implemented in StarLogo, a freely available simulation software developed at MIT, Cambridge, Massachusetts, and conceptualized as "[…] a programmable modeling environment for exploring the workings of decentralized systems – systems that are organized without an organizer, coordinated without an coordinator" (http://education.mit.edu/starlogo/; see also Colella et al. 2001). The representation of the spatial dimension embraces several steps: First, a raster image, produced in ArcGIS, will be imported into StarLogo (in a future step we intend to link GIS and simulation software more tightly). Due to the fact that the raster image is rather fuzzy in its resolution, a preprocessing is then necessary to sharpen the image. After that step the development of the area takes place. During 200 time steps the buildings of the first phase of construction will be erected (represents past and present development). According to the above mentioned planning guidelines three categories of houses/apartments are differentiated: those for low income households (blue colored), those for medium income households (sky blue), and those for high income households (purple). In addition to houses, also three categories of commercial buildings are discriminated: retail stores, including the shopping centre 'Riem Arcaden' (at the end of the first phase) (orange), social services (dark red), and others which are of no relevance in our model (brown). The second phase of construction (future development) with the same differentiation lasts 200 time steps too (houses are colored turquoise, magenta, and pink; the colors of retail stores and social services remain unchanged; others in dark brown). All retail stores except the shopping centre and all social services (currently 24 facilities each) are distributed randomly (Fig. 3). At step 200 and 400, respectively, a random sample of houses will be drawn where social agents live. This step is for transparency reasons. At this point, hoewever, the model doesn't represent the real situation appropriately, because inhabitants at a whole do not move into their new homes at a time at which the entire area is completely developed. This is not due to programming restrictions but due to drawing a random sample – we will overcome this in a later stage.

The representation of the social dimension is characterized by the following properties: Partly depending on the result of the random sample and partly on the chosen coloring scheme, about two hundred low income households (called 'poors'), about three hundred medium income households ('averagers') and about 200 high income households ('riches') are distributed randomly to their social state specific homes, i.e. a social agent is representing one household. This aggregate level will be disaggregated in a subsequent stadium of model development. Agents' sociality is currently created in a very simple manner, namely by themes of communication. There are four different sets of codes with which agents can 'talk about': code 1 comprises 'weather' and 'sports', code 2 'politics' and 'culture', code 3 'science' and 'economy', and code 4 'place' and 'hobby'. Each set also includes a 'none' for having no theme to communicate. Every agent, regardless of its social state, receives one theme per set by picking it randomly (Fig. 4). So, it could happen that an agent is unable to communicate due to the possible fact that it picks 'none' four times. The intention behind is to create a premise for emerging sociality from an initial stage (but not yet implemented). The mobility of agents is also quite simple at the moment, they move in their environment without prior planning.

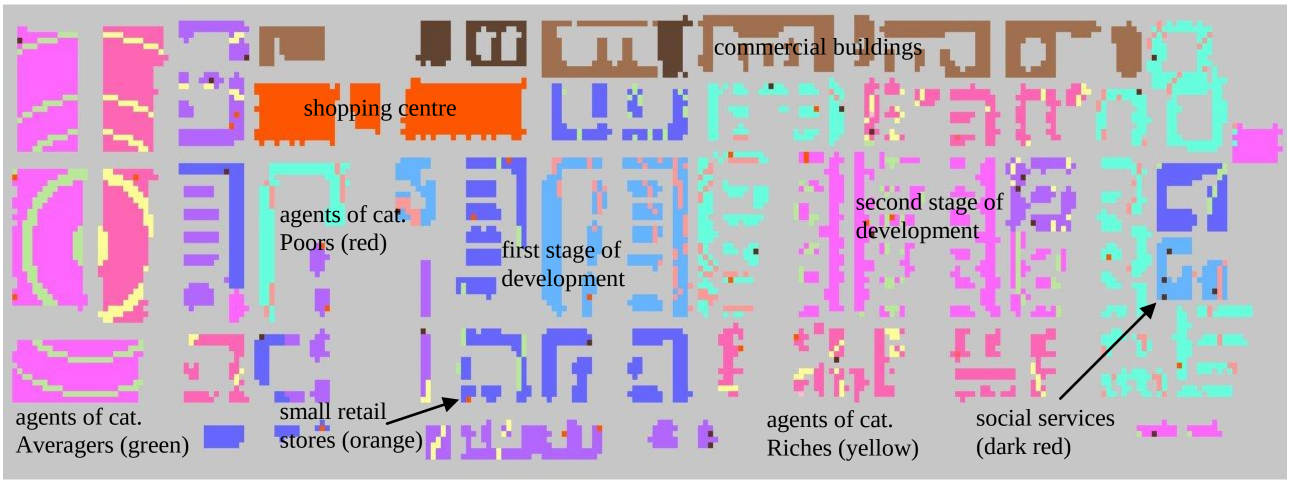

Fig. 3: The grid of the MAS model Messestadt Riem (without Fair Trade Centre (north) and open space (south))

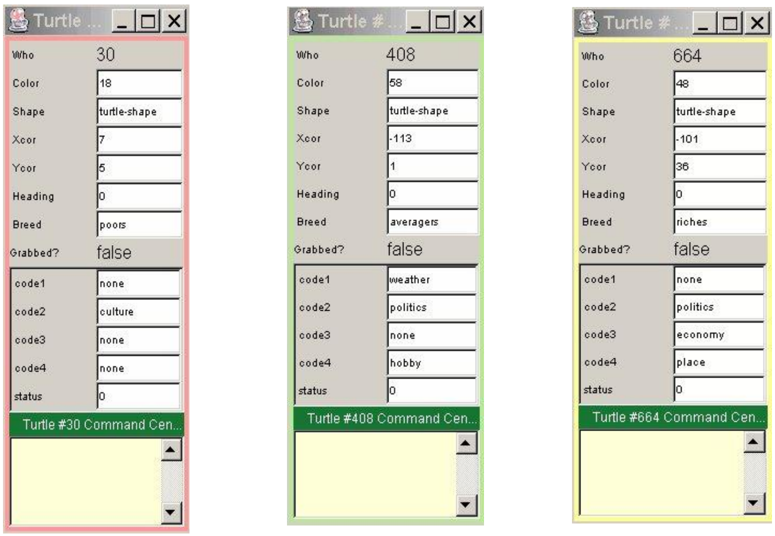

Fig. 4: Three representations of social agents – 'poors' (left), 'averagers' (middle), 'riches' (right)

Although this approach of generating sociality and social identification, respectively, is currently rather simple conceptualized, it enables a remarkable variety of social interactions through communication. A few of them are presented here. One distinguishing feature is related to the locations of social interactions, a second differs between communication among social agents of the same social state and of different social states, and the third feature differs whether social agents 'only' talking about the given themes or whether one social agent accepts themes from another social agent in order to capture the theme of interest (learning in some way). The principle process is as follows: as soon as two agents meet each other in a retail store or a social service institution, they are able to interact as far as they have at least one theme. Fig. 5 shows the result after 10.000 time steps (one time step is equal to one movement or grab of every agent) for the case that communication takes place among agents of the same social state. After that time only 4% of the 'averagers', 12% of the 'riches' and 13% of the 'poors' interacted at the selected locations. If one enlarges the places where communication could take place to streets (colored gray) then, obviously, the interaction level increases dramatically as is shown in Fig. 6. After 2.000 time steps the share of interacting agents, independent of its social state, reaches already values of about 70%.

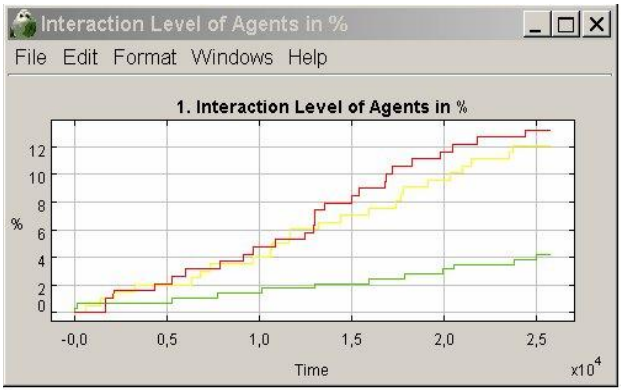

Fig. 5: Interaction level of agents (without streets)

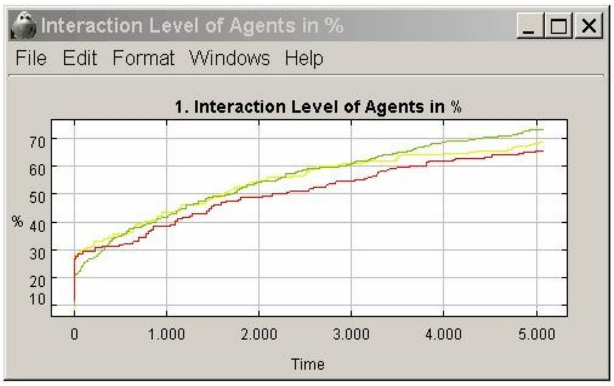

Fig. 6: Interaction level of agents (including streets)

Agents who entered a retail store or a social service institution and interacted with another agent, return to their homes and then move again elsewhere. This repeated circle of movements is visualized by a shading of agents' colors from light to dark (Fig. 7). Allowing agents for grabbing each other wherever they meet then a relatively high share of agents move repeatedly at home (Fig. 8). In addition to the pure measurement of contacts it is, herewith, possible to relate private locations (the homes) with public spaces.

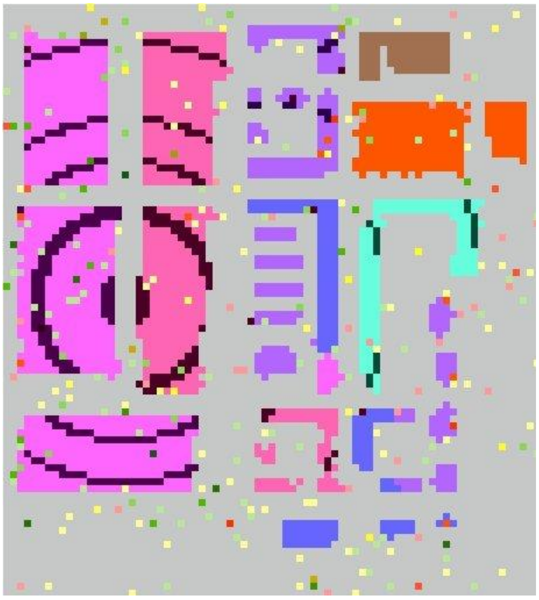

Fig. 7: Agents with different shades depending on their returns

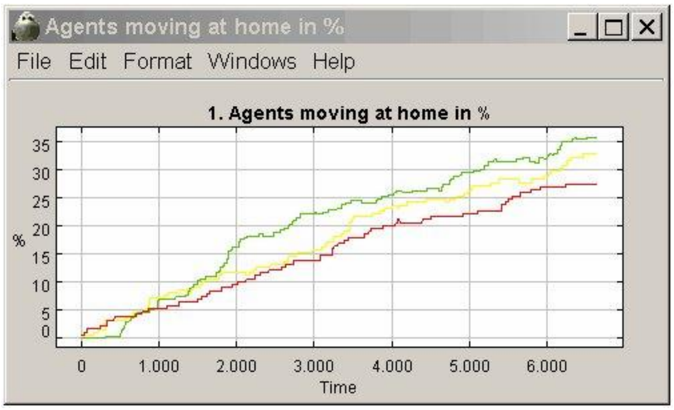

Fig. 8: Share of agents moving at home (after 2.500 time steps)

The random walk of social agents is, no doubt, unsatisfactory. To reach a more goal-oriented behavior of agents, i.e. to improve their headings towards particular sections of their field of perception, requires a deeper spatial segmentation of agents' locations (or better, a tight coupling with a GIS). Nevertheless, the conceptualization of social agent made here points out that some of the agents' properties mentioned in Tab. 1 are realized, at least in a rather weak form of agency (Benenson & Torrens 2004, 157). This is especially true for the properties of mobility and communication. Others like reactivity and goal-orientedness have to be implemented in a more realistic fashion.

4 FUTURE WORK

The MAS model in its contemporary stage is still in its infancy. Several steps towards a sophisticated agent-based simulation model have been achieved, others still have to be realized. Moreover, we do not intend to include every facet of social and spatial interaction. For example, social interactions of the new inhabitants with their former neighbors are excluded. Future tasks are among others concerned with an implementation of social interactions in the surroundings of agents' places of residence. Representing particular locations where spatial interactions among and between places of residences, public and open spaces generate spatial networks is a further challenge. Based on these modes of *interaction* the question of processes of *identification* can be elaborated. More precisely, our aim is to discriminate individual elements of socio-spatial behavior from general ones and to represent the patterns of the latter in its dynamic complex structure. For this reason statistical data and qualitative information are necessary. No model is an end in itself. It is, however, a model of sufficient generality (related to the framing conditions). In principle, social agents have the ability to talk to each other regardless of their social state. This might happen under certain circumstances, like for example when parents meet at the playing grounds; it might be unprobable at other locations and because of different conditions. In social interactions, communication themes can have an excluding as well as an including effect. It therefore enlarges the range of tools of exploration and recognition. Nevertheless, the MAS model of Messestadt Riem represents in its current state of development an appropriate tool to fill the gap of methodological approaches in exploring socio-spatial processes of identification. The model is able to visualize processes and relations of identification in a dynamical manner which is unable for the other tools. As soon as real world data are available and an adaptation of the model to actual conditions can be realized then satisfying outcomes are expected.

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Digital Transport Model EMME/2 as Tool in Transport Planning in Riga City (Abstract)

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During the past years, the transportation economy in the context of globalisation is becoming much significant for all cities in the world not excepting Riga. The geographical location of Riga always serves the good possibilities for city development. In this respect in Riga, which is significant junction of international traffic routes, transport played the important role in the history of city.

However, from the beginning Riga had to face difficulties connected with transportation. The main problem was caused by the narrowness of the city already in the middle ages. All the city functions and communications were concentrated in the small Old Riga. Nowadays this serves the overflows and bottlenecks in the streets especially in the historical centre as well as close to the bridges across river Daugava. Moreover, since 1990 the process of auto-mobilization in Latvia and especially in Riga has grown up very rapidly.

With this respect, the problems of traffic in Riga have been increasing so critically that it can disturb the possibilities for future development both in Riga and in Riga metropolitan region.

The research of transport and appropriate planning are the essentials that can enable transportation improvement in urban territories. Therefore, this paper deals with transport modelling in Riga and its contribution to urban transport development.

In this regard, the computer-based EMME/2 model is being used. Therefore, the modelling approach and methods are used according to this software and related databases. EMME/2 software allows making the modelling and complete analysis of the transportation network for area the database is created for. Due to this The Riga Model represents current traffic volumes of morning peak hour as well as future forecasts and modelling of various scenarios of Riga transport infrastructure development.

The essential part of the model is matrix that describes the trips between different areas in Riga. Therefore, there are coded street network into EMME/2 software that contains the important streets and connections in order to describe traffic flows and travel times between several places. In addition the studied area is divided into statistical zones (124). Consequently, the related transport database is created including the input of population and employment data representing each zone.

To calibrate the model the traffic volumes at peak hour (8–9 AM) were observed at 126 essential links in Riga city and surroundings. Besides, in order to map the pattern of vehicle movements during the morning hours, additional information regarding destinations of car and truck trips was collected through a travel survey at the technical control stations of vehicles.

Originally, the model was elaborated in 1997 within co-operation project between City Development Department of Riga City Council and INREGIA AB (Sweden). Furthermore, the model is powered by Riga City Development Department and has been updated, refurbished and improved in 2004 under the same co-operation framework.

EMME/2 is the incremental model and it is valid for modelling at least 5 years with annual updates of demographic and employment as well as car ownership statistics.

The system provides possibility to analyse and to forecast transportation flows in the city, taking into account inhabitants' choices regarding destinations, travel modes and routes of their trips during the morning peak hour.

Since 1997, the model was used in several important projects (e.g. the Northern Bridge study by PHARE, Riga Traffic Master Plan), providing basis for strategic planning decisions. At now, the most important project is the elaboration of new Riga City Development Plan 2006 – 2018 and EMME/2 model is the essential tool for evaluation of different infrastructure developments like, for instance, bridges over the river Daugava as well as major expressways.

Using the computer based EMME/2 transportation model database and its results for Riga city, the current and anticipated traffic situation was analysed. This will facilitate development of a sustainable, comfortable, economical and environment friendly transportation system in Riga city.

According to the results of the model the crossing of the river Daugava and the dense traffic in the city core were determined as the particular features of Riga transportation system.

In relation to these problems it has been concluded that such problems are necessary to solve by improving the traffic infrastructure and organisation as well as to encourage the economical development in the suburbs and surroundings of Riga. Besides, the particular attention has to be paid to the improvement of effectiveness of public transportation system, which plays significant role to the mobility of inhabitants of Riga.

GIS in fighting the effects of the frequent floods over the Romanian counties

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1 THE SITUATION

1.1 Geo-spatial situation

The geographical situation consists mainly in a dense hydrographic network, with a low developing level, thus with many overflowing risks when it rains too much. Also we have all kinds of earth surfaces, from plains, to hills and mountains, and irregular forests. From a demographic point of view, the rural and suburban regions are populated mostly with poor people, surviving with temporary jobs and with the goods from their own small around-houses farms.

When rains intensely fall, the running waters flowing from forested versants can easily break the farms assets and even small buildings (including houses). Here it must be said that in several regions the forests have been illegally and abusively cut, and as a result the danger of terrain-sliding raises and the soil absorption capacity is reduced.

At the end of winter, due to the rapid environmental temperature rise, there are also possible floods on rivers across the country (caused by snow thawing and ice-bridges melting).

Another potential danger consists in the subterranean caves resulting from previous salt-exploitation which, because they have remained hollow after the mining stopped, the mine plafond can fall in case of intense/long rains (at Ocnele-Mari, a locality from the Vâlcea district, somewhere in the center of the country, where there are several unsecured mine ceilings). Such terrain sliding/falling happened in a couple of times (2001, 2004), and many houses and farms located over/near the mine excavation were destroyed (by sliding/falling earth or by the salted-water overflowing from underground).

The "cartographic" situation of Romania: the country is divided in forty districts, totaling an area of 238427 km2, each of them having a local administration (council), a capital-city, and containing several tens of localities. Also we have a water administration office and an environmental guard (which are governmental institutions/organizations) in each district.

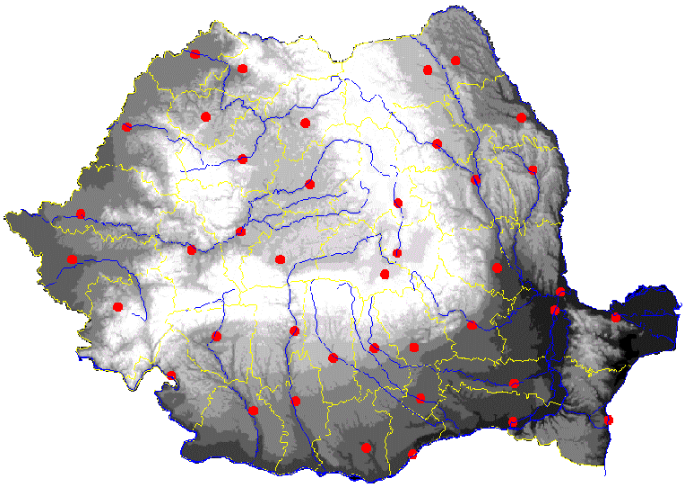

Figure 1 - A map of Romania

A GIS project/application for managing such natural-disasters has to a priori represent (mainly as thematic layers) and deal with:

water networks (rivers, lakes, canals), with a comprehensive symbology, including the capability to reveal particular sectors/branches of waters (showing the types of river-guide-banks, water alarming levels, water flow discharges);

transportation infrastructure and accessing ways (roads, paths, railways, highways, bridges, tunnels, passages, etc);

terrains and residential areas (buildings, parcels, land-use);

utilities infrastructure (electrical networks, gas pipes, drinking-water networks, sewerages). [Here we can identify a bidirectional matter concerning this kind of natural disaster: the utilities which can be affected by floods, and – on the other hand – the utilities which can be used/employed in crisis management.];

institutions (e.g. public institutions, hospitals, schools, local govern);

terrain conditions (critical soils; slopes); etc.

The classic GIS analysis function (from finding locations on digital map and from spatial entities directly querying, to complex/mixed scenarios simulations) must be, needless to say, supported.

Of course, a GIS designed for dealing with such disasters must hold trustful data (fresh, coherent and complete), and even to be able to up-date the on-the-field information in real-time. This up-dating feature is advisable for dynamically modeling the situation (river overflown basins, flood levels, affected terrains, particular risks). If the GIS application has 3D facilities, then a three-dimensional model of potential dangerous areas-zones can be deployed (flood simulating/modeling). The "buffer" simulation of the flood (which

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is a bi-dimensional analysis tool/function) supplies good information only in a symmetrical terrain situation, thus sometimes (especially when the river banks are asymmetrical) a 3D flood modeling can bring better information. A representation of the flood inundation areas can be based on many elevation models (2D″, DTM, shaded raster, isolines/hypsolines).

Also, it is advisable that the regional/zonal analysis engages aerial/satellitar photography/imagery (and the ideal GIS supports spatial raster-based queries).

In order to support the mobile teams, a modern GIS can participate with LBS functions (support for dynamical geo-location): stating objectives toward which the assisted team should go; tracking moving object(ive)s; real-time guidance; traffic control; etc.

1.2 Weather situation

We commonly known that springtime brings a lot of precipitations. But the global climate changes from recent years also make this happen in summer, autumn and winter.

When the rains fall too intensely, often exceeding 25 l/m2/h [liters per square meter per hour] (thus a water quantity which overpasses the combined absorbing capacity of the soil and of the sewages; in the Vrancea district in the summer of 2004 an amount of 138 liters on squared-meter in 80 minutes was recorded), overflowing appears on many rivers and the resulted floods affect people's lives, mostly in rural regions, where the residences are not systematized, and sometimes where there are very few sewage canals. Many people’s assets are then destroyed (including houses and cars), and even human deaths occur (mainly children, women and aged). Similar flooding situations happen in springtime when, after a rich winter, the snow is thawing.

Figure 2 - Overflowing effects

The summer precipitations of 2004 affected many districts from Romania (Arges, Bacău, Buzău, Cluj, Gorj, Hunedoara, Neamț, Sibiu, Suceava, Vâlcea, Vrancea, etc), and seemed to be some of the worst floods from the last 30-40 years.

These floods affect not only the human habitats, but also the whole environment.

The abundant rains have destroyed bridges, roads and railways, thus many farms became isolated, and these families were then supplied with foods (drinking/mineral water, bread, conserved meet, other foods) through extraordinary means (temporary bridges, boats, helicopters, etc).

The running waters – instantly developed by torrential rains what came after long, hot sun, dry days, with thunder-lightning and strong wind, sometime becoming hailstorms – provoke deep despondency to the agriculture people: many crops across the country were destroyed (vegetables, pot herbs, wine-yards, grain cultures, corn fields, etc – sometimes in a proportion between 50 and 100%).

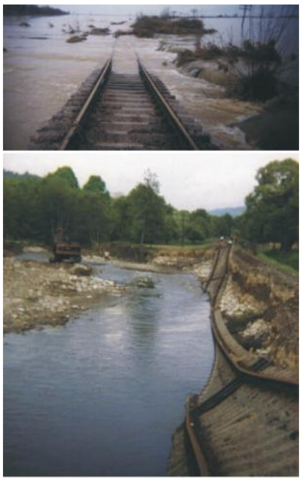

Figure 3 - Railway destroyed by flood

From another perspective, such weather angrily combining day-after-day torrential rains (exceeding 60 liters/m2), hailed precipitations, wind and thunder-lightning, could interrupt or dangerously delay the summer agricultural works. And this, in the rural regions, can negatively affect people’s life.

Sometimes, hailstorms (bringing egg-sized stones) have destroyed roofs of hundreds of houses. Overflowing rivers took away barns, stables and mews, often killing farm animals.

Thunderstorms and/or floods have affected occasionally the electrical power network (by destroying stations, breaking lines, plants), and this outages affect both residential and commercial/industrial consumers.

Floods have inundated roads and even stopped trains.

The same rains, affecting the Ocnele-Mari area by terrain-sliding and by salt-water overflowing from mining cavities, not only have destroyed many farms and houses, but have also affected the environment by salt debouching into the Olt river (one of the largest rivers from Romania). The neighboring chemical companies which currently use the water from this river have been affected too.

Figure 4 - Terrain-sliding at Ocnele Mari

In this summer the river overflowings and the terrain-slidings have destroyed thousands of houses, tens of bridges, hundreds of kilometers of forest roads, tens of cars, many water pipes, electrical power lines, columns/pillars and electrical transformation stations, hundreds of hectares of agricultural terrain, kilometers of banks, hundreds of fountains, kilometers of railway, many water-stations, shop houses, stores, etc.

GI in weather monitoring:

GIS functions for monitoring, recording and analysing weather information (at national and local scale/level);

Internet published weather forecasts (having GIS servers as core for web-based forecasting services);

subscription-based periodical communication about weather conditions and forecasts from weather institutions (national, local).

2 POSSIBLE AND PRACTICAL SOLUTIONS

2.1 Proactive solutions

Of course, the most practical measure for preventing and minimizing flood negative effects is to build guide banks for rivers and brooks. The presence of a safety embankment or/and of a longitudinal dike is very advisable on sides of almost all flowing waters (from big rivers to creeks), especially where the natural banks are not high enough, but such stream harnessing costs. (I presume that in the poor- and developing-countries not all the flowing waters have a proper basin development.)

Another prime solution consists in the extension and/or rehabilitation of the water duct networks (first the waste-waters sewages, but also the potable-water adductions).

This kind of works needs proper designs, which will be well served by GIS and CAD software (from the incipient phases – strategical design –, to the concrete constructive and detailed design, and also to the exploitation and maintenance).

As it might be expected, weather statistical analyses (showing the most "rainy" month of the year, and particularities of the rain-falls), combined with a dynamic connection at the regional/national/local weather forecasts services/information, can play a leading role in forestalling flood effects.

Beyond the main purpose of real-time monitoring of the river levels along the hydrographic basin of the potentially dangerous rivers, the adjustment of the former alarming levels (possibly in correlation with majors factors which previously have not appeared) can become useful, and so can develop statistical research/studies over the levels database to find behavioral patterns.

Another basic key in preventing the crisis consists in increasing the reaction speed of the emergency services: rescuing, ambulance, hospitals, police, fire-brigade, gendarmerie, et cetera.

Similarly, with or without previous/practical experience, communities need plans for fighting against disasters. They have to define crisis-management strategies, to know about able-to-be-involved resources, methodologies, and responsibilities, to be ready to apply such knowledge (because by acting ad-hoc, only on the spur of the moment (under the moment's inspiration), decisions can be compromised by not-knowing all the aspects and even by human emotions). In the "Information Technology" perspective, this need of planning and monitoring actions in case of necessity is served by the CMS applications (Crisis Management Systems), from those for communities (generally serving people) to those for particular enterprises (including utilities and infrastructures).

Before seeing effective use of the GIS in emergency management, let us shortly remember why we use geographic information when we deal with crisis:

» a better understanding of the real facts and of the situation;

» a better, sharper and faster decision making.

GIS for proactive disaster management:

it is vital to have a geo-spatial database representing the district, with people's residences, infrastructures, buildings, and water networks, supporting major editing and querying functions;

is also advisable to possess GIS functions for revealing geo-risks situations;

floodplain simulation analysis (2D vector, 3D, DTM, raster based or mixed);

engage specific queries, from distance measurements to proximity analysis.

Also as a preventive measure the dispatchers/headquarters of emergency public services (ambulance, police, fire-brigade) must have GI application (or GIS function in their phone-call CRM application) for controlling the district and for tracking and assisting their mobile teams/equipages.

On-the-field disaster simulation alarming exercises (with the GIS off-line or on-line support) help the responsible people with regard to: managing resources; starting and deploying actions; monitoring reaction times; watching simulation results (as time-frames, costs); revealing weaknesses; analysing and proposing alternatives. It is an operative way to find solutions for disasters mitigation.

2.2 Reactive solutions

In the summer of 2004 many efforts were engaged for helping people affected by floods (mostly from national and local administration, and with a "political will" catalysed by the fact that it was an election year).

One top measure was leveraging the emergency services: rescue, ambulance, hospitals, police, fire brigade, etc.

Figure 5 – Roads restoration

Whenever most of these situations happened, the local-government (the public administration) constituted crisis management teams, having the task to initiate/control several back-up measures for people from the affected regions:

A. Immediate actions:

homing the people who can not anymore use their houses (in hospitals, schools, other public facilities);

assuring live-support for affected people (health-care, foods, utilities);

identifying dangerous areas in case of other consequent overflowing occurrences;

(local/national) government operative group (non-stop, or continuous shifts) as call-center for situations monitoring, for receiving signals and calls from citizens, and also for humanitarian help calls.

B. Long-term actions:

epidemiological monitoring, diseases controlling, vaccination campaigns;

identifying lands for people relocating and for house building;

assuring building materials (cement, lumbers, steel, BCA bricks, glass, etc) bought from the state's strategical reserve; etc.

Relocating people (by building houses for them to replace those broken) presume several key aspects:

» assuring their lives (life support) for a relatively long period (hosting; feeding; health support), until the new houses and/or farms are ready;

» giving financial and/or material aids;

» finding vacant/disposable terrain areas (mostly from the public domain patrimony) - this is the most suitable for being effectively served by GIS/GI applications;

» quickly contracting and deploying building yards [construction/project sites];

» providing social assistance (social services), and sometimes legal consultation (e.g. due to the many aspects concerning the property); etc.

The Ministry of Health has solicited the districtual health offices to intensify their activities in the flood-affected areas: information broadcasting for citizens; surveying the quality of drinking water; watching for pest holes and epidemic diseases signs; vaccine campaigns.

Because many people from stricken hard-hit regions left without drinking water sources, the local administration and the Red Cross distributed thousands of mineral-water bottles and many potable-water auto-cisterns, and they put banners signaling the disease potential of affected fountains. People must know that drinking water from affected subterranean sources (affected by clogging, silting or aggradation) can provoke severe diseases, like "A hepatitis".

Also, many cargoes with foods for farm-animals were distributed (grains, flour, brans). Beyond these material aids, the administration deployed many financial aids.

The govern approved, in fast mode, several statements concerning the systematizations and developments of hazardous rivers banks.

A particular and dangerous local situation is that assets insurances in Romania only reach a low level. There are governmental and non-governmental efforts to stimulate and to encourage the Romanian people to use the insurance systems, but the legislation is still perfectible in this direction. Because of the many facets of the floods, it is obviously advisable to engage not only life- and house-insurances, but also those which cover agricultural risk assessment, therefore insuring crops (including hail damage) and livestocks.

GIS and IT&C for reactive disaster management:

the GIS solution must allow the operators (from dispatching center, or even from field) to quickly introduce and edit those entities that model the flow affected areas, in various aspects (as polygons, lines, points, raster, annotations, etc).

portable/mobile GIS application (for notebooks, PDA with GIS essential functions; GPS pocket-receivers; other mobile devices combining geo-spatial information and telecommunications: GIS, LBS, GSM, etc) connected with the central GIS (databases and applications from team headquarter);

easiness of installing and supporting dispatching centers for crisis management (an opened GIS environment based on LAN, VPN and Internet/intranet, able to disseminate geo-spatial data to thick- and thin-clients: from full-featured PC stations to web browsers and mobile devices);

seamless communication between crisis management team members (by mobile telephony, paging, instant messaging, e-mail, fax, etc);

Internet publishing for information dissemination (web portals for disaster management; media/press communication);

green phone call lines (for affected citizens, also for people who need to report new situations and changes, and for citizens who want to help others).

Other important requirements for the geographic information systems/application involved in crisis management:

_ a high level of reliability (guaranteed by using quality stuff: hardware, software, human resources; back-up solutions; uninterruptible power supplies, redundancy of critical hardware/software components; hot-swappable devices; etc)

_ fast map-producing (for printing on paper, for publishing through Internet, or for accessing through wire-less connections), dedicated to a larger audience (than those “IT familiarized”);

_ data interoperability/interchange with other information systems/applications (including GIS, CMS) from other involved organizations (the local administration, civil defense, police, ambulance, public health offices, environment guards, and committable private organizations);

_ connections and conformance with local/national SDI portals (Spatial Data Infrastructure).

But, above all these administrative and technical issues, the human spirit rules: from knowing and thinking, to helping one another.

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Technical Push on 3D Data Standards for Cultural Heritage Management

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1 INTRODUCTION

The *World Heritage Site Schloß Schönbrunn* comprises various buildings and a park with different vegetation, altogether some 1.5 km². To provide an economic basis for future operation and maintenance, to extend the business area and to increase the service quality, an adequate information system based on spatially related data is essential. Data acquisition devices combining laser scanning (often referred to as LIDAR) and digital photogrammetry, are well suited to capture the geometric information together with the photo-texture of historical sites. The level of detail provided by such sensors is permanently increasing, thus, affecting data modeling and management. Unfortunately, broadly accepted standards for handling these data in a proper way are still missing.

This paper discusses attempts by the *European Commission* and by national authorities on standardizing spatial data management. The current trend towards *Free* and *Open Source Software* is highlighted as well. The conceptual design of the *Integrated Facility and Asset Management (IFAM) Schloß Schönbrunn* will be used to point out the advantages and deficiencies of currently available standards for spatial data interchange and management. The current status of three-dimensional data structures for efficient data management in spatial information systems are addressed, too.

2 DATA ACQUISITION

During the past ten years, an amazing shift, from basically manual geometric data acquisition methods based on analogue techniques towards automatic or at least semi-automatic workflows, mainly based on digital data acquisition, took place. Current digital cameras provide images at a resolution, comparable to analogue films. Laser scanning – airborne and terrestrial – enables the sampling of highly accurate three-dimensional point clouds of objects at almost any scale, ranging from large scale models at a very high degree of details (e.g. statues, coins, reliefs, etc.) to small scale representations of whole buildings or even cities. Therefore, these methods of data capture enhance the documentation of historical sites and cultural heritage.

The *Schloß Schönbrunn Kultur- und Betriebsges.mbH* participates in the *Christian Doppler Laboraty for „Spatial Data from Laser Scanning and Remote Sensing"*, affiliated to the *Institute of Photogrammetry and Remote Sensing, Vienna University of Technology.* Different data acquisition instruments and methods are currently investigated in order to define preferably automated or at least semi-automated workflows for data acquisition of the *Schönbrunn* facility. For testing purposes, the following datasets were recently acquired or already available:

full-waveform airborne laser scanning data, acquired by a *Riegl LMS-Q560* covering the whole area comprising the buildings and the park at a total extend of some 1.5 km²

"conventional" airborne laser scanning point cloud of the whole area (first and last pulse), acquired by a *Riegl LMS-Q280*

digital aerial images, acquired by the airborne digital camera-system *Vexcel Ultracam-D* (10 cm ground resolution in panchromatic mode and in pan-sharpened true color (RGB) and color infrared (CIR) mode)

laser scanner point clouds and digital color images covering several historic rooms, acquired by a *Riegl LMS-Z420i* in combination with a *CANON EOS 1Ds*

line drawings, orthoimages and CAD-based 3D reconstructions from facades

The following Fig. 1 shows a three-dimensional plot of the signal amplitude registered by the full-waveform laser scanning system *Riegl LMS-Q560*. The target was a horizontally fixed tree in front of a slab (see Fig. 2). As can be seen from Fig. 1, the amplitude of the backscattered signals on the slab is smaller for beams which have passed through the tree due to signal attenuation, i.e., the signal energy is partially absorbed by the tree.

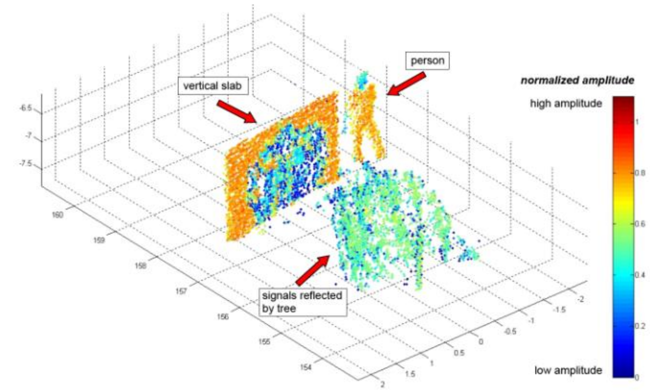

Fig. 1: 3D plot of the registered signal of the full-waveform laser scanner.

Fig. 2: Image of the full-waveform test field.

In this example, we registered up to 9 echoes per beam. This information will enable us to derive a truly three dimensional representations of the sensed objects as opposed to the prevalent 2.5 models derived form first/last-pulse data. Furthermore, even the

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surface characteristic (i.e. roughness, steepness, …) will become discernible. Wagner et al. (2004) describe the theoretical model and basic ideas of full-waveform laser scanner application.

Further investigations aim at:

automated modeling of roofs fusing airborne laser scanning and digital aerial images (Peternell und Steiner, 2004; Rottensteiner et al., 2004)

reconstructing historic rooms and facades for virtual modeling and further visualizations

These data acquisition methods will provide geometric models as a reliable basis for the *Integrated Facility and Asset Management (IFAM) Schönbrunn*. The *IFAM* is intended to support the maintenance and restoration of *Schloß Schönbrunn* as World Heritage Site in an economic manner and to increase the efficiency of the provided services (e.g. tourism). The fundamental basis of this system are geometrically accurate and topologically consistent models of the facility. As a matter of fact, the necessary data structure has to support four dimensions: three location coordinates (x,y,z) and the time component in order to maintain the historical state. As it might be used for planning purposes as well, future states have to be managed, too.

3 3D DATA STANDARDS

As mentioned above, current data acquisition workflows enable a fast and precise capturing and modeling of real world entities such as cultural heritage. Furthermore, the internet has emerged as the standard medium for data transport and distribution. Therefore, real-time data requests from different, distributed data repositories are feasible. This bears the possibility to create multi-nation information frameworks for any kind of spatial information. Thus, it should be easily possible to combine information and models available from different sites.

International and nationwide committees have recently started to work out and subsequently define standards for geo-data management and exchange. Their main intention is to create a basis for *eGovernment and eCommerce*. On the one hand, the efficiency of managing country-wide, or even continent-wide available spatial datasets (e.g. land register information, road maps, power lines, ...) shall be increased by avoiding redundant storage of information. Thus, only one institution which is in charge of the data has to manage it. On the other hand, the availability of the data for other administrative and commercial users shall be simplified by supporting direct access to the originally managed datasets. This principle is also knows as “data at the source” model.

3.1 International and European Frameworks for Data-Standardization

The *eEurope 2005 Action Plan* (eEUROPE, 2005) is a common initiative defined by the *European Commission (EC)*. This plan aims at *“developing modern public services and a dynamic environment for e-business through widespread availability of broadband access at competitive prices and a secure information infrastructure”*. The “*Interchange of Data Between Administrations*” (IDA, 2005) is a European program using advances in information and communication technology to support electronic exchange of information between public administrations across Europe. IDA as contributor to reach the *eEurope Action Plan* published a working paper *“Linking up Europe”*. This contribution aims at *“achieving acceptance from key decision and policy makers in Europe on the need for interoperability both within and between administrations and with the enterprise sector”*.

Infrastructure for Spatial Information in Europe (INSPIRE) is an initiative to *“create a legal framework for the establishment and operation of an Infrastructure for Spatial Information in Europe, for the purpose of formulating, implementing, monitoring and evaluating Community policies at all levels and providing public information.* […] *INSPIRE focuses on environmental policy but is open for use by and future extension to other sectors such as agriculture, transport and energy.* […] *INSPIRE will not set off an extensive programme of new spatial data collection in the Member States. Instead, it is designed to optimise the scope for exploiting the data that are already available, by requiring the documentation of existing spatial data, the implementation of services aimed at rendering the spatial data more accessible and interoperable and by dealing with obstacles to the use of the spatial data. INSPIRE will pave the road for a progressive harmonisation of spatial data in the Member States.“* (INSPIRE, 2005). The INSPIRE proposal for a directive has been adopted by the *EC* in 2004.

The *European Committee for Standardisation (CEN, Comité Européen de Normalisation)* set up a technical committee *CEN/TC 287 – Geographic Information* (CEN, 2005). This committee defined a set of eight European norms and four European reports from 1992 to 1999 concerning geo-data related topics (e.g. spatial schema, quality, metadata, ...). The *International Organisation for Standardisation (ISO)* set up the technical committee *ISO/TC 211* in 1995, absorbing the European work program of CEN in the beginning. Currently, ISO has already published some 20 standards. All together 40 work items concerning geographic information are currently dealt with. These are commonly referred to as ISO 19000 series (ISO, 2005).

3.2 Austrian Efforts

Several countries have already decided to realize web based data repositories of spatial data for public administration. E.g. the *British Ordnance Survey* (OS, 2005) provides its *Master Map* as a seamless and feature based dataset including topographic information on every landscape feature – buildings, roads, open areas, wooded areas, water and much more in a polygonal format. Data accessibility is realized using the standardized *Geography Markup Language* (GML – see section 3.3.1).

In Austria, several committees have recently started to work on standardization of spatial data management and distribution. A final decision is still missing. Active decision makers are *Österreichische Raumordnungskonferenz (ÖROK, 2005)*, *Österreichischer Dachverband für Geographische Information (AGEO, 2005)* and *Austrian Standards Institute (ON, 2005)*. *ÖROK* integrates members of the Federal Government, the Federal provinces and the communities. One of the goals of *ÖROK* is the definition of a framework for an Austrian Geo-Data-Infrastructure (GDI). It aims at preparing a statutory, nationwide framework for non redundant management and distribution of spatial data. *AGEO* acts as umbrella organization between the public and the commercial companies and thus, supports the acceptance of public decisions. Finally, the task of the *ON* is to provide an applicable framework of standards and norms, which meets the Austrian requirements.

3.3 Available Implementations

International and nation-wide standards define a basis for standardized data management and exchange between data vendors and customers. But they are not applicable for common usage. Therefore, widely acceptable implementation specifications and data formats need to be defined. An independent organization for standardization of spatial data is the *Open GIS Consortium* (OGC, 2005).

The OGC provides specifications at two different levels: *Abstract specifications* and *implementation specifications*. Abstract specifications define standards in a general way without considering their application on a specific platform. On the contrary, implementation specifications consider specific platforms. Therefore, they can be applied by software developers and data vendors.

OGC specifications define two structures for the representation of spatial objects. These are *geometrical (i.e. simple feature specifications)* and *topological (i.e. complex feature specifications)* (Stoter and Zlatanova, 2003). The Simple Feature Implementation Specification is implemented in many commercial systems. But Simple Features are restricted to a two-dimensional representation of simple geometry object types such as line, poly-line or arc. Some systems allow to assign a height attribute to each coordinate tuple, thus, describing a 2.5 dimensional geometric model. Three-dimensional objects cannot be represented using Simple Features.

Topology describes neighborhood relationships of objects. The basic structures are *nodes* (representing points), *edges* (representing border lines), *faces* (representing areas) and *volumes* (representing bodies). Two different types of topological relations can be defined. The *inner topology* describes the relationship between the elements of an geometric object. The *external topology* describes the relationship between different geometries. *ISO* and *OGC* have started to define specifications for *Complex Features* and *3D Geometries*. Up to now, only Technical Reports are available and no International Standard has been released so far.

3.3.1 Geography Markup Language

The *Geography Markup Language (GML)* is an application of the Extensible Markup Language (XML). XML is a structural and semantic language which enables to describe the encoded information using a predefined syntax consisting of three different logical structures: *Tags*, *attributes* and the *data* itself. XML is a meta language. Thus, it can be used to define other markup language such as GML. The valid structure of an XML document is defined either by Document Type Definitions (DTD) or by XML Schema Definitions (XSD). XML Schemas are standardized by the *World Wide Web Consortium (W3C, 2005)*, defined using XML and provide more flexibility than DTDs. Thus, they are preferably applied to define XML applications.

Currently, GML version 3.0 is released since January 2003 (version 3.1 is available as committee draft). The following list gives an overview on features of GML 3 which were not addressed or adequately met by the previous version 2 (Cox et al., 2003):

representation of geospatial phenomena in addition to simple 2D linear features, including features with complex, non-linear, 3D geometry, features with 2D topology, features with temporal properties, dynamic features, coverages, and observations;

an improved support for properties of features and other objects whose value is complex;

representation of spatial and temporal reference systems, units of measure and standards information;

usage of reference system, units and standards information in the representation of geospatial phenomena, observations, and values;

representation of default styles for feature and coverage visualization;

conformity with other standards from the ISO 19100 series.

Thus, GML 3 provides the capability to represent complex, non linear (e.g. Cubic Spline, BSpline, Bezier, Clothoid, ...) 3D geometries. By aggregation of individual geometry objects, more complex objects can be defined (e.g. facility models). Coverages can be used to describe surfaces e.g. as Triangulated Irregular Networks (TIN) or as rectified grids. The rectified grid specification allows any affine transformation of the given rectangular coverage. Furthermore, GML 3 supports to define a topology, but restricted to 2D.

3.3.2 Industry Foundation Classes

The *Industry Alliance for Interoperability (IAI, 2005)* is an international cooperation of more than 650 members drawn from more than 20 countries. It was funded in 1995. The IAI's vision is *"to provide a universal basis for software interoperability in the AEC/FM (Architecture, Engineering, Construction, and Facilities Management) industry"*. Its solution for common, global interoperability are the *Industry Foundation Classes (IFC)*.

The IFC are designed to support the whole life-circle of a facility from planning, through construction and usage, to its demolition. They define all available parts of a facility as objects. Thus, all applications supporting the standard are able to interpret the represented objects. In contrary to common 2D and 3D geometry data formats (e.g. DXF, ESRI shape files, ...), IFC are capable to model numerous attribute and meta information related to the geometry. The current version 2x2 supports 3D geometry types.

IfcXML (current version 2, ifcXML2) defines the complete IFC Model using the XML Schema Definition Language (XSD). The ifcXML2 methodology is compatible with the current pre committee draft (CD) version of the upcoming standard to convert EXPRESS structures into XML schema structures - ISO10303-28 ed.2. IfcXML2 is approved for the generation of XML schema definitions for IFC2x Edition 2 and forthcoming IFC releases (IAI, 2005).

Currently, the IFC-interface support of some 10 software developers (e.g. Autodesk, Bently Systems) is positively validated within a two step certification process by the IAI.

3.4 Database Management Systems

Almost any mainstream *Database Management Systems (DBMSs)* support spatial data types and spatial operators for Simple Features. Some systems provide very basic functionality (e.g. length, perimeter) to be applied to 3D objects which are evaluated three-dimensional. Even three-dimensional queries are supported to a certain degree. But no current system provides three-dimensional geometry primitives such as, e.g., tetrahedron or polyhedron and, as a matter of fact, more complex geometries are not supported, too.

Complex Features, i.e. topology, are currently not supported by most DBMSs. Oracle Spatial 10i (released in spring 2004) is the first and only commercial system which supports topologic primitives, i.e. nodes, edges, and faces. But these are restricted to coverages (two-dimensional). Nevertheless, several topological operations are supported (Oracle, 2004).

All above mentioned DBMS are based on the relational database model. This model describes real world object types (often named entities) using relation schemata $R=\{A_1, A_2, ..., A_n\}$ with the attributes A_i representing common properties of an object. Relational DBMS (RDBMS) are currently dominating the commercial market. This model was invented in 1970 by Edgar F. Codd (1970). Due to the restrictions of the relational model concerning the adequate management of objects, most systems implement so-called Object-Relational extensions. These provide object data types and adequate functionality enabling the modeling of geometry primitives (Simple Feature) as single attributes.

The *Object-Oriented Database Model* (OODBM) would be more appropriate for managing both, geometric and topologic information. A hierarchic approach for a geometric model of a building (e.g.: building – room – wall – surface structure – ...) could be realized easily using object-oriented data modeling. Furthermore, restrictions of the standard query language for relational databases, the *Structured Query Language* (SQL), could be overcome. For example, SQL can not be applied to navigate through a topological model (e.g.: follow the edges until the start point is reached again). But, there are several restrictive facts concerning OO-DBMSs. On the one hand, the commercial market is dominated by several powerful database vendors which rely on the relational schema. On the other hand, no standardized query language is available for OODMBs and the separation between the DBMS and the application is rather fuzzy (Oosterom et al., 2002).

3.5 Open Source / Free Software

Currently, there is a remarkable trend towards *Open Source Software (OSS) / Free Software (FS)* solutions. OSS means, that the source code of an application is available to the user. But an OSS need not be a FS as well. FS includes *"the users' freedom to run, copy, distribute, study, change and improve the software"* (GNU, 2005). This does not imply the availability of the source code.

Following this development, the *Schloß Schönbrunnges.mbH* migrated from a commercial *Windows* environment to an OSS/FS *Linux* system in 2004. This decision has two advantages: It helps to save license costs (but additional user training costs have to be considered) and it provides the possibility of source code transparency. Thus, it should be possible – for experts – to interpret the functionality of the software system and therefore, no hidden features should occur (e.g. unintentional information transfer to a third party, ...). The opportunity to modify the source, e.g. to guarantee data security, is another advantage which encouraged several national authorities to migrate from proprietary to FS/OSS solutions. Nevertheless, considering the complexity of several OS-systems, the effective transparency of the source-code might be questionable. Furthermore, the EC is currently thinking about new laws concerning copyrights and patent law of FS (and for commercial software as well) leaving a large field of uncertainty concerning possible future license costs or royalties.

4 DISCUSSION

The previous section gave an overview of the current situation on standard and software availability, necessary to build up a Geo-Data-Infrastructure (GDI). In the following, several technical aspects and decisions concerning the realization of a GDI are discussed. In this context, the conceptual design of the *IFAM* is used as exemplary application.

4.1 3D has to Overcome the Restrictions of 2.5D

Most spatial data repositories are based upon 2.5 dimensional geometric models. This might have historical reasons, as former data acquisition and management techniques were not able to support real three-dimensional data structures in an economic manner. E.g., an analog map is not an appropriate tool to represent the complex geometrical information modeling a facility like *Schloß Schönbrunn*. Furthermore, most currently available datasets (land registers, building maps, ...) were digitized once and stored in appropriate two-dimensional data formats. In some cases, an available height attribute was assigned. To model this information in a DBMS, the application of the Simple Feature Specification is sufficient. In order to realize a full three-dimensional cultural heritage management system like the *IFAM*, also data structures have to be realized throughout three-dimensional. This includes the availability of three-dimensional geometric data types, of topology representation and of appropriate functionality for management (e.g. indexing) and retrieval (e.g. querying) of the data.

4.2 Topology versus Geometry

As a matter of fact, a three-dimensional data structure is more complex to be dealt with compared to a 2.5 dimensional one. In order to increase the data quality by preventing redundant and inconsistent data, the modeling of the topology becomes essential. Oosterom (2002) lists the impact of consistent topologic models on the quality of the corresponding geometric model:

it avoids redundant storage (more compact than a full-polygon model);

it is easier to maintain consistency of the data after editing;

it is more efficient during the visualization in some kind of front-end, because less data has to be read from disk;

it is the natural data model for certain applications; e.g. during surveying an edge is collected (together with attributes belonging to a boundary); and

it is efficient for certain query operations (e.g. find neighbors).

Considering this, and due to the fact of the very inhomogeneous availability of the geometric information (ranging from very inaccurate, digitized old maps to highly sophisticated three-dimensional models, e.g. derived from terrestrial laser scanning and photogrammetry), the *IFAM* is intended to be based on a consistent topological model. The geometric information will be treated as attribute information with a strict relation to the topological model.

4.3 Features versus Maps

A *Web Service* is an interface that describes a collection of operations that are network accessible through standardized messaging, preferably based on XML (Kreger, 2001). Doyle and Cuthbert (1998) defined an *"essential model of interactive portrayal"*. A slightly modified visualization of this concept is shown in Fig. 3.

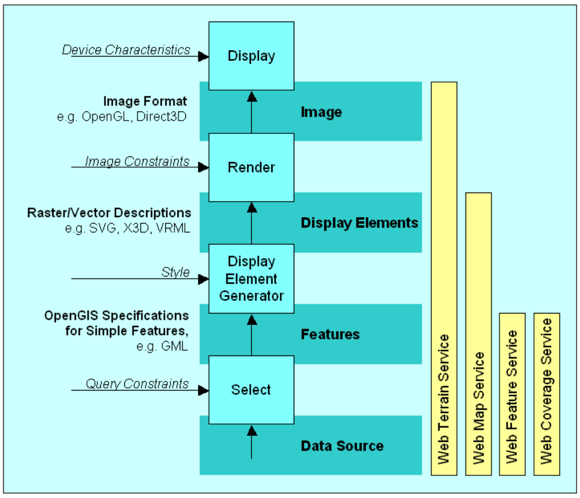

Fig. 3: Portrayal Model for presentation of spatial data (modified from Doyle and Cuthbert, 1998).

The portrayal model separates storage (data source), access (features) and manipulation (display elements), and presentation (image). Fig. 3 shows this separation and the corresponding communication between the different tiers. Possible formats for data representation at the individual tiers are given as well. The bars at the right side represent several OGC Web Services (OGC, 2005) and their integration in this model.

The current OGC standard for *Web Map Services* (WMS) was released in November 2001 (version 1.1.1, Beaujardiere, 2001). Since August 2004, a Draft International Standard of WMS 1.3 is available. According to the specification, a WMS dynamically creates maps of spatially referenced data from geographic information. This standard defines a "map" to be a portrayal of geographic information as a digital image file suitable for display on a computer screen (Beaujardiere, 2004, p. vii). The resulting maps are generally rendered in a pictorial format (GIF, PNG, JPEG and TIFF are supported), i.e. in a rectangular pixel array of fixed size. Occasionally, vector-based graphical elements (SVG, WebCGM) can be generated. Vector-based formats support a scale-independent description of the graphic elements to be displayed (including points, lines, curves, text and images), such that the size of the display may be changed while preserving the relative arrangement of the graphic elements. Almost any currently available Web Services on spatial data support static, pictorial formats, only. Dorninger (2004, p. 49ff.) compares pictorial and vector-based implementations of WMSs highlighting the higher flexibility of vector-based formats considering final presentation and rendering of the requested data.

Web Feature Services (WFS) provide the requested objects at the feature level without any rendering information. Providing spatial data at the feature level has several advantages compared to static (pictorial) formats. E.g. the rendering can be performed client-side, thus, bearing the possibility to consider the requirements of the user. Furthermore, data of different data sources can be combined easily to derive one integrated result-set, finally represented in an arbitrary format.

Unfortunately, providing features raises several problems. Compared to image data, it is very difficult to guarantee the correctness and the consistency of requested datasets. Therefore, it is essential to define a framework of standardized meta-data describing the content of a WFS-result-set. Furthermore, copyright issues have to be discussed. The data is provided in a "raw" format. This allows any kind of further processing and visualization. Therefore, it might become very difficult to control the future application of information once requested.

Anyway, defining a Geo-Data-Infrastructure on an image level would only be a very short time solution. Currently, several countries are preparing digital, three-dimensional land register systems (e.g. Norway, Sweden, Australia, British Columbia/Canada, ...) (Stoter et al., 2004). Providing three-dimensional information using image formats would be very restrictive. On the contrary, providing it at the feature level enables the support of three-dimensional geometries in an appropriate way.

4.4 Schloß Schönbrunn Management System as Standardized Prototype

Fig. 4 shows the conceptual design of the *IFAM*. It consists of three parts: The core *IFAM*, external data sources and a conventional facility management system. The fundament of the *IFAM* is an adequate data acquisition, providing the geometric information in a consistent manner, based on a predefined, topological model. In order to enable the management of historical states, an appropriate data repository is introduced. This is realized as a "snap-shot" representation of distinct historical states. Following the "data at the source model" (compare section 3), several external data repositories (land register, multi-purpose-map, ...) are integrated as well. This requires the availability of these data in an appropriate way: In a standardized format (e.g. GML) at the object level (e.g. WFS). Following the concept of the "data at the source model", actually acquired data is provided to the external repositories (dotted arrows) in order to enable a current state of these datasets. If data is requested from external sources, it is integrated into the *IFAM* as a virtual database. Thus, it is not transparent for the application server, if the data is managed internally or externally. According to the "Portrayal Model" the application server itself will implement OGC Web Services. Thus, it can be used to generate "final" results such as virtual models or proof documents for Cultural Heritage Certification (every Cultural Heritage has to pass a certification process every seven years in order to retain the status of a Cultural Heritage). And it might serve as external data repository for other systems as well.

An additional requirement is to support a future integration of a "conventional" facility management (FM) system. As there are several "of-the-shelf" software solutions available, the *IFAM* is not intended to serve as such an FM-system. But the concept should be defined, so that the *IFAM* and a future FM may communicate using an appropriate interface and thus, support each other without data redundancy.

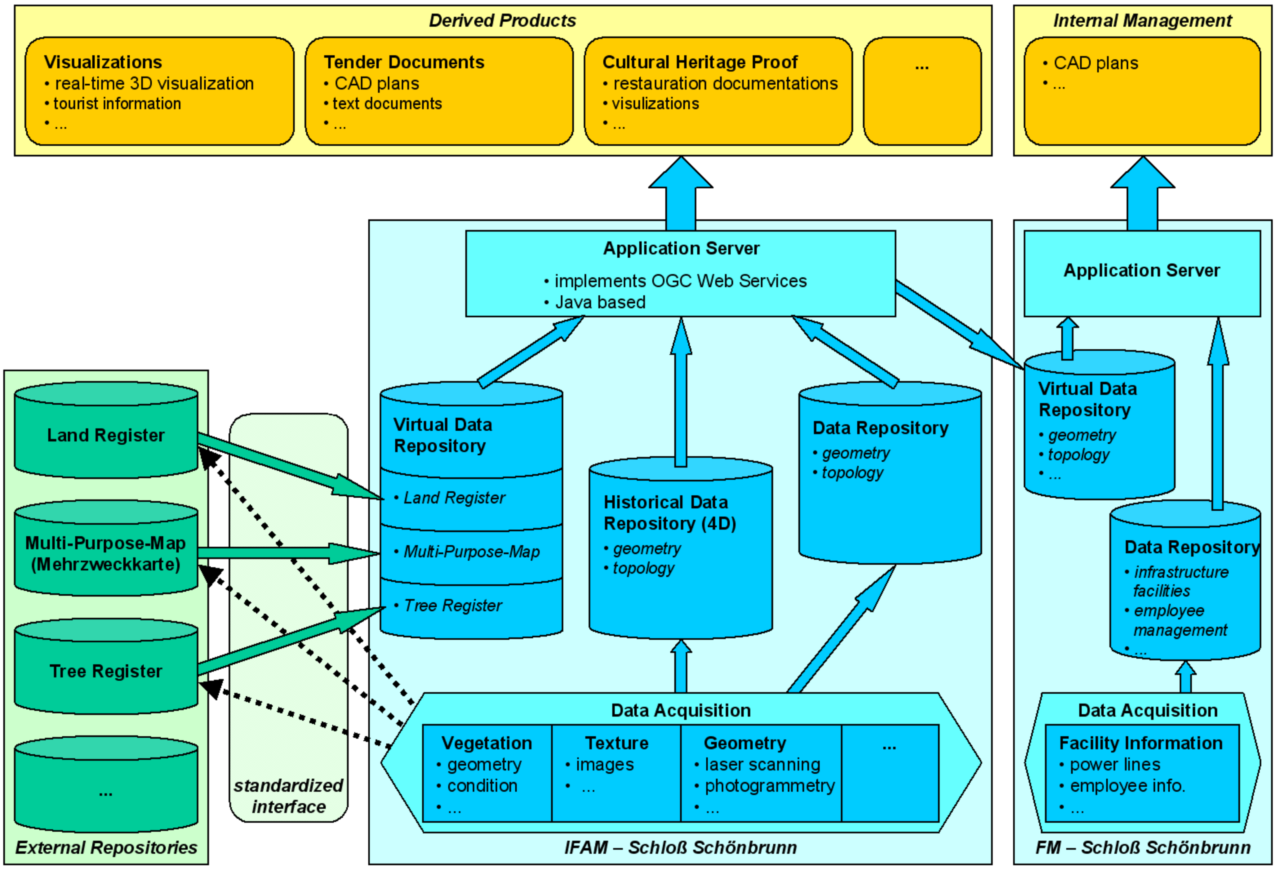

Fig. 4: Conceptual Design of the Integrated Facility and Asset Management System (IFAM) Schloß Schönbrunn.

A basic idea of the project is the integration of the *IFAM Schloß Schönbrunn* in existing public information systems (IS) using standardized interfaces. But most of these systems are currently not available in an appropriate way. That means, the responsible service providers do not support appropriate interfaces or the datasets are not available yet. Nevertheless, the *IFAM* is expected to be a test field for evaluating the conceptual design of such systems to be subsequently applied in a greater context (e.g. a detailed tree register comprising geometric and vegetation information on all trees for the whole city of Vienna).

5 CONCLUSIONS

There are several efforts on the European and on national level to define frameworks for spatial data interoperability. Several nation-wide providers of spatial data (e.g. Britain Ordnance Survey – Master Map) have already implemented standardized web interfaces to their data repositories enabling external data access at the feature level. The standardized availability of such nation-wide (or even continent-wide) spatial datasets would provide the basis for a European Geo-Data-Infrastracture (GDI). A standardized and consistent GDI would have a great impact on the European *eGovernment* and *eCommerce* efforts on the one hand. On the other hand, it might influence and support other systems, as well, as the GDI can be used as external data source. This was demonstrated by concepts for the *IFAM Schloß Schönbrunn*, a geometry-based management system of the *World Heritage Site Schloß Schönbrunn*.

The *IFAM* is intended to support the maintenance and restoration of *Schloß Schönbrunn* in an economic manner. A consistent, geometrical model of the facility enables the derivation of numerous applications. E.g. computer based virtual models of ancient rooms can be used to reconstruct historical states which are no more available in the real world. Another field of application might be a precise management of the park vegetation, based on, geometric models of every individual tree. This can be used to bridge the gap between the strict directives of nature preservation and the preservation of cultural heritage, as the concrete state of every tree can be described.

The following list summarizes the current state of the definition and implementation of a European GDI and its impact on other spatial information systems like the *IFAM*:

a basic framework for a GDI is currently defined by the *European Commision* (e.g. INSPIRE, 2005)

CEN and *ISO* have been or are still working on standards for spatial data management and exchange (e.g. ISO 19100)

standards for two-dimensional data representation are available (e.g. Simple Features)

standards for three-dimensional and complex (topology) features are worked on, but not released yet

OGC provides implementation specifications for Simple features but not for complex ones (are currently at work)

an effective GDI has to be based on appropriate DBMSs

DBMSs have great deficiencies considering three-dimensional and topological object representation and appropriate functionality (Are the currently dominating relational DBMS appropriate to serve as data repository for a GDI?)

considering further application (integration of different data sources) and three-dimensional datasets, it is essential to provide data at the feature level (WFS) instead of image level (WMS)

several countries have already realized first projects (British Ordnance Survey – Master Map, three-dimensional land registers, ...)

Austria has recently started to define a statutory framework for an Austrian GDI

information systems based on spatial data (e.g. the *IAFM*) can be realized more easily, as they can be based upon external data repositories, providing their data in a standardized way on the feature level

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MODELLING FAVELAS
Heuristic Agent Based Models for Squatter Settlements Growth and Consolidation

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ABSTRACT

In the present paper, we argue that the relative location of peripheral spontaneous settlements is dynamic and changes with the growth of the city. The periphery is a place under constant mutation, always reproducing new extensions of land while the old peripheries are gradually incorporated to the city and occupied by new inhabitants. It focuses on the process of consolidation within the urban growth dynamics of third world cities. Our aim is to study, in a heuristic basis, how the global process of urban growth contributes to both the formation of spontaneous settlements and its morphological transformation in time. We argue that the process of consolidation is a feature of the process of spatial growth and, therefore, there is a two way growth process: the urban growth determines the consolidation of spontaneous settlements and this consolidation changes the course of urban growth process, contributing to a fragmented and discontinuous urban form. This issue is explored through 'Favelas', an agent-based model (built in StarLogo for PC) that focuses on the process of consolidation of inner-city squatter settlements within a decentralised process. Preliminary results suggest that favelas are the result of a growth and consolidation process in which resistance is the cause, consolidation is the process and fragmentation is the result.

1 INTRODUCTION

Recent studies have pointed out that the level of consolidation, "the spatial configuration of settlements, and particularly the way in which the site is embedded in the larger spatial structure of the city determines whether the spontaneous settlement is successfully incorporated to the city body or remains 'slum-like'" (Hillier et al, 2000, p.62). Other studies (Mujhika, 2001) argue that the location of settlements, the land use in them, the settlements layouts and the size of the lots within them, all can impact the success of upgrading process.

Actually, when analysing the development of squatter settlement areas in third world cities, one can observe a feedback process: the urban growth determines the consolidation of spontaneous settlements and this consolidation changes the course of urban growth process, contributing to a fragmented urban form.

In this paper spetial attention is dedicated to inner-city squatter settlements, that are located close to the most integrated urban areas and generally present high densities, since most of these settlements are consolidated and have reached the limits of growth (UNCHS, 1982). These settlements are usually bounded by roads, which are highly integrated in relation to the overall structure of the city. Because they develop in spatially restricted non-occupied land, these settlements face spatial restriction, and therefore tend to present a highly dense spatial structure. Besides, the proximity of central sites to job opportunities makes them a more competitive and overcrowded site (figure 1).

In this paper, the inner city squatter settlements development is analysed in two complementary scales, through two agent based models: AxialAgents and Favela. Both models are based in random walk dynamics and are built in StarLogo, a parallel programming tool developed by the Epistemology and Learning Group of the Massachusetts Institute of Technology for agent based heuristic experiments (Resnick, 2000).

Through AxialAgents we discuss the arising and development of spontaneous settlements in a virtual city centre where some aspects of the typical structure and dynamics of Third World cities are reproduced. This process is analysed according to the location of these void spaces (non-occupied land), in relation to the grid structure and to the existence of movement generators. AxialAgents is an heuristic agent based model in which decentralised agents run over an axial lines like environment, searching for available space to settle.

Figure 1 - squatter settlement in Caracas, Venezuela - source: author's collection

Favelas is also an agent based model which simulates (or illustrates), in a heuristic basis, some aspects of the process of settling dwellings inside an non-occupied land surrounded by attractive and non-attractive boundaries. This approach is developed in a closer scale, and is related to the development of the squatter settlement itself. We analyse the growth and consolidation of squatter settlements according to decentralised agent based decisions.

Before going to the models analysis, some considerations must be presented, about complexity as a theoretical basis to agent based models construction.

2 COMPLEX, BUT NOT COMPLICATED

The morphological structure of the city is built from the interplay of different dynamics, offering an extra level of complexity to these systems. As Holland (1995, p.1) suggests, "a city's coherence is somehow imposed on a perpetual flux of people and structures". From Holland's words one can identify two different kinds of fluxes: the flux of people and the flux (or change) of structures. The ever-changing nature of cities, however, seems to require both interpretations for a better understanding. Not only it is necessary to understand the complexity of its structure, but it also seems to be necessary to understand the movement of people in it.

Spontaneous settlements are clear examples of complex subsystems within a complex urban system. Their morphological characteristics combined with their development process are misunderstood as chaotic and unorganised, when complex should be the appropriate designation. And so are Third World cities, traditionally known for their apparently chaotic feature, because their discontinuous spatial patterns and rapid and fragmented development process.

The idea of a structure emerging from a bottom-up process where local actions and interactions produce the global pattern has been widely developed through Emergence based tools and technologies. Although a number of models have been developed using agent-based techniques to simulate urban scenarios, including land use, pedestrian modelling, and so on, the use of agent-based simulation to urban spatial change is not a consensus in the research community. Indeed, agent-based models can arise too much complexity making difficult to track elements and relationships within the model and thus, make difficult any kind of conclusion. But the choice of increasing the degree of complexity of the model or keeping it simple depends entirely on the researcher and the purposes of the model in hand. So, from this perspective, Agent based models are more suitable to simulations focusing on the human behaviour in a given spatial environment. Viewed as such, they open up an avenue for analysis of dynamic processes that link spatial development with social issues. This kind of analysis is of fundamental importance when dealing with cases characterised by a highly decentralised development process as the case of urban growth in the Third World (Barros & Sobreira, 2002).

3 AXIAL AGENTS

3.1 The economy movement of third world cities

The Economy Movement, proposed by Hillier (1996), relates spatial structure to social development. This is the basis of 'natural movement', which is the relationship between the structure of the urban grid and movement densities along lines in an urban structure: "natural movement is the proportion of movement on each line that is determined by the structure of the urban grid itself rather than by the presence of specific attractors or magnets" (Hillier, 1996, p. 161). So, according to Hillier, the structure of the grid itself accounts for much of the variation in movement densities. In this sense, considering a city from the axial map perspective, the most integrated streets would be lined by the most developed areas, while the less integrating streets, as the most segregated areas, would line the poorests areas of the city.

But third world cities are characterized by a typical fragmented structure (Balbao, 1993). The urbanization process in cities of developing countries is often insufficiently planned and poorly coordinated. The morphological result is a fragmented set of patches, with different morphological patterns often disconnected from each other. This fragmented pattern has its origins in the successive superposition of different urban typologies, including planned areas, spontaneous settlements, housing tracts, slums, vacant sites, institutional areas, shopping malls, informal town centres and so on. The Third World city is the result of the combined dynamics of fragments that are in constant mutation and evolution. It is fairly common to find, in highly integrated areas, lots of non-occupied land, some of them being occupied by squatter settlements, as well as less integrating areas occupied by high class private residential areas.

Spontaneous settlements fill some of the gaps in this erratic development, at the same time creating obstacles for any attempts to rationalize the development process and introduce effective land-use control measures (UNCHS, 1982). Spontaneous settlement is not only one of the elements that compose this fragmented pattern but also it is itself a fragmented object, composed by smaller fragments. It lead us to suppose that along with structure itself other complementary elements could be considered when analysing squatter settlements in Third World cities.

According to Pacione (2001, p. 497), "the form of squatter dwelling and their location in the city vary. Most cities have squatter communities in their central areas adjacent to the major employment sources". An example of that spreading dynamics is the city of Kuala Lumpur, in Malaysia. In the figure *2.A* one can see that squatter settlements spread along the main roads of the city, from the city centre to the peryphery. Squatters usually follow jobs opportunities areas, and then look for available and affordable places close to these areas. The following diagrams present some clues about these movement processes. In figure *2.B* - Pacione (2001) - one can observe migration patterns among low-income neighbourhoods in a Third World city. There is a rural migrant flow (A) that leads people to low-income inner-city slums, searching for job opportunities and places close to them. From this point, when no affordable space is found, people move to intermediate and peripheral zones (L2). A similar approach is suggested by the diagram in figure *2.C*, from which one can speculate that "land availability and proximity of high-intensity mixed land use, usually jobs opportunities, are the major controlling elements in spontaneous settlement location" (Dwyer, 1975).

So, despite there is no generally accepted or consensual theory about spontaneous settlement location, there is an agreement that because the discontinuos, fragmented and decentralised growth process in Third World cities, the street pattern itself is not enough to analyse development, as the poor and rich areas are located bothly in segregated and integrated areas. It seems that central business districts, commercial corridors, employment centres, transport connection points (train and bus stations) are complementary elements to be considered along with the spatial configuration of the grid, when analysing squatter settlements development in highly integrated areas. It seems important, therefore, to better understand the consolidation of inner-city squatter settlements (already located in highly integrated areas) to consider, as complementary parameterrs, two key elements: movement generators and people flux. Both of them can be analysed from the agent based perspective.

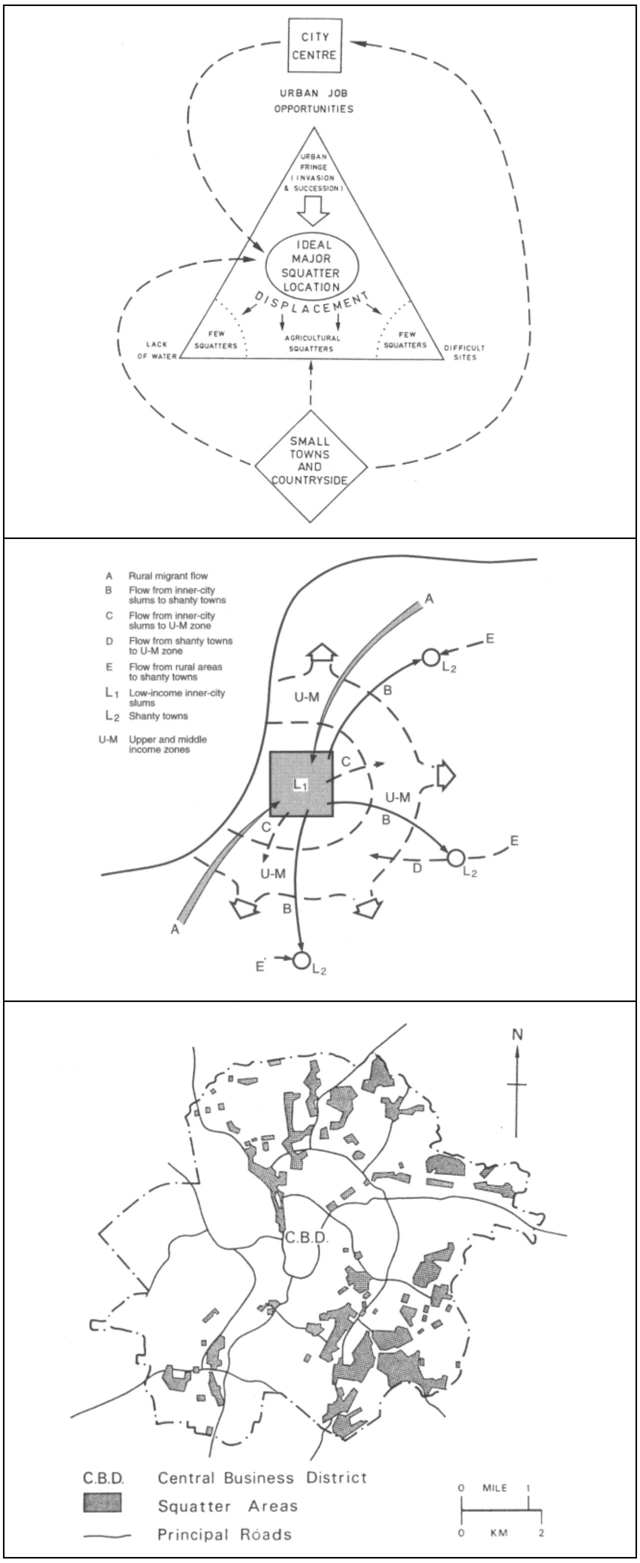


Figure 2 – (A) Top: movement dynamics in Third World cities - source: Dwyer, 1975 ; (B) Middle: migration movement patterns - source: Pacione, 2001; (C) Bottom: Kuala Lumpur squatter settlements map - source: Dwyer, 1975

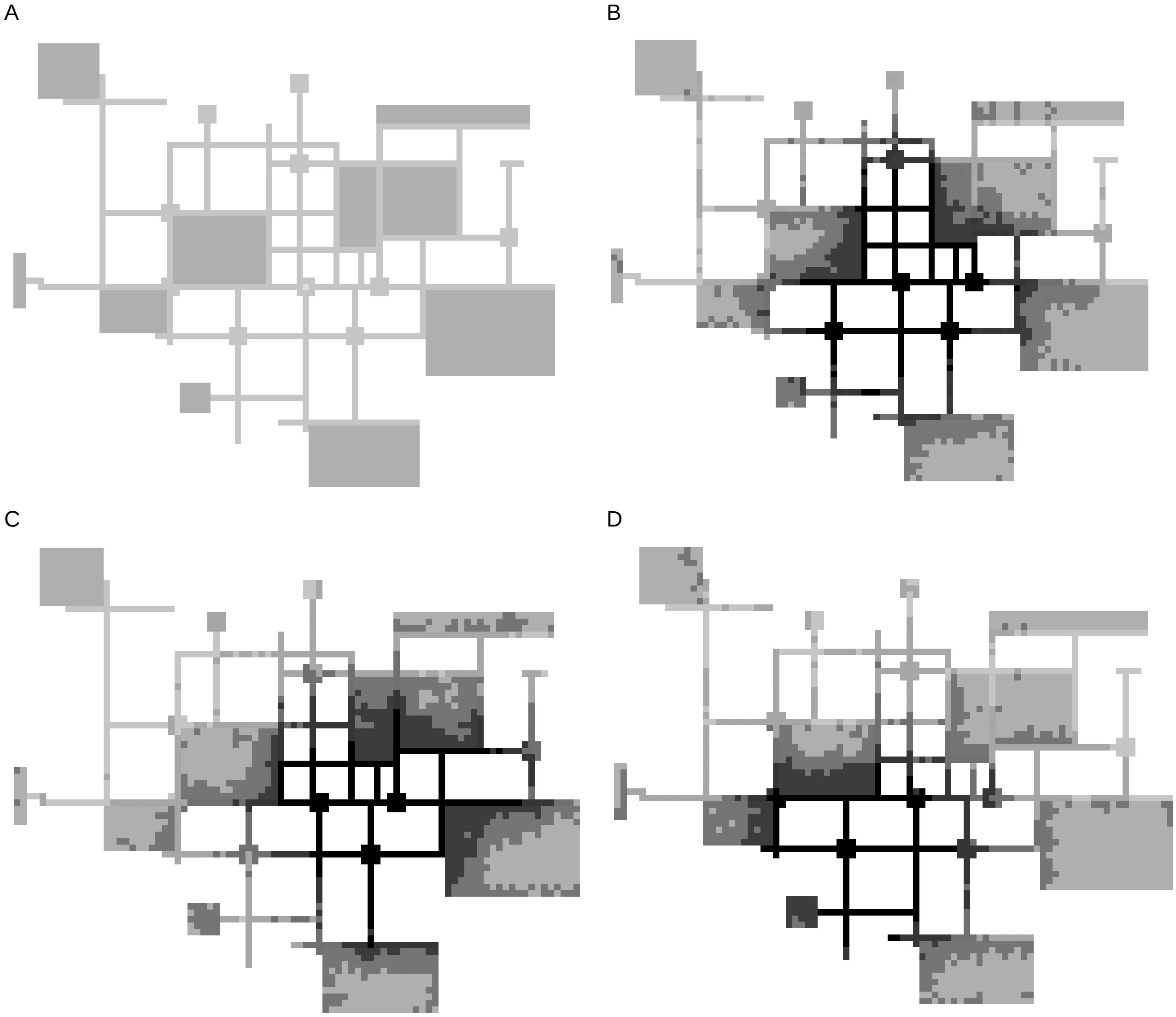
3.2 An agent based model in an axial like environment

Through AxialAgents we analyse the interrelationship between the growth of spontaneous settlements and the movement flows in the urban grid. It is based on random walking agents which are set to search available spaces (in central non-occupied land) to build their dwellings, in an axial like environment which represents a Third World city highly integrated area (city centre, for example).

The agent's movement depends essentially on randomised walking parameters and on the cordinates of movement generators. The model interface allows the user to control parameters, as well as the start up cordinates, the number of agents running over the virtual environment, and the consolidation limit.

The consolidation limit controls an important development rule: it refers to a process in which spontaneous settlements are gradually upgraded, and, as time passes, turn into consolidated favelas or, in other words, spontaneous settlements that are harder to evict. As a result of the introduction of the consolidation logic, it is possible to speculate about differences of development among settlements.

Technically speaking, the consolidation process is built into the model through a "cons" variable (Barros & Sobreira, 2002). This "cons" variable has its value increased at each iteration of the model and, at a certain threshold (defined by the user), the patch turns into the consolidation state (represented in the open spaces by the dark grey cells. In resume, once the "go" bottom is pressed, the model start running and the agents go walking through the axial like structure, surrounded by open spaces ready to be occupied. The user has the option to hide or show the agents while running the program. Another element present in AxialAgent is the "flux gradient", that is a spatial representation of the most visited streets in the system. Each time an agent passes through a cell, it adds value to the flux gradient variable of that cell. The resulting map is a network of streets varying from black (high flux) to light grey (low flux). This mapping process can be used as a complementary tool along with the integration maps of space syntax. Both of them illustrate street hierarchy according to movement patterns. The first one through a dynamic mapping, while the latter by a static graphic representation.



Figures 3.A-3.D - AxialAgents outputs

Figure 3 shows a sequence of outputs originated from AxialAgents. In the figure *3.A*, it is presented the irregular grid that is the virtual environment for the agents search. It is composed by lines and open spaces (both represented by light grey color) and represent a highly integrated section of an urban centre in a Third World city. The following parameters are common to the three experiments shown in figures *3.B* to *3.D*: 1000 agents running in a random walk, defined by an random angle between +93º and -93º;

consolidation threshold: 8 ; and final snapshots at 407 iterations (programming time). The only difference between the three experiments is the start up cordinate. In experiment 1 (figure *3.B*) the agents search starts up from cordinate (0,-3), leading to a development pattern in which 628 cells were left as open spaces and 506 were occupied, resulting in a average density for the overall system of 44%. In experiment 2 (figure *3.C*) the origin cordinate is (12, -3), that is quite close to the previous one, but resulting in a distinct pattern of development. The average density in this case is 53%. Finally, in experiment 3 (figure *3.D*), the movement generator is situated in cordinate (-11,-11), and the snapshot shows a development where 725 cells refers to open spaces, 409 to occupied plots, resulting in a low average density of 36% (probably because the relative low integration of the cordinate).

From the experiments some observations can be made. Firstly, a quite obvious result that is confirmed by the model: by varying cordinates of the movement generators and keeping the same axial lines structure, we find distinct patterns of development and consolidation. This seems to reinforce the pressuposition that movement based on people flux and movement generators can be an additional parameter to be considered, when analysing settlements that present a similar degree of integration in the structure. So, we conjecture that for each new cordinate of generators, there is a new consolidation map and development pattern. In other words, in a real urban centre of Third World cities, even keeping the same axial structure, if some generators (as employment sources, transport central stations, business and services areas) are displaced or inserted into the structure, there will be different in development pattern of informal growth.

So, if through integration maps it is possible to take conclusions about squatter settlements consolidation, through AxialAgents or other similar agent based models it is possible to speculate about development patterns, which will affect their configurational properties, growth tendencies and even details on consolidation degrees.

4 FAVELA

4.1 Growing from the edge

Inner-city squatter settlements grow and consolidate from the edge (Sobreira, 2002). They are dynamic systems and result from the decentralised behaviour of local agents that can be illustrated by generative models based on boundaries as attractors and on emergence as a process. It reinforces a conjecture (Sobreira & Gomes, 2001) according to which in spatially constrained squatter settlement development, boundary is the cause, packing is the process and diversity is the route. The *Favela* project simulates the spatial development of spontaneous settlements at local scale. The experiments are based on randomly walking agents over a cellular environment, constrained by attractive and non-attractive boundaries. This is based on the features of most of the inner-city settlements, which grow in empty sites within urban areas resulted from the fragmented and discontinuous development of Third World cities as described previously. These settlements grow from “attractive boundaries” towards the inner part of the urban site, and the built structure is developed prior to any network and rough foot tracks arise in between built structures and often consolidate, connecting houses to local services situated on the site’s borders (Sobreira, 2002).

In such settlements, the streets of the existent city, which bound the site, tend to attract the development of building structures to the borders. Following this logic, the model’s rules are based on the idea that the spatial development of spontaneous settlements is both constrained and stimulated by the boundaries. In the Favela project the agent’s rules resemble some of the constraints and opportunities faced by actual people when looking for attractive urban sites to settle. The behaviour rules tell the agents to wonder around the site and, when reaching an attractive boundary, find an available place to settle.

Among a number of interface options that allow the user to draw the site and change the parameters of development, the model presents a “feedback” procedure in which the agents are “fed” with information about the environment and, based on that information (as global density, for example), change their behaviour, which in turn drives the spatial development to a different path. The most important parameters are the settling patterns (dwelling tipology), the agents searching features, and the density threshold. *Figure 4* illustrate a sequential output of Favela, in which the site in bounded by attractive boundaries at the bottom and right hand side only.

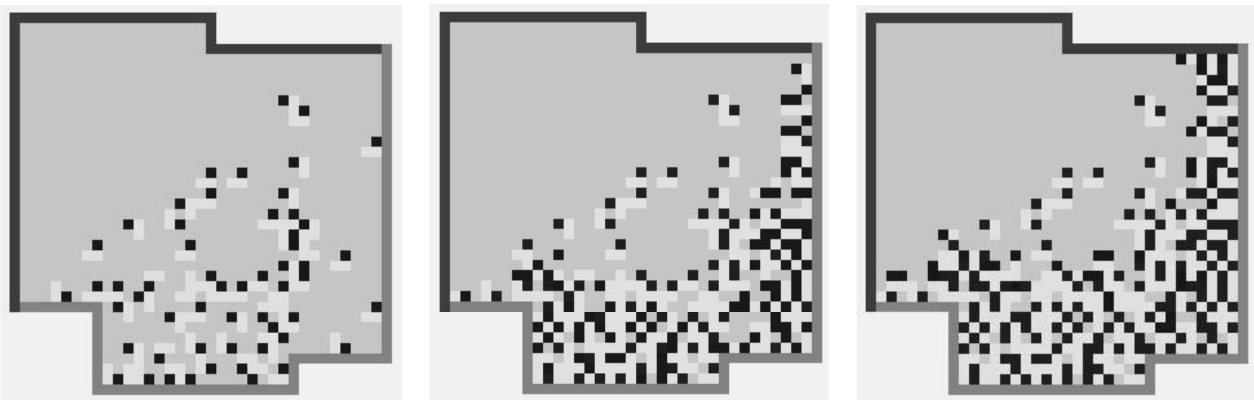


Figure 4 - sequential output of Favela experiments

As one can see from the snapshots, the spatial configuration resemble the development process of a settlement in Acera, Ghana (*figure 5*), starting with isolated building units combined with open areas (left) and as the density increases, the clustering and densification are inevitable (right). As the settlement gets dense and more agents come to the site searching for available space, agents take longer in the searching process, finally settling in more restricted spaces, occupying vacant spaces between existing dwellers and, thus, causing in this case the diversity of size of building clusters. Different initial conditions were also tested, in an attempt to explore to what extent path dependence influences the model’s behaviour.

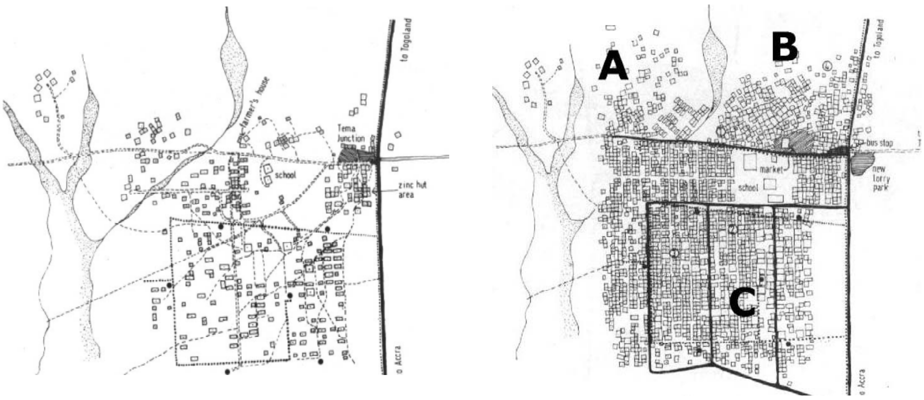


Figure 5 - squatter settlement in the city of Acera, Ghana. Early situation (left) confronted to the consolidated one (right)

4.2 Fragmentation: statistical properties of spatial complexity

In recent years a great deal of effort in pure and applied science has been devoted to the study of nontrivial spatial and temporal scaling laws which are robust, i.e. independent of the details of particular systems (Bak, P. 1997; Batty, M. and Longley, P. 1994; Gomes, M. et al, 1999). In recent work, Sobreira e Gomes (2001) show that spontaneous settlements tend to follow these scaling laws in both scales, local and global. This multiscaling order is analysed here by a fragmentation measure which is related to the diversity of sizes of fragments (built units) in these systems. Diversity is understood here as a measure of complexity (Gomes et al, 1999) and an expression of universal dynamics. In the settlement scale the fragmentation pattern refers to the diversity of size of islands (cluster of connected dwellings).

Figure 6 presents the maps three squatter settlements showing in black the islands formed by groups of houses. The *figure 7* presents three samples run through the Favela project. The snapshots are related to the time when the development reached approximately the same number of houses of the real settlements of *figure 6* (around 250 dwellings), what allows a more precise statistical comparison.

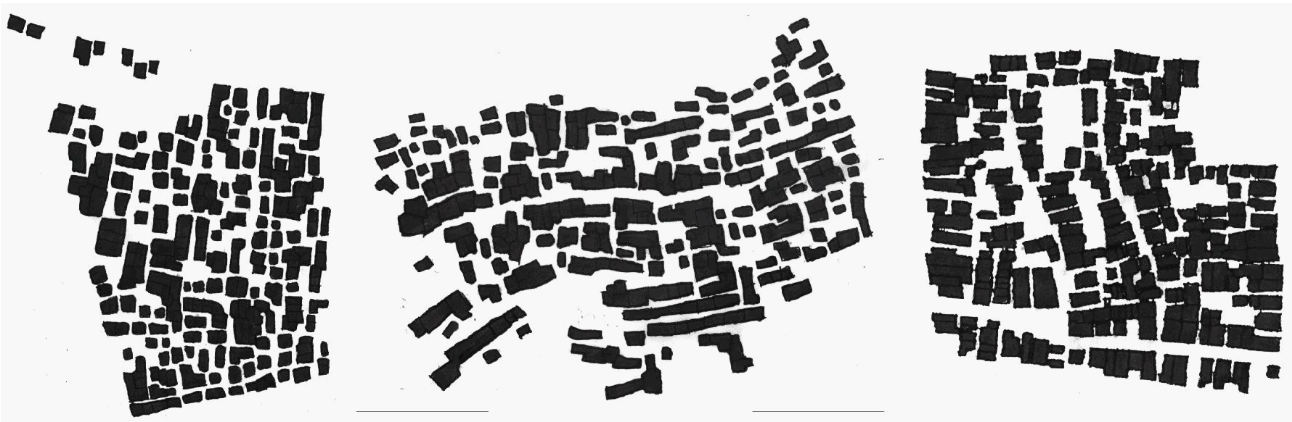


Figure 6 - graphic representations of three squatter settlements situated, respectively, in Bangkok - Thailand, Nairobi - Kenya and Recife - Brazil.

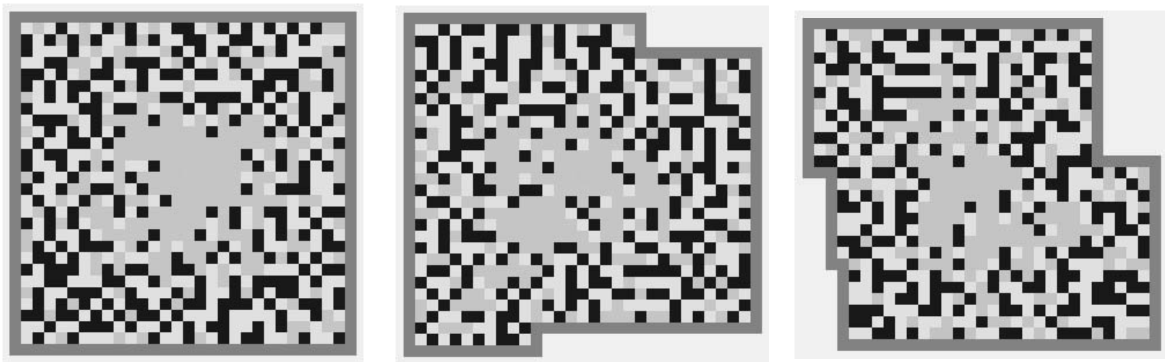


Figure 7 - Favela snapshots

The graphs in *figure 8* describe the correlation between the frequency of islands "f(s)", according to its size "s". The discrete variable "s" gives a measure of the size or area of an island (group of interconnected houses). The scaling distribution found for the settlements in Figure 6, represented by the graph of figure 8.A, is statistically the same that is related to the settlements generated by Favela (figure 8.B), which reinforce our conjecture, which connects boundaries, packing and diversity as the interrelated key aspects to the internal development of squatter settlements. The distribution f(s) in both graph of figure 8 obeys a scaling relation given by $f(s) \sim s^{-\tau}$, with $\tau = 1.6 \pm 0.2$. The exponent τ is robust and refers to the degree of fragmentation of the settlement. The negative exponent τ indicates a non-linear scaling order, in which there is a great number of small units (islands, group of houses), a small number of big units, and a consistent distribution between them.

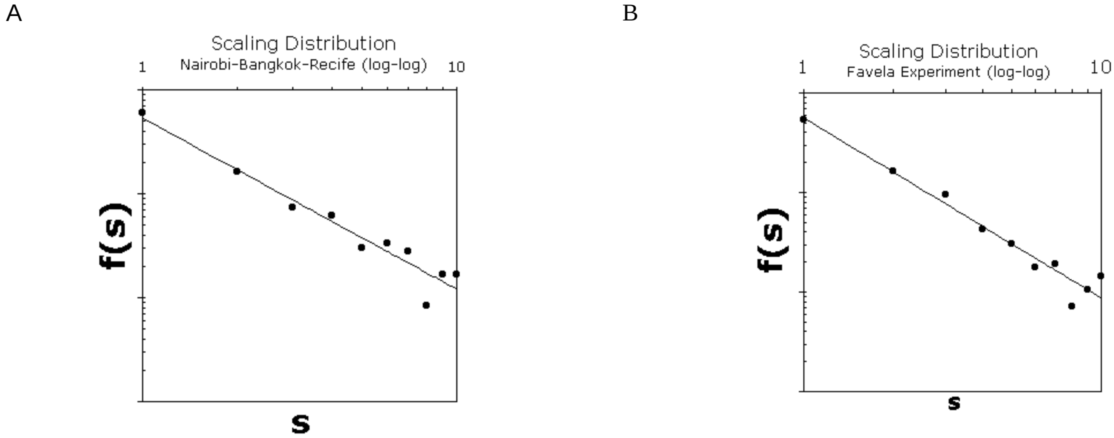


Figure 8 - Fragmentation analysis: (A) Scaling distribution - settlements in Bangkok, Nairobi and Recife; (B) Scaling distribution - virtual settlements generated by the Favela agent based model

Fragmentation measures come as a way to compare the result of experiments on the dynamic processes, that is, on how these systems behave in time and space with the patterns found in empirical examples. In this aspect, we argue that such similarity of patterns is clearly an empirical evidence of a decentrilised process of development of inner-city squatter settlements, which leads to a fragmented pattern, growing from the edge.

5 CONCLUSIONS

From the AxialAgents experiments, preliminary results suggest that it seems to be important a complementary analysis considering flux and relative location of movement generators to better understand the squatter settlements development dynamics. This approach can be complementary to axial lines based analysis, adding a dynamic view to that static perspective, despite some mathematical validation to the model would be usefull.

Regarding Favela, experiments led us to come up to a suggestive indication that squatter settlements decentralised dynamics can be simulated by agent-based models, which can describe the fragmented features of these self-organised systems. In this dynamics, boundaries play an important role in the settlement development, which occurs through a decentralised packing process and results in a robust and universal fragmented pattern. Statistical analysis based on Fractal Geometry, presented in 4.2 is suggested as an way of mathematical validation of this model

It is important to stress that both projects were built with strictly speculative purposes. They focus on how simple local rules generate emergent and complex structures. In other words, how do people without collective leading, searching for a place to settle their own houses, are capable of building such intriguing and surprisingly complex spatial structures.

Naturally, as it is suggested by Pacione (2001), the subsequent development of the squatter settlement into a settled community is a complex process that is related to the socio-economic status and motivation of the inhabitants and dependent upon the attitude of the government towards illegal settlement. Speculations presented in this paper are centred on rather specific spatial aspects of such complex and multifaced urban dynamics. Therefore, both AxialAgent and Favela models are set to be complementary (and not exclusive) tools for spatial analysis of decentralised and dynamic urban process as those related to Third World cities.

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eParticipation in Narva, Estonia, towards sustainable urban development

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ABSTRACT

The paper is based on the premise that the use of Internet and Communication Technologies (ICT) in government has the potential to increase citizen participation leading to greater transparency, more democratic decision-making and reaching sustainable development. However, the development of an equitable, functional and participative decision-making structure based on ICT has to address a variety of aspects. The eCommunity project, which will be presented, promotes more transparency in decision-making in the city of Narva, Estonia, and therefore aims to develop a more effective dialogue between administration and town inhabitants and better understanding among the public of decisions adopted by the municipality.

This paper presents the results of interviews conducted with the municipal administration of Narva in 2004, adressing the issues of trust, access, institutional change as well as will and time to participate, for the successful implementation of the eCommunity tool.

How can we cope with the possible excessive demands, information and knowledge needed and the complexity of any online tool?

Within the scope of the eCommunity project we research conditions for a broader and more effective participation with the help of ICT, in order to reach sustainable development at all its levels (ecological, economic, social).

1 THE ECOMMUNITY PROJECT

1.1 Project description

The objective of "e-System for real Time Democratic Land-Use Planning of Urban Environment – Pilot Action in Narva Municipality" (eCommunity) is to promote sustainable and democratic urban planning by using opportunities offered by information technology and WWW. The project is applying innovative web-based software solutions to make information on urban planning and development available to the citizens of Narva as well as to interested organizations and persons internationally for promoting public involvement into decision-making on issues of local development and to increase investments in Narva. It is aimed that the project will demonstrate the use of the system as a tool for urban planning; if this project experience is positive, the same tool could also be used in urban planning in other cities across Europe.

The eCommunity project promotes therefore more transparency in the decision-making process in Narva and offers a) a window of opportunity to the municipal administration to develop a more effective dialogue with the town inhabitants and b) better understanding by the citizens of decisions adopted by the municipality. Creation of the eCommunity web-based information system implies development of a "virtual reality", where the town spatial plans drawn by specialists will have their own 3D spaces, realistic models of the planned area, which can be virtually walked through, and where citizens will have possibilities to make additions and corrections to the plans and transfer them to a new 3D model representing the recent changes. The system is planned to be able to accept user requests in a fuzzy human form and convert it to a specification of what is to be displayed and how.

This IT-tool will allow synthesizing concrete decisions from statements made by citizens, giving the decision-making process a new democratic identity in real time. The system, available on internet, is developed tailor made to needs of specific stakeholder groups and will includes components such as an "investor web" or a "tourist web". The system includes a range of thematic information sub-systems, such as a city master plan, a bicycle path plan, a public transport agenda; a thematic park of old town; and more.

Sustainability Issues will be considered in the tool: the social side with participation in decision-making, the econmic side with the adressing of potential investors in the region, the environmental side with dealing with the follow-ups of the enourmous environmental problems, produces by the oil-shale power plants, the institutional/cultural side in challenging the existing institutions to adapt. The underlying principle of the project is sustainable urban development: this tool shall be a helping hand towards it.

1.2 SERI Tasks in the project

SERI undertakes several tasks in the project: the main responsibility is, to monitor the project deliverables in respect to sustainability issues. Further we evaluate the interim results of the project and act as an advisor providing guidelines and background information, so that the project can actively contribute to a sustainable development of the region.

One major task of the project is "involvement of the citizens". The aim of this task is to create the preconditions for more transparency and democracy in the local urban eGovernance System. The hypothesis is that more transparency – within that project through the help of Internet and Communication Technologies – will lead to more participation, and therefore lead to more democratic, dynamic and sustainable decision-making processes at the municipality level.

The success of the eCommunity project will depend on the level of political commitment by the local authorities to involve local stakeholders into the decision-making process regarding issues of urban planning. Only the commitment of the municipality to an open, transparent planning process and the readiness to provide human and financial resources in time can lead to creating interactive and dynamic communication processes with the citizens.

The focus for this paper will be put on the issue of eParticipation, in order to follow the intentions of creating more transparency and interest in decision-making of the municipality.

2 METHODS - QUESTIONNAIRE DEVELOPMENT, AIM, EXPECTATIONS AND FURTHER USE

For this reason, we conducted interviews first with representatives of the municipal administration to get information on their expectations and needs besides the technical solution, to allow creating a tailor made tool. The plan for the further progress of the project is to interview administration and citizens before and after the implementation of the new eTool, to receive feedback about the eParticipation expectations, possibilities and actual use. Only then an online tool can be successfully used, and contribute to sustainble participation solutions in urban planning.

In that context SERI has developed a questionnaire to evaluate the actual state of eGovernment and eParticipation in Narva and how these preconditions influence the implementation of the new eTool. The questionnaire is standardized with partly open and partly closed answers and and covers questions about citizens interests, technical questions about the current system, questions about sustainability strategies and data, and questions related to economic and administrative processes in the city. The answers given were assembled in a table and analyzed, the results are supposed to help design the process of promoting the tool and for the needs of training sessions.

These questionnaires are also used by Peipsi, a local NGO and project partner, conducting the training sessions for the system for the municipal staff. With the answered questionnaires and additional informed group discussions with stakeholders, to be held in March 2005, the status-quo can be evaluated, while after transforming the questionnaire into a checklist for the municipality the progress of eGovernance and participation in Narva can be further evaluated.

The interviews we conducted had a major bias source: the language, as they were translated twice (from English to Estonian and back to English). Further, over 90 % of the inhabitants of Narva speak Russian as their first language. We helped us with task sharing and thanks to the translation work of Peipsi could get results.

3 RESULTS OF INTERVIEWS WITH THE MUNICIPAL ADMINISTRATION IN NARVA

We conducted individual interviews in August 2004 in Narva: We interviewed three individuals of Narva Municipality and one representative of a local NGO as basis of comparison, if the requirements and perceptions differ between the administration and the civil society, and to be able to put the answers into perspective. They had revieved the questionnaire beforehand, the open questions then were asked in an interview situation and were transcribed and translated by project-partner Peipsi.

3.1 The socio-economic situation in Narva

First, we posed questions to the economic, social and environmental dimension of sustainability, and the relation to the possibilities of improvement the eTool offers.

3.1.1 The current situation in Narva:

The economic situation

All interviewed persons named different businesses as the main important ones. Textile is the most named, followed by transit, tourism and energy. The border location to Russia (with the Russian speaking inhabitants and the low local labour costs) is commonly seen as the big plus for addressing investors.

The business sector can communicate its needs well with the municipality: For special issues round tables are organised including stakeholders from businesses and the City.

Of special interest for eGovernment issues are the already existing privatisations and public private partnerships, which are common in Narva. Reported was that the privatisation of City businesses needs some improvement and no IT related services are used yet.

The social situation in Narva

The manyfold social problems of Narva were always present, but not explicetly listed in the interviews. For giving a complete overview about the situation it is necessary to know, that the social situation is very harsh: The unemployment rate is very high, leading to poverty. Further the town suffers from heavy narcotic abuse and smuggling, as well as a high HIV rate among the inhabitants and the cultural separation – as 96 % speak Russian as their first language – from the rest of Estonia. This percieved seperation results also in the feeling of many citizens, that their voice stays unheard. Consumer satisfaction is not sampled regularly according to some officials, but there are yearly social surveys about citizens' opinion on city development.

Unemployment was mentioned as the major problem in the city, which was also sharpened in recent years by the restructuring of the biggest employer in Estonia, a textile company located in Narva. One interviewed person expressed hope for reducing unemployment by the development of tourism and by attracting investors. Citizens communicate with the municipality via demonstrations in front of the town house or signature collecting, which was not seen as an effective way of communication by the administration.

The environmental situation

The environmental situation in Narva is influenced by the economic growth, increased urbanisation and transport in the new member states, which results in a rapid increase in greenhouse gases emissions. Nevertheless, in Narva also the remainders of past environmental damages are still present: The environment of Narva is threatened mainly by two local power plants burning oil-shale, which are the principal electricity generating plants in Estonia, but have a desastrous local and regional impact due to fly ash and alkalisation of soils, as well as atmospheric SO_2 emissions. Further the emissions of the textile company and air quality were mentioned as environmental problems.

3.1.2 Strategies for sustainable development:

According to all interviewed persons, Narva has no specific strategies related to sustainable development.

However, the interviewed all mentioned, that Narva compiled a development plan for 2004–2008, which includes some of the relevant sustainability issues. It covers issues like transport and waste, and has a social development strategy for improving the social situation and a public paticipation plan. This development plan was compiled because of state requirements. The representative of the local NGO said, that Narva lacks strategic thinking, but instead concentrates on day-to-day problem solutions. Further the City would lack a common goal or vision. Allthough there are also no strategies for overall environmental sustainability, the city concentrates on the issues air quality and waste. Narva wants to invest in a waste seperation plant.

Some important issues, which were mentioned for sustainable urban development are: to battle unemployment, land ownership (as a lot of land is state owned and not by the municipality), and the attraction of tourism and business to help chancing the social situation.

3.2 Existing web-based information system

Further we asked questions about the technical side of the current web-solution of the municipality and its usefullness for participation.

3.2.1 The technical content of the current system:

Overall the administration is more content with the current system than the private user. The satisfaction with the quality of the provided data is better average. The issue considered worst is the up-to-dateness of the data provided. Quality of writing and the accuracy of the data provided was rated highest, the quantity of the provided data was rated lowest by the interviewed.

The minimunm elements of an online tool were indentified in previous best practice research and checked against the current webpage: The current webpage lacks a calender, regular updates, newsletters on (topic specific) updates, opinion surveys, an on-line library for sustainable urban planning, online tutorials and an easily manageable document search form.

The most different opinions were stated in the possibility of all inhabitants of Narva concerning access to relevant information, where the administration side was quite satisfied and the private interviewee was not. Documents are claimed to be missing in English.

3.2.2 Present state of eGovernance in Narva community:

The set about the present state of eGovernance in Narva was posed to get more information about the fields of administration the City covers. In the field of services offered by the municipality, we were most interested in the existing 2-way interactions and full electronic case handling. At present there is none of those available on the Narva website. One way interactions, like downloading papers and forms are available for online applications and online consultation possibilities, as well as access to local politicians. Information only is available for: civil registration system, health system, pension system, civil benefits and educational system, tourism system, GIS and transportation system, public procurement. In the responsability of the City of Narva lie far less issues, then we would consider as in the power of the local government (labour system, birth certificates, personal documents..).

3.3 Expectations for the eCommunity tool:

For getting an idea and also support the discussion about the eCommunity tool we asked about the possible future. The rationale was that IT tools are not in the perception of the active administration now, but this might change over time, a the youth uses the web and ICTs in its everyday life (Vedder, 2004).

3.3.1 The administrative processes:

Language is not percieved as a problem in communication, as virtually everyone of the City staff is bilingual. The most common information channels about city issues now are newspapers, text TV, local radio, (all in both languages), all are typical one-way communication systems. Remarkable is, that no one mentioned the internet as a common information source for the citzens, but for promoting the eCommunity tool the internet was nevertheless favoured. The inhabitants have a strong connection to Russia, but know less about Estonian issues. Calls, letters or personal contacts with the municipality (2-way interaction) clearly range further down the scale. The administration expressed some incontentment with one-way communication, because they want to receive more feedback than now from the community for their actions. They do not consider one-way systems in combination with personal lobbying as effective modes of communication.

A chance for improving the communication would be – according to the interviewed persons – an up-to-date electronic document system or discussion forums on the City homepage, for face-to-face contact, the holding of info-days were suggested. There is also a need seen for applying the same processing rules for emails and online requests as for letters.

Another issue is the possible connection of the access to the eCommunity tool with an Estonian ID-card, then many non-citizens or Russian citizens might be disadvantaged. We could not get a clear response on the topic of ID cards. According to two persons, non-citizens are equal before the local law.

3.3.2 The citizens' interests:

There is a need seen for computer trainings for the citizens, and to improve public accessible computers, in particular regading special user groups like handicapped people. The opinion regarding the transparency of administration actions or the ease to give feedback to the administration, or to participate in urban planning differs a lot among the interviewed. The administration consideres the content offered on the webpage less interesting than the citizen did. It is seen as easy to give feedback to the municipality, but it is perceived as difficult to influence the decisions or actions of Narva. In particular the possibilities to participate in urban planning decisions are seen as lacking from both administration and citizen.

It was stated, that the internal commmunication and coordination between the departments and the current web-system is not functioning well enough, on the other hand the communication with the citizens needs to be improved, as well as the deliverance of information about Narva for tourists and investors. At the moment, citizens can communicate their problems in person and by phone or mail, wich favours only a certain part of the citizens.

None of the interviewed is totally satisfied with the current situation in any field, this result confirms the results of previous surveys and justifies the implementation of the eCommunity project.

3.3.3 Promotion of the eCommunity tool:

For better contacts between the administrative bodies itself, a functional internal system or at least the set-up of an emailing-list was desired by the interviewed. According to them, this has to go hand in hand with intensified training activities, which now only for single departments exist. Further the need for a person or group who clearly is responsible for maintaining and updating and running the system, was mentioned, otherwise the system would die out.

For the eParticipation features of the tool further rules and aspects, which need to be considered, were named: clear regulations how to deal with online requests, differentiated approaching of different groups, to gain the will and trust of citizens to use this form of communication. As the planning tool is supposed to be in the possession of Narva municipality, the system design needs to be easily maintainable also by non-specialists. A need for better guidelines how to use the new system in sence of more efficiency towards sustainable urban development and planning was argued.

4 DISCUSSION

4.1 Sustainable Urban Development

Sustainable Urban Development (SUD) is defined as “a complex system of legal, economic and other incentive systems, methodologies and tools, data and information resources by which society provides the necessary and appropriate support for efforts by individuals and cities to implement sustainability" (see Paskaleva, Curwell et al. 2002). To reach SUD cities need to be economically efficient, socially integrated and environmentally friendly if they are to provide good quality of life in order to survive and prosper (see Curwell et al. 2003). In order to reflect the aspirations of all individuals and groups of society interactively and interdependently, sustainable development has to comprise the ecological, the economical, the social as well as the cultural dimension.

4.1.1 The environment and resource use dimension

In the networked knowledge society, the use of ICTs is believed critically important for dematerialization of production and consumption, of lifestyles, for corporate responsibility and for sustainable communities (European Commission 2002). Information systems play an essential role in reaching **environmental targets** for sustainable development. (Club of Rome, 2003). The eCommunity system creates the first system in Narva, which is able to funcion as an exchange hub with other ICT city management systems. Furthermore the eCommunity system will reduce the amount of physical transactions, will collect environmental data to conduct analyses in depth, and will support communication with unprecedented coverage and efficiency.

4.1.2 The social and cultural dimension

Equity and social cohesion are prerequisites for building sustainable communities as well as motivating the local population. (Club of Rome, 2003). For sustaining networks, and to create the political and social support to implement policies successfully and to create the communication strategies within and between the administration and the citizens are considered key to success. Sustainable development can according to a **local Agenda 21** process be reached in close cooperation with local stakeholders. Development cooperation requires an approach involving all actors, which ensures that innovations are firmly anchored institutionally, and which brings together economic, ecological and social negotiating processes on future policy at local level (local governance) (BMZ,2001).

The role of the eCommunity system is, to improve communication and information exchange, to avoid that ICTs reduces the opportunities of weak social groups to take part in an LA- process, and additionally to improve the integration and participation of young people (and women) in the local development processes.

4.1.3 Local economic development

Promoting ICT is seen as an opportunity to improve local economic development, as the development of new industry and employment opportunities may generate positive impacts on sustainability. Both private and public sector organisations play an important role: Their understanding of an online economy and new ways of working will be a key factor for local economic development. Through informed group discussion with local stakeholders the needs and requirements for the local situation has been taken into account. The results have been implemented into the design of the interface as well as in the design of functions of the system.

4.1.4 eParticipation

It is clear that new efforts are necessary to strengthen or restore the role of Europe’s cities as places of social and cultural integration, as sources of economic prosperity and sustainable development, and as the bases of democracy. According to our findings of best practice case studies from throughout Europe (Hester, 2003) at least the following requirements for the success of an eParticipation tool need to be addressed: Access, trust, institutional change, and eInclusion. These best practice studies of eGovernance systems show, that the dynamic of participation is one crucial factor of success for those systems. One one hand, will and time of citizens to participate, on the other hand will and time of politicians/administration to change power structures remain crucial. The demands for a dealing with an complex system are high, but a tool cannot supplement a non-functioning participation in real life. A prerequisite is, to deal with the information and knowledge needed in a way, which not excludes citizens from the process and wich fosters trust in the actuallity, and correctness and usefullness of the given information and decision possibilities.

In the responsability of the City of Narva lie far less issues, then we would consider as in the power of the local government, this might be influential on the development of a public private partnership eGovernment system. We see a need for other communication and promotion modes as the internet for the tool as well, so as to act inclusive. A first eParticipation process could be the common creation of a vision for the future (sustainable) development of the city – in accordance to the development plan prepared by the city.

Participation is one solution for solving complex (governmental) matters and in particular implementing them based on a broad consensus between all relevant stakeholders. For facilitating interdiciplinary, participatory processes with those stakeholders, a well functioning form of communication is basic: the eCommunity tool represents a new form of broad communication and is therefore in a region with language and cultural diffenrences one possiblity for making participation a success.

5 ACKNOWLEDGMENT

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Measuring Seasonality in Central Europe's Tourism – how and for what?

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ABSTRACT

Based on the intensity or quality of tourism, the concept of 'seasonality' describes the unevenness or fluctuation during the course of a year, with the 'season' including (at least one) peak period. Such seasonal fluctuations in Europe, which are mostly influenced by seasonal climate changes, are quite common. For the tourism industry, this factor is very important because of utilisation of tourism infrastructure and effects on a region's economy and employment. Nevertheless, the characteristics and measures of tourism seasonality, compared over different regions, are not well known; problem analysis and a search for solutions in the competition of tourist regions are coming more into use, but so far only on a regional level.

This investigation is based on dates from arrivals and overnight stays in the 142 "Tourism Areas" of Germany and the 36 NUTS-III regions of Austria. It includes first, tourism seasonality based on various indicators and then with the help of a Cluster Analysis arranges them by region to various types of seasonality. The results only partially match the expected tourism types (e.g. city tourism) based on regional (tourism) characteristics. This gives an approach for a study, which classifies an interregional comparison of tourism areas and finds methods for solving related problems over a wider regional context.

1 WHAT DOES SEASONALITY MEAN?

1.1 The Etymology of 'Season' and 'Seasonality'

The concept of 'season' stems from the french word 'saison' which represents an ideal or favorite business period. 'Saison' is derived from the Latin word "satio" = (time of the sowings) (Duden 1989) and therefore has its roots in agriculture. One current key-meaning of 'season' is based on the definition found in Duden (ibid.) which defines season as "the most important period within the year, in which some certain things are abounding". A similar definition is found in the Merriam-Webster Dictionary (1993). In both dictionaries, the various examples illustrate the themes of climate (rain season), animal life (wandering), agriculture (the harvest of specific products), society (opera season) and tourism (travelling to a certain area).

The concept of 'seasonality' is neither in the named, nor in other known encyclopedias (e.g. the German encyclopedia, "Der Große Brockhaus") or found in professional/technical terminology (e.g. Spektrum Lexikon der Geography 2001/2002). It is, however, well documented in tourism research, especially in North America and northern Europe (e.g. Bar-On 1975, Butler 1994, Baum & Lundtorp 2001, Koenig & Bischoff 2004), as well as in Austria (e.g. Bundesministerium für Wirtschaftliche Angelegenheiten 1998). It is obviously derived from the adjective 'seasonal' = "concerning the season; affected by the season" (Duden 1989). It also refers to the existence of uneveness or fluctuation during the course of the year, which occurs in relation to a specific season.

1.2 Causes for Tourism Seasonality

Seasonality in tourism is caused by two basic elements, one, which is 'natural', and one which is 'institutionalised' (Bar-On 1975), that, in some cases, are linked to each other. The first relates to regular temporal variations in natural phenomena, particularly those associated with climate (temperature, rainfall, snow, sunlight, etc.) and the true seasons of the year (phenological aspect of land cover). Travelers have specific preferences which makes it necessary to distinguish between different types of tourism (bathing-, hiking- or ski vacations).

The second form of seasonality depends on social factors and policies concerning specific costumes and legislated holidays. Early examples include certain religious holy days and related pilgrimages made. There were also trends among the higher social classes to divide the year into specific 'seasons': Winter meant staying in town, while summer was spent on country estates, and included activities such as farming and hunting (so called "villeggiatura" in Italy). Later, in the 19th century, winter seasons were spent at spas or on the mediterranean coast. Thus, for the privileged elite it was considered socially necessary to participate in selected activities which took place in seasonally different locations (Butler 2001).

In the 20th century, especially in the age of mass tourism, vacationing often depended on school, industrial and public holidays, which, even until today, have been based on historic conventions (e.g. agriculture high seasonal working periods) and climatic condition adjustments (e.g. summer heat). Today, about half of the population is dependant on school holidays for planning their holiday trip (Kessler 1990). The staggering of school holiday times over different regions (federal states of Germany and Austria) has, to a certain degree, compensated for seasonal variations.

1.3 Implications of Tourism Seasonality

Seasonality "may be expressed in terms of dimensions of such elements as numbers of visitors, expenditure of visitors, traffic on highways and other forms of transportation, employment and admission to attractions" (Butler 2001, p. 5). The phenomenon may also cause overuse as well as under-utilisation of resources and facilities. Seasonality can be considered as a major economic problem for the tourism industry, not only because of low returns on investment and problems caused by obtaining and employing full-time staff, but also because of the temporal effects from heavy traffic and the exhaustion of infrastructure and natural resources such as water consumption (Ball 1989, Ashworth & Thomas 1999, Krakover 2000).

For this reason, it is for Butler (2001, p.5) not surprising, "that considerable efforts have been made by both public and private sectors to reduce seasonality in destination areas through a variety of approaches." This has been done not only by promoting economic development, but also by adressing regional planning and policy making. He furthermore confirms that (ibid., p. 5 ff.), "there has been relatively little research devoted to this topic which has been published in academic literature. (…) Comperatively, few detailed studies have been made of its nature or on all of its effects. Problems still exist in identifying the basic causes of this phenomenon, such as the reasons for its persistence, and its measurements. (…) Equally little research has addressed the problem of whether seasonality varies in nature and intensity on a spatial basis either within or between destiantion areas, although there has been speculation that this has been the case." Finally, there is no scientific concept or theory on tourism seasonality (Lundtorp 2001, p. 23).

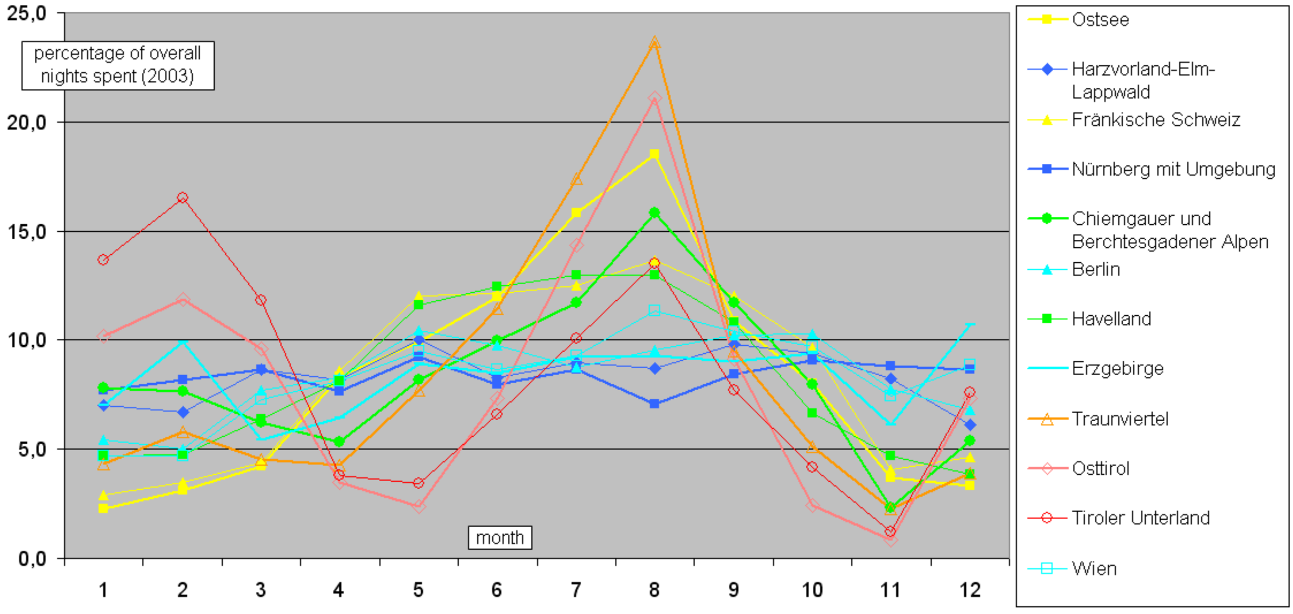

Fig. 1: Yearly curve (2003) of nights spent in investigated tourism areas (see area types in section 3.3).

1.4 Some Usual Presentations of Tourism Seasonality

The interrest in research on tourism seasonality depends on the magnitude and effect that seasonal fluctuations have for a region or national economy. It is therefore amazing that, despite the social-economic importance of seasonality, a substantial deficit still exists concerning research on the characteristics and extent of tourism seasonality in Central Europe, especially in Germany.

The depiction of seasonal fluctuations in tourism is mostly limited to the following indicators and graphic representations:

the number (single peak, two-peak or non-peak patterns, Butler & Mao 1997) and timely order of the respective seasons and their duration;

the ratio/relationship of summer- and winter seasons in the form of a simple statistical measure (e.g. Kessler 1990, Smeral 1994);

the annual curve, based on monthly values, graphically presents a more simpler format (e.g. Bundesministerium für wirtschaftliche Angelegenheiten, 1998).

These types of representation make it possible to recognize, to a good degree, the course of seasonal variations. However, the extent of seasonality cannot be fully explained and they only allow a limited interregional comparison; a typecasting of regions is hardly possible.

2 THE DATA TO EXPLORE SAISONALITY

2.1 Research Area and Regional Research Units

The following study of tourism structures in Central Europe covers an axis stretching from the high mountainous Alpine regions to the coasts of the North and Baltic Seas. The entire territories of Germany and Austria where selected because they have traditional tourist destinations and corresponding data for both countries are available on a regional basis.

Tourism data is reported in both countries for those represented municipalities ("Berichtsgemeinden" in Austria) and enterprises which have a minimum standard capacity for tourism. Data for both countries was collected and published by their respective statistical state and federal offices. Aggregations were made at the communal, state and federal levels respectively. In Austria, data is also available at the district (NUTS IV) level, and in Germany at the level that is based on the 142 so-called "Tourism Areas" ("Reisegebiete"), which usually do not correspond with the size of the administrative districts. These "Tourism Areas" were designated by the respective states as well as by their role as specific cultural landscapes (Nature Parks) and/or functional regions, or according to the administrative districts ("Landkreise", NUTS III) (Kessler 1990).

The german "Tourism Areas" were slightly modified for this study (summary of units smaller than administrative districts or "Landkreise", especially in Upper Bavaria), while for Austria, the district data was assorted into 36 regional units, similar in size to the "Tourism Areas" in Germany and analogical to the concept of NUTS III. To this effect, 166 tourism areas were created that can be statistically and, by measures of cartography, visually compared.

2.2 Data Availability

Tourism statistics in both countries are legally regulated, e.g. for Germany by the Accomodation Statitics Law from 1980. In 1995, EC guidelines were established for harmonizing respective national tourism data collection. The implementation of these guidelines in EC member states still varies (Spektrum Lexikon der Geographie 2001/2002).

In the monthly reporting process, the following data is collected: arrivals, overnights stays as well as the nationality of the guests, the number of available beds, vacation appartment units and camping sites (lodging capacity). Tourism statistics will be completed by a sporadic census that will record the number of commercial enterprises, restaurants, jobs, persons employed and the amount of business turnover.

For german "Tourism Areas", monthly based data on the number of arrivals and overnight stays can be found free of charge on the internet (www.DESTATIS.de). The respective Austrian district-level data can be purchased via the internet using the ISIS data-bank system (Statistik Austria), for which registration is necessary. Based on the numbers of arrivals and overnight stays, the average length of stay can be calculated and, therefore, makes it possible to carry out the present study.

Due to inconsistant data availability, the following relevant themes could not be covered for the entire study area: Over-demand during the main season and the potential maximal values for arrivals (cf. Smeral 1994); stays made in a second home (cf. Lichtenberger 1997, pp. 223ff.) and the characteristic of local recreation and leisure time traffic (without overnight stays); seasonal distribution of visitors to cultural and tourism sites; regional overlapping of different tourism forms, travel originating from different regions or countries as well as the different purposes of visits (e.g. congress and culture tourism in cities, etc.).

2.3 Algorithms

Various indicators were defined for all 166 tourism regions for the seasonality of arrivals (A), nights spent (N) and mean length of stay (D):

MXMON = Month (1 = Jan., 12 = Dec.) with the most arrivals/overnight stays and the longest average stay.

MNMON = Month (1 = Jan., 12 = Dec.) with the fewest arrivals/overnight stays and the shortest average stay.

This data characterizes the peak and the turning point during the course of the year (see section 1.4). Further characteristics for irregularities during the year could be shown by the number of peaks and their duration (whereas a flattened peak indicates higher intensity over several months while a pointed or steep peak indicates high intensity over a short period). As there is no existing algorithm, the indicators must be interpreted visually on an yearly curve.

ASS = Sum (May – October) / Annual Sum
for the summer- to winter season ratio (see section 1.4)

D_MX = 100 - (100*Monthly Average) / Monthly Maximum
as the proportion of monthly average to the monthly maximum (cf. "Seasonality Ratio", after Yacoumis 1980 and "Seasonality Indicator", after Lundtorp 2001).

MN_MX = 100 - (100*Monthly Minimum) / Monthly maximum
as the proportion of the monthly minimum to the monthly maximum (seasonality span)

SAW_D = 100*Standard deviation of the Monthly Value / Monthly Average
as a variation coefficient (V) (cf. "Coefficient of seasonal variation", after Yacoumis 1980)

SV_2G = 100*Sum of all Monthly Differences/ 2*Annual Sum
as a percent of the maximal possible variation between the monthly values

SAIS = (SV_2G + MN_MX) / 2
as an indicator, which is calculated from the variation between the months and the span of variation during the year

GINI = 100*Gini Coeffizient
calculated as the area between the Lorenz Curve and the 45-degree equality line divided by the entire area below the 45 degree line, as a generally recognized measure for inequality (cf. Wanhill 1980, Tsitouras 2004)

All these values are representing the extent of inequality during the course of the year. The range of values is between 0 and 100 (except with SAW_D, then the value is > 0).

2.4 Data Correlation

Even though all the inequality indicators possess nearly the same potential range of values, the respective Z-values will be transformed. Thus, the calculated seasonality indicators will be processed through of a Correlation Analysis (bivariate Pearson Correlation), which should allow for the choice of a reliable set of indicators and help with preparation for making further analysis.

The analysis essentially shows, that all measures of uneveness for arrivals and for overnight stays are very highly correlated with each other (> 0.75), the measures for the length of stay are highly correlated (> 0.5). The maximum- and minimum months of arrivals and overnight stays are just as highly correlated (> 0.5), while the respective month of length of stay were not found to be significant (< 0.2).

		Arrivals						Nights spent						Mean Length of Stay					
		SV_2G	MN_MX	GINI	ASS	MNMON	MXMON	SV_2G	MN_MX	GINI	ASS	MNMON	MXMON	SV_2G	MN_MX	GINI	ASS	MNMON	MXMON
Arrivals	SV_2G		0.83	0.83	0.06	0.34	-0.35	0.94	0.80	0.83	0.02	0.29	-0.35	0.69	0.66	0.69	-0.04	-0.02	-0.16
	MN_MX	0.83		0.94	0.43	0.10	-0.35	0.80	0.95	0.92	0.38	0.05	-0.25	0.61	0.64	0.67	0.07	-0.06	-0.12
	GINI	0.83	0.94		0.48	0.10	-0.32	0.80	0.89	0.96	0.44	0.04	-0.24	0.59	0.61	0.65	0.11	-0.04	-0.10
	ASS	0.06	0.43	0.48		-0.20	0.14	0.07	0.39	0.43	0.97	-0.24	0.30	0.11	0.17	0.23	0.35	-0.09	0.14
	MNMON	0.34	0.10	0.10	-0.20		0.00	0.36	0.16	0.15	-0.22	0.67	-0.06	0.38	0.31	0.32	-0.08	0.13	-0.06
	MXMON	-0.35	-0.35	-0.32	0.14	0.00		-0.28	-0.32	-0.31	0.13	0.03	0.64	-0.28	-0.29	-0.29	0.01	0.13	0.10
Nights spent	SV_2G	0.94	0.80	0.80	0.07	0.36	-0.28		0.86	0.87	0.06	0.33	-0.27	0.70	0.69	0.72	0.08	0.01	-0.11
	MN_MX	0.80	0.95	0.89	0.39	0.16	-0.32	0.86		0.94	0.39	0.09	-0.19	0.64	0.70	0.71	0.24	-0.09	-0.02
	GINI	0.83	0.92	0.96	0.43	0.15	-0.31	0.87	0.94		0.44	0.07	-0.21	0.66	0.70	0.73	0.29	-0.06	-0.02
	ASS	0.02	0.38	0.44	0.97	-0.22	0.13	0.06	0.39	0.44		-0.26	0.32	0.11	0.20	0.23	0.54	-0.08	0.26
	MNMON	0.29	0.05	0.04	-0.24	0.67	0.03	0.33	0.09	0.07	-0.26		-0.12	0.27	0.21	0.21	-0.24	0.24	-0.19
	MXMON	-0.35	-0.25	-0.24	0.30	-0.06	0.64	-0.27	-0.19	-0.21	0.32	-0.12		-0.18	-0.16	-0.16	0.20	-0.01	0.21
Mean Length of Stay	SV_2G	0.69	0.61	0.59	0.11	0.38	-0.28	0.70	0.64	0.66	0.11	0.27	-0.18		0.93	0.94	0.18	-0.01	-0.08
	MN_MX	0.66	0.64	0.61	0.17	0.31	-0.29	0.69	0.70	0.70	0.20	0.21	-0.16	0.93		0.96	0.29	-0.05	-0.04
	GINI	0.69	0.67	0.65	0.23	0.32	-0.29	0.72	0.71	0.73	0.23	0.21	-0.16	0.94	0.96		0.28	-0.08	-0.08
	ASS	-0.04	0.07	0.11	0.35	-0.08	0.01	0.08	0.24	0.29	0.54	-0.24	0.20	0.18	0.29	0.28		-0.12	0.53
	MNMON	-0.02	-0.06	-0.04	-0.09	0.13	0.13	0.01	-0.09	-0.06	-0.08	0.24	-0.01	-0.01	-0.05	-0.08	-0.12		-0.07
	MXMON	-0.16	-0.12	-0.10	0.14	-0.06	0.10	-0.11	-0.02	-0.02	0.26	-0.19	0.21	-0.08	-0.04	-0.08	0.53	-0.07	

Tab. 1: Bivariate Pearson Correlation for seasonality indicators (Z-Transformation, this table is explained in section 2.3).

3 FROM REGIONAL PARTICULARITIES TO SEASONALITY TYPES

3.1 The Course of Tourism Seasonality

One simple approach for getting orientated with the seasonal cycles is to consider the maximum and minimum value months (fig. 2). Most tourism regions have a low frequency of visitors in January and in November, with November being the month that has the fewest overnight stays. Normally, most guests come during the vacation period in August and during part of September. A considerable number of regions also have their main tourism period in May, since a number of holidays occuring during that month allow for extended weekends to take place. Central European summer tourism, including vacations made in high mountain regions, has been experiencing a loss due to increasing competition from destinations reached by air travel.

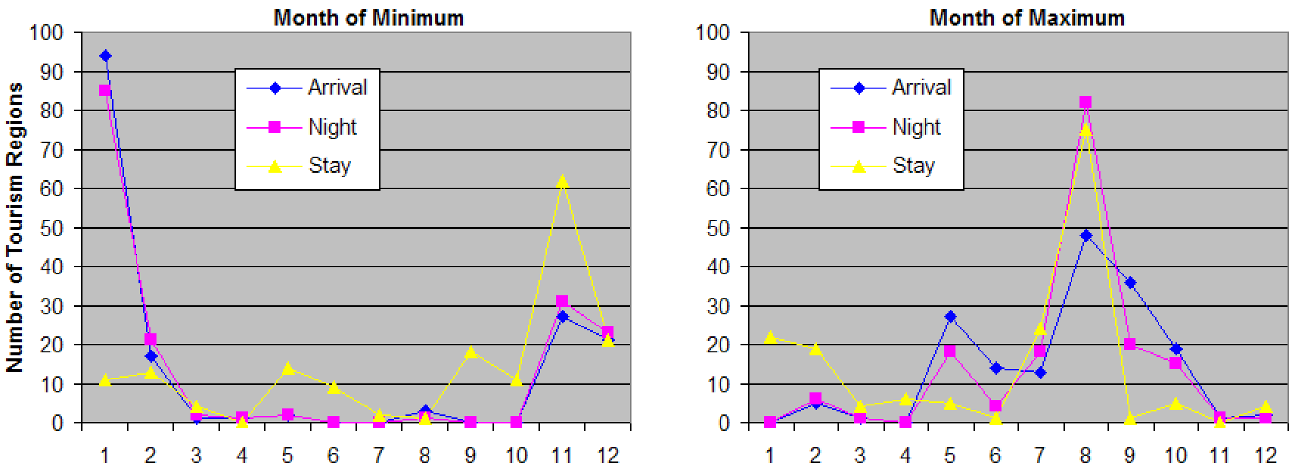

Fig. 2 / 3: Number of minimum und maximum month of arrivals / nights spent / (mean) length of stay in overall 166 Tourism Regions.

The Inner Alpine winter sport regions have their maximum of overnight stays in February, however, not all regions have a maximum for the average length of stay during that period. The Alpine Region has a certain monopoly hold on winter tourism, which has been continously growing over the last 30 years. Only those regions which are equipped with the necessary tourism infrastructure and capacity are the ones which profit (Lichtenberger 1997, Zimmermann 1998). It is also interessting to note that two regions in Germany, Nürnberg and Erzgebirge, have their most arrivals in December, as they are popular Christmas destinations.

The number of peak season periods (one ore two seasons) and the duration of the season (including 'shoulder season'; "Nebensaison") can be observed in the yearly curve (fig. 1). We determined those regions with either one or two short seasons (sharp peaks) that are predominantely located in the Austrian lake– or winter sports regions. The lack of a 'shoulder season', depends on the number of foreign guests – which, in Austria is relative high compared to Germany – as well as on the preference of Austrians to have a second home (cf. Lichtenberger 1997).

A much longer season with a distinct maximum and minimum can be observed at the German holiday destinations, e.g. the Baltic Sea (Ostsee) or the Franconian Alp (Fränkische Schweiz) region. The rest of the regions, as well as all metropolitan areas in the study, show a weak maximum peak level in terms of overnight stays, as in the case of Berlin in May and Wien in August. To this effect, some of these regions have registered a clear minmum in Winter (Berlin and Wien) while others show more eveness throughout the whole year (Nürnberg).

3.2 The extent of Tourism Seasonality

The various indicators quantify the extent of seasonal fluctuations in a particular region and therefore allow for a direct comparison to be made between different regions. Information regarding tourism capacity is of general economic interest. The indicator, D_MX shows the percent of unused bed capacity, based on the assumption that the supply of beds remain constant and that full occupancy is reached during the maximum month. In this regard, Nürnberg has a low, i.e. advantageous, comparative value of 11%, while the lake region in Carinthia has an unfavourable value of 72%. Similar results could be obtained with the indicator ASS, which reflects the relationship between summer- and winter seasons. In any case, it shows that the classical summer destinations, for example, the coast and lake regions, as well as the Franconian Alps (Fränkische Schweiz) and the Mosel Valley are revealing even more unused capacity in comparison to the Austrian winter sports regions, which show the existance of at least one additional season in summer.

The Gini Coefficient is a classical measure to account for the uneveness over all months. In concern to overnight stays, the classical vacation regions are showing the largest degree of uneveness, whereas urban areas and nearby tourism regions, i.e. potential areas for local recreation, are revealing less fluctuation. Based on the newly developed indicator SV_2G in which the differences between two consecutive monthly values are summed up, vacation regions can be assesed differently. Using this indicator for all Austrian tourism regions, the summer as well as the winter regions have the most conspicuous values. Here, the span between high-season and off-season is largest.

3.3 Cluster Analysis – an Attempt to Distinguish Tourism Seasonality Types

Hierarchial cluster analysis was able to catagorize the 166 investigated various tourism regions into various groups. Cluster analysis classifies large differences between the groups and similarities within groups. This study shows two main approaches: One of which analyses yearly patterns based on 12 monthly values. The other approach is based on a set of indicators which are chosen with the help of correlation analysis, in which a numeral representation is given to the maximum and minimum months that were considered as interval data. The indicator sets consist of (respecitvely with reference to arrivals, overnight stays and average length of stay): ASS, GINI, SV_2G, MXMON, MNMON (see section 2.3). The calculation of clusters was performed by SPSS statistical software.

The cluster analysis of the indicator sets essentialy showed more differentiated results as opposed to the patterns of the course of the year. Also, a comparison with the yearly curves reveals that the indicator set is better suited for arrangement in groups. This is despite the fact that by indicating the maximum and minimum months, the pattern of the year can only incompletely be portrayed. Information, however, is still missing for the number and duration of the seasons. This way, it would be possible to make further refinements using additional algorithms. Finally, it remains to be discussed as to how far the groups from the cluster analysis display seasonality types, or rather, from which groups seasonality types could be derived. Without additional information the clusters themselves could be hardly interpreted. To this effect, and in order to explain how many seasonality types should be formed, we reccommend to refer to the yearly curve (see fig. 1).

Whether the number of arrivals, overnight stays and/or length of stay have to be included into the arrangement of seasonality types depends on the purpose of the investigation. While those values for arrivals and overnight stays are generally highly correlated, the category 'length of a stay' proves to be quite different from the other two. For this reason, processing the three catagories together can prove to be difficult. Concerning the tourism economy, overnight stays is the most significant unit of measurement for capacity utilization. Therefore, the following recommendation of seasonality types just refers to overnight stays:

A. *Regions with strong distinct forms of seasonality (predominantly tourism region):*

    1. with two defined seasons, with the winter season more predominant (Austrian Alps; e.g. Tiroler Unterland)
    2. with two defined seasons, with the summer season more predominant (Austrian Alps; e.g. Osttirol)
    3. with a dominant summer season and no shoulder season (lake regions of Austria; e.g. Traunviertel)
    4. with an extended summer season and a distinct minimum in winter (german coastal areas and lake regions, low mountains)

B. *Regions with a moderate seasonality (predominantly regions close to the urban centers, partially vacation regions):*

    5. with more or less wide summer season, weak shoulder seasons or at least a weak minimum in winter (esp. northern Alpine rim and Alpine foothills, Eastern Bavarian, Hessian and North Rhine-Westphalian low mountain ranges)

C. *Regions with a weakly pronounced form of seasonality (partially urban regions and regions close to cities, but also low mountain areas, which includes rarely vacation regions):*

    6. without a particular season, but with a clear minimum in winter
    7. with only a minimum amount of variation

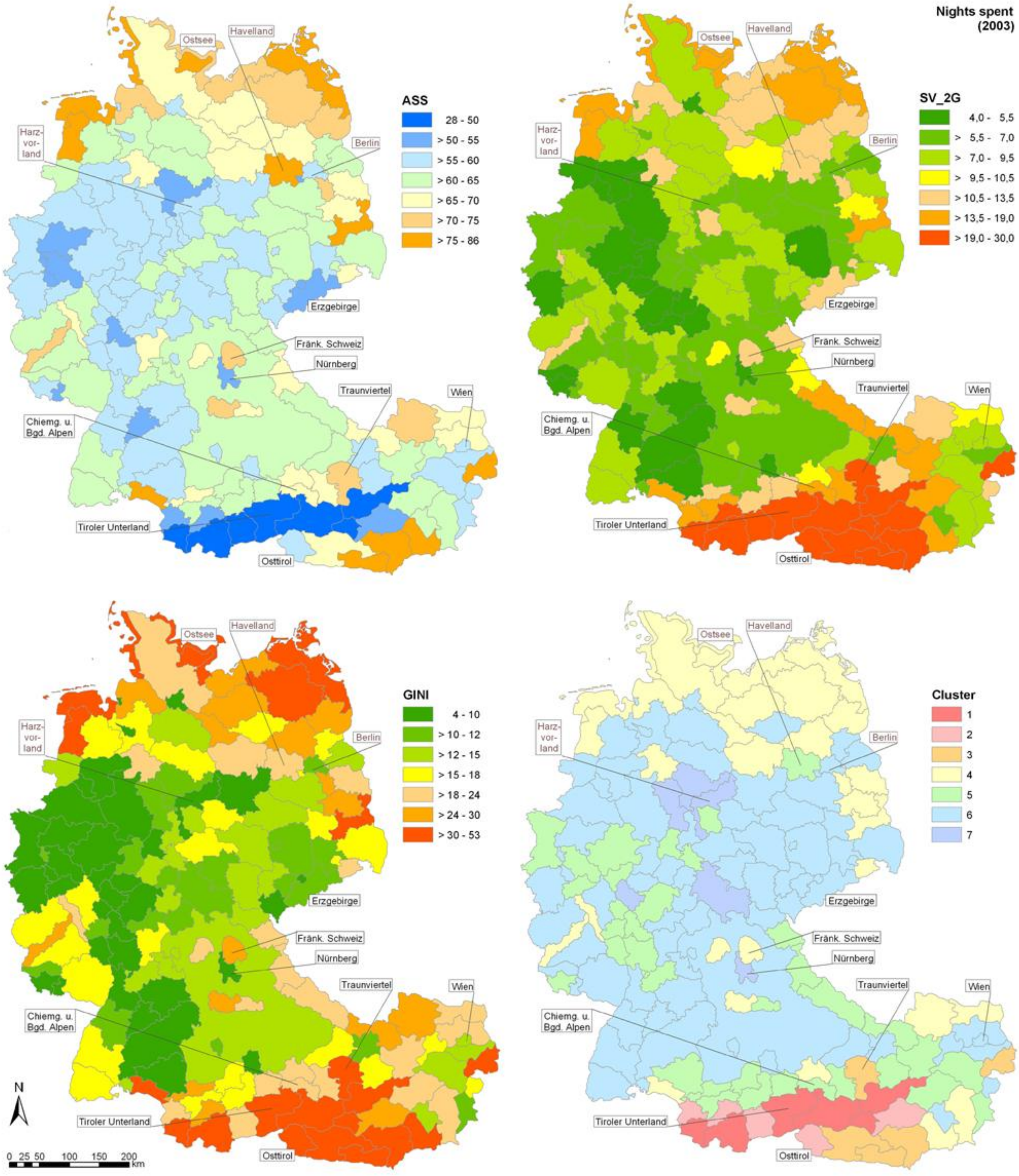

Fig. 4–7: Seasonality based on overnight stays (monthly values from 2003) – 3 indicators (above and below left; for an explanation, see section 2.3) and hierarchical Cluster Analysis with 7 groups based on a set of indicators (below right; for an explanation, see section. 3.3).

4 CONCLUSIONS

This study was motivated by the assumption that seasonality had rarely been investigated (Butler 2001). Our comparative assessment and categorization of tourism regions reveal a considerable amount of interregional differences, even between neighboring regions and between regions with the same or similar touristic images (e.g. low mountain, and urban regions, respective with and without a distinctive winter minimum). Thereby, we have to note that the results depend not only on the choice of indicators but also on the separation and size of the different investigated areas. If larger regional units had been aggregated, seasonal peaks would have become leveled as regional differences would cancel each other out.

It is generally recognized that sesonality tends to have more negative effects, especially from a socio-economic viewpoint. This also affects approximately 2 million jobs in Germany that are dependent on tourism (Harrer 2003). There has been several attempts made to overcome seasonality, such as lengthening the main season, establishing additional seasons, diversifying markets, using differential pricing and tax incentives on a temporal basis, encouraging the staggering of holidays, encouraging domestic tourism in off-seasons, and providing off-season attractions or "events" (Butler 2001, with other references made). Also, special events such as festivals and conferences could help overcome the seasonal effects within tourism regions, provided that they take place in the shoulder or off-season (Freyer 1996). It could be pointed out, however, that tourists expect to have attractive programmes organized during the season (Ashworth & Thomas 1999).

In the process of regional planning in federal states such as Bavaria and Baden-Württenberg, one priority is protecting and developing tourism areas. To this effect, more pressure is being placed on infrastructure. However, in the planning programs, it remains unclear whether infrastructure should be more orientated to the needs of the main tourism seasons. In this paper, the analysis of problems and search for solutions concerning 'seasonality' can be seen in a wider regional context. At the moment, "Learning Regions" is a common concept in regional planning. In order to successfully carry this out, one must know which other regions present the best examples. Therefore, as a main conclusion to our study, we are proposing a method for the monitoring of seasonality in tourism regions that should be more specifically defined.

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Preservation and Valorisation of cultural and environmental resources and information systems, an investigation into a Web GIS

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ABSTRACT

One of the most important uses of a GIS for the cultural and environmental resources would be in the planning of tourism. Cultural tourism is both a friend and for of historic and natural sites. The money it brings in can be used to support the management of the site and to benefit the surrounding community, which is particularly important in developing countries. The study highlites how the introduction of digital information technologies such as Geographic Information Systems (GIS) and the World Wide Web influences both the preservation and valorisation of cultural heritage and attraction for tourist consumption. Since the social and cultural context of an organization influences the chances of reaching the goals of any new policy or technology, implementation should be seen as a process of social interaction between the technology and its organizational context. Adoption of a Web GIS cannot succeed unless those who use it are convinced of its legitimacy, are well-trained in its use, and have adequate support. The case-study affords easy and rapid collection and dissemination of spatial information in Sicily and would be based on such factors such as cultural and natural resources, biodiversity and the capacity for assimilation of any impacts and residues produced.

1 TECHNOLOGIES FOR THE CULTURAL TOURISM

Heritage tourism, as a part of the broader category of "cultural tourism", is now a major pillar of the nascent tourism strategy of many countries. Cultural heritage tourism strategies in various countries have in common that they are a major growth area, that they can be used to boost local culture, and that they can aid the seasonal and geographic spread of tourism (Richards, 1995).

New Information and Communication Technologies for Cultural heritage is a rapidly growing niche market. This market is fuelled by an increasing number of studies on the field of cultural heritage and by the increasing availability of web communication. Recent studies about cu1tural heritage tourism and new information and communication technologies have focused on identifying the characteristics, development, and management of cultural heritage tourism, as well as on investigating demographic and travel behaviour characteristics of tourists who visit cultural heritage destinations. Micelli and Di Maria (2000) provided a common pattern of cultural heritage towns by analysing the way in which digital technology have significally changes consumer's demand. Musumeci (2000) also analysed how that the exploitation of cultural patrimony produces a positive impact on the economy, particularly in those areas that are better equipped from a cultural and tourist point of view. Formica and Uysal (1998) explored the existing markets of a unique annual event that blends internationally well-known cultural exhibitions with the new information and communication technologies.

ICOMOS analysed how the Preservation planning is perhaps the most effective use of some particular technologies such as geographic information system, since careful planning can prevent some threats to Cultural Heritage sites before they become problems.

ICOMOS and UNESCO are supportive of tourism to Cultural Heritage sites; in fact, the very idea of the World Heritage implies public access to these sites. On the other hand, both organizations are concerned about the destructive effect which tourism can have on a site. According to an article in the *UNESCO Courier* from 1996, UNESCO encourages study and action in four areas:

- defense and promotion of the cultural heritage and cultural identity;
- protection of the natural environment against inroads from tourism;
- encouragement of a form of tourism that respects the social, cultural and natural environment and provides a basis for development;
- extension of cultural tourism activities that generate income and jobs, especially for young people in developing countries. (Bequette, 1996)

UNESCO and ICOMOS are not alone in their concern for sustainable tourism. In 1995, 500 participants in the World Conference on Sustainable Tourism adopted the Charter for Sustainable Tourism. This Charter states, "Tourism should contribute to sustainable development and be integrated with the natural, cultural and human environment; it must respect the fragile balances that characterize many tourist destinations, in particular small islands and environmentally sensitive areas. Tourism should ensure an acceptable evolution as regards its influence on natural resources, biodiversity and the capacity for assimilation of any impacts and residues produced."

States Parties are encouraged to document and protect all culturally and naturally important sites within their borders, not just those which are already listed as World Heritage sites. On such a large scale, tourism planning can play an important role in the protection of sites. For example, some sites are over-visited while others have not yet been discovered by tourists. One way to protect over-visited sites is to divert tourism to other sites. Which sites to develop for tourism should be decided not only on the basis of the sites' cultural or natural interest but also on their ability to support tourism.

For both natural and cultural sites, a tourism carrying capacity can be calculated using a GIS. This analysis would be based on such factors as soil type, biological fragility (some species can tolerate more human interaction than others), topography, and hydrology. Other factors to consider would be the proximity of existing infrastructure such as roads and airports, and the proximity of other sites of interest. Spatial elements such as these are important to consider not only in the selection of a site to develop, but in the planning of that site. A large natural area may have many possible entry points, but one may wish to encourage entry in a particular location because of its lower fragility and proximity to other sites of interest.

A model for the selection of a tourist destination could include the following elements:

Cultural Elements	**Natural Elements**
Favorable: Proximity to roads	Soil Type
Type of road (capacity & speed)	Steepness
Proximity to airports	Aspect (e.g. north-facing)
Capacity of port	Biological Fragility
Proximity to border Proximity to population centers Size of population center	Proximity to wild populations (e.g. large mammals or bird colonies
Proximity to cultural monuments	Proximity to special geographic points (e.g. beaches, caves)
Importance of city centres	Importance of geographic points
Unfavorable: Visual access to distracting views	Visual quality (views)

Table 1: Cultural elements for tourist destination

These lists could be expanded upon, but considering only the elements listed above would result in a complex model. To perform all of these analyses with paper maps would be extremely time-consuming. With a GIS, the task of analysis is much simpler. Analysis commonly begins with an operation to remove unsuitable sites from the analysis, those sites which do not meet the boundary conditions. Then the remaining sites are rated in a multi-step process and spatial aspects are weighted according to their importance.

A GIS does more: it allows the user to see spatial relationships such as clusters of sites, patterns of distribution (linear groupings which may suggest a tourist route rather than a single destination), and relationships to other elements which may not have been clear in the initial formulation of the model. Spatial models usually include the option of refining the model at several stages, because the analysis process usually reveals erroneous assumptions. It is the automatic and rapid display of selected spatial data as a map which allows a researcher to explore many alternatives and to perform a complex analysis in a reasonable time period.

The Charter for Sustainable Tourism states, “all those responsible” must take upon themselves a true challenge, that of cultural, technological and professional innovation, and must also undertake a major effort to create and implement integrated planning and management instruments."

2 PROJECT OVERVIEW: THE CASE STUDY

The architecture of the web GIS includes the definition of the information space in terms of identification and representation of its contents, and of the protocols that support the interaction of agents in an information system making use of the space. Web architecture is influenced by social requirements and software engineering principles. These lead to design choices and constraints on the behaviour of systems that use the Web in order to achieve desired properties of the shared information space: efficiency, scalability, and the potential for indefinite growth across cultures and media**.**

The Etna Park of the on-line environmental resources (www.parcoetna.it) represents an important Web source. It is based on an integrated platform which incorporates on-line resources, contacts, information, and administrative programs and services. According to the article in the *UNESCO Courier* from 1996, its principal tasks are:

- the implementation of a web tool for the environmental protection and valorization
- the evolution and the development of the web GIS portal in the future

- the development of Web services and activities
- the extension of cultural tourism activities that respects the social, cultural and natural environment

Based on these considerations the project goal was to develop a single, operational and technical prototype (software and services) which can be set up as a web GIS offering to visit on the internet sources on number of sites (elements of significant architectural, archaeological artistic and historic value, natural areas protected by law such as SIC and ZPS, etc). It works as a joint portal (vertical portal)[36] and GIS.

The geographic access of data through the geographic information technologies stores environmental data on a GIS platform. The system is able to easily produce several services such as real-time thematic maps, more or less complex visualizations, in order to implement tourism on-line services and cultural and environmental promotional tasks.

The GIS on the Web integrates in the same record cultural sites and describes cultural and environmental heritage of the Etna Park and its cultural activities.

The GIS integration with internet has some principal benefits. The position of tourist objects (such as hotels, restaurants, bed and breakfast, sights, event location, etc.) onto map has the objective to integrate tourist information and GIS data. For this reason the location of each tourist object is integrated on to map and identified by geographic coordinate. As user can identify the object location of their objects by selecting the objects position on the map. The geographical coordinates is calculated by the GIS system and is stored in the GIS database. At map creation the object is represented on the map by means of a meaningful object symbol, the object name, the category if the object is an hotel. The object symbols are linked with the homepages to enable further navigation.

The primary sources of information are the cartography of I.G.M.I. (Italian National Geographical Military Institute) and other different cartography (CTR “Carta Tecnica Regionale” sc 1:10.000, parcel orientation maps, development constraints and zoning maps, infrastructure maps, and orthophoto-based site maps, etc.), then projected on the different layers. The GIS is organised according to administrative territory of the Etna Park, within which shapefiles and tables are divided in "base map" layers.

This GIS system involves creating an extensive geographic database that includes many types of *"mappable"* information: roads, zoning, digital orthophotos, utilities, streams, elevation, soil types, parcel boundaries, steep slopes, floodplains, etc. An ArcView GIS system was established (from scratch) to house the geographic database, which was then used to develop high-quality maps and graphics that depict economic development opportunities located throughout Etna Park. The second phase involved designing World Wide Web pages which incorporate the maps and graphics - along with text and photos - into a complete, computer-accessible marketing package.

The Web pages are designed to stimulate local job creation by promoting land development, new business investment, and tourism. The Web sites orient users with locator maps, and allow them to access detailed information on the area based on their interests. For example, this system implements spatial relationships and clusters of itineraries such as Burò, Gurrida, Monte Nero-Zappini, Monte Zoccolaro, Pietracannone-Cubania (http://www.parks.it/parco.etna/Eiti.html) of which suggest tourist routes and charming itineraries also for disabled people rather than single destinations (religious buildings, terracings, dry stone walls, the stone "casudde", the folds, etc).

A family planning a vacation to the Etna Park can also point and click their way to information on Etna Park's visitor attractions, lodging, entertainment, historic places, campgrounds, and vast natural amenities. The project Web sites are being linked to other sites on the World Wide Web to increase their usefulness and reach.

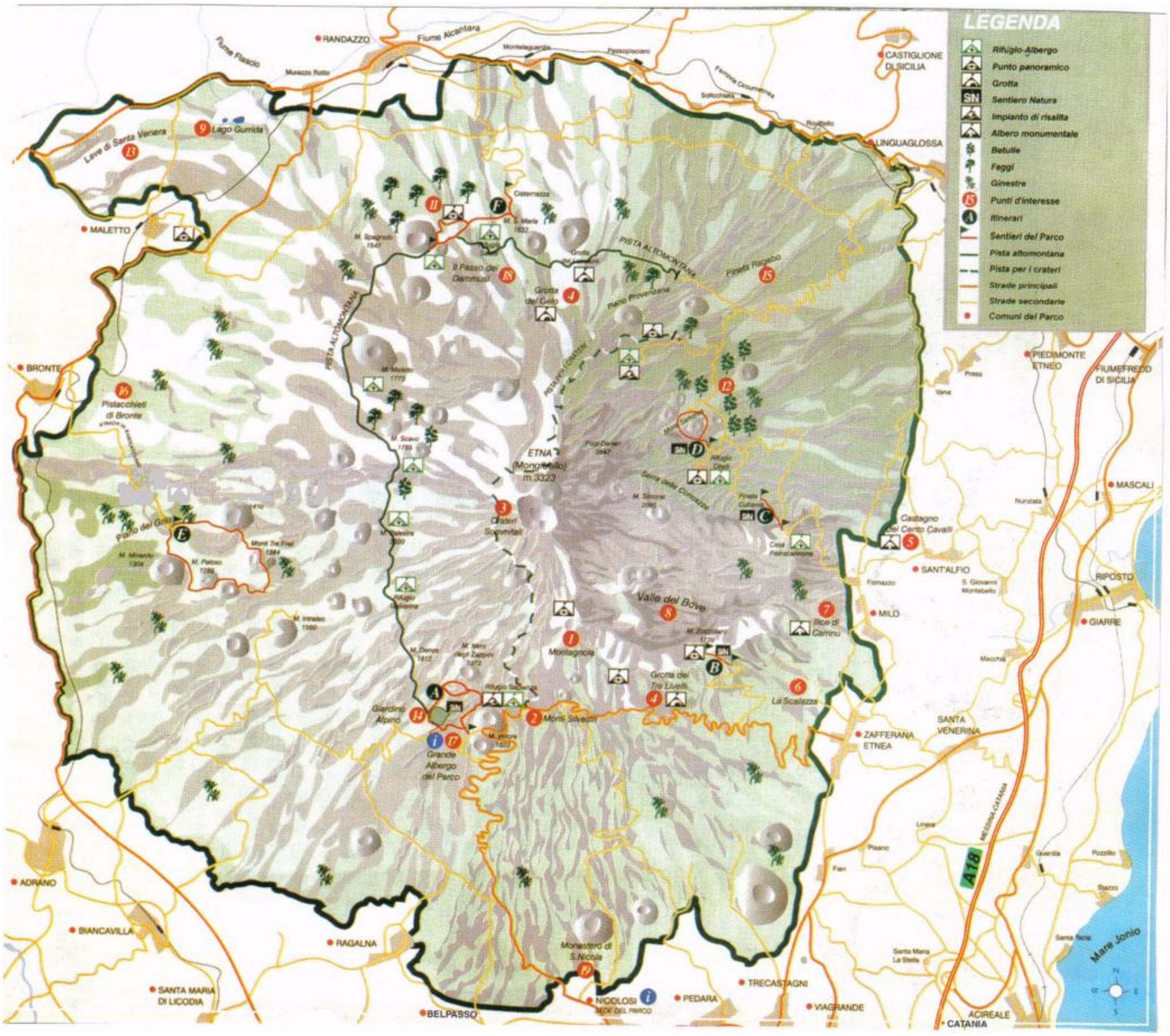
Because of this, GIS on the Web covers a wide range of audiences (exsterna; internal) such as tour operators (in particular in the field of cultural tourism), experts in the field of education and training, small and medium-sized enterprises, citizens and in particular the joung generation, techical and administrative staff.

It is useful for administrative management of the Etna Institution (for internal users) and the data necessary for describing the environmental sources (for external or general users). Because of this, different user interface is dedicated to the Administrators or more skilled personnel of the Etna Park Institution, which has the task of implementing databases and web sources. For this reason it contains all functions - tools and buttons – of GIS software (the native ArcGIS) plus tool windows with newly created buttons for the choice of the type of selection for the implementation of the databases and sources.

In other words it is possible to distinguish two search modalities: access for “general users” and access for the members of the staff itself.

This organisation permits to transfer quite easily the entire database under the web GIS structure.

[36] According to Eisler (2000) there are two broad categories of portals -- Horizontal and Vertical. Horizontal portals provide links to a broad spectrum of information across various categories on the same Web page. An example is Yahoo!, where every visitor to the site sees the same display of information categories and these categories range from news to shopping, email, entertainment and so on. They aim to provide all the information a person could be seeking on the Web. Vertical portals (vortals) on the other hand, provide information on a single subject, closely related subjects, or information directed at particular groups of users. Vortals can provide a unique view to a user by recognizing the user class to which they belong, through an authentication process.

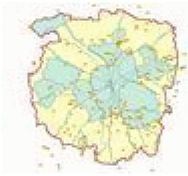


Graph 2: GIS on the internet - Cultural elements for tourist destination

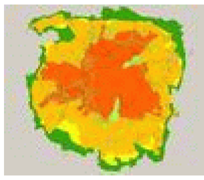
The GIS of the Etna Park provides the integrate access to the following layers and maps:

- Administrative boundaries
- Zoning (A, Ha 19.200 – B, Ha 25.350 - C Ha 4.100 and D Ha 10.250);
- Woodlands, forest areas and vegetation;
- Protected areas (SIC and ZPS);
- Species (wild populations e.g. bird colonies - migratory birds, like ducks and grey herons) and their habitat
- Land use;
- Communication systems (Type of roads, railway "Circumetnea, greenways, etc.)
- Cultural heritage (religious monuments, rural industrial sites and buildings, etc.)
- Special geographic points (e.g. beaches, caves)
- Geomorphology and idrology
- Tourism services and tourism/recreation facilities
- Layer of the habitat boundaries

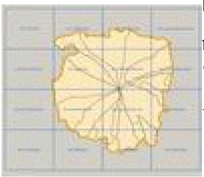
Geographic information System of the Etna Park



Areas under law protection, SIC "*Siti di Interesse Comunitario*" and ZPS "*Zone di protezione Speciali*", caves and "environmental monuments ".

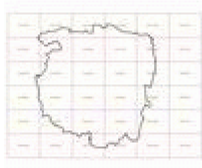


Communication systems, Park zoning, greenways, tourism services and tourism/recreation facilities.



Administrative boundaries

the CTR (*Carta Tecnica Regionale sc. 1:10.000*)



CTR (*Carta Tecnica Regionale*) and zoning of the Etna Park.

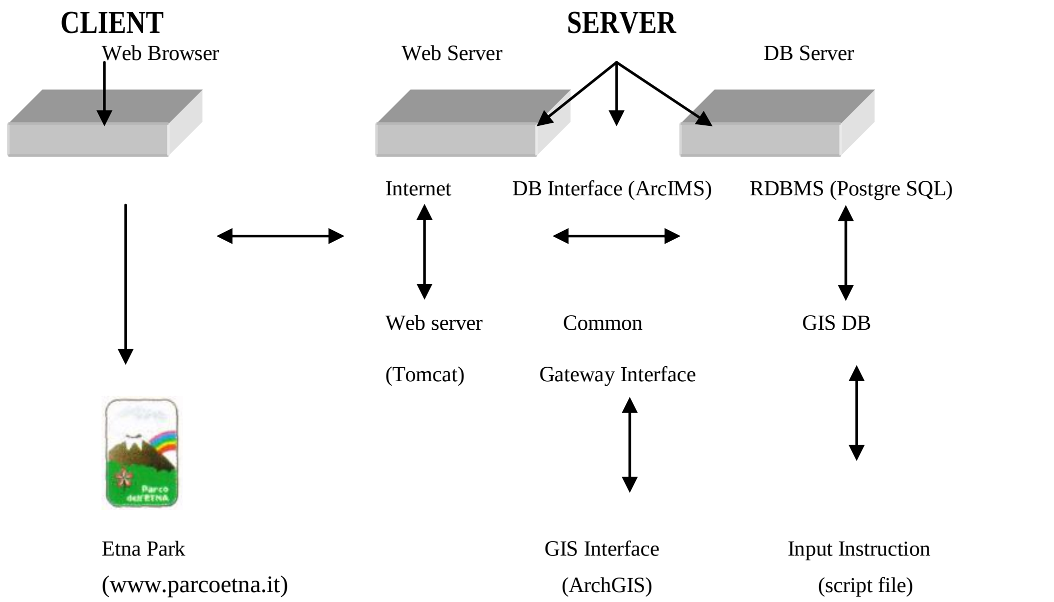
Graph 3: The interactive layers and maps of the GIS (produced by the GISAT www.gisat.it and financed by P.O.R. 2000-2006 - 1.11 "Integrated Information Systems" www.parcoetna.ct.it/sitgis.htm)

Dynamically generated, interactive layers and maps offer a variety of trend-selling functionalities like integration of vector shapes, images and performance panning inside of graphics without reloading data, in combination with the possibility of all related technologies. In particular, tourist maps in information system offer a powerful, clear and user-friendly access to tourism data with great benefits for substantial advantages for tourism information systems because maps change from static raster graphics to interactive graphical.

3 PROJECT OUTCOMES

Internet based geographical data services in the field of cultural and environmental heritage involve management spatial and non-spatial (attribute) data. As we have seen, Geographic Information System (GIS) has come to be an indispensable tool for analysing and managing spatial data. Data pertaining to spatial attributes were efficiently managed using Database Management System (DBMS Microsoft Access). The development of the Etna Park Web-based system by integrating GIS and RDBMS serves two crucial purposes. Firstly it allows the user to operate the system without having to grapple with the underlying intricacies of GIS and RDBMS technology. Secondly, it allows sharing of information and technical expertise among a wide range of users. The system described aims at providing a web-based platform for collaboration and data sharing between specialists, planning agencies, citizens, and private entities. In order to access the spatial database, the user need only have a Web browser and access to the Internet.

The system is a hybrid vector-raster GIS designed to provide digitising, image processing, map production, and GIS system capabilities to its user. The web GIS contains several routines for importing spatial data of a wide variety of commonly used formats. The spatial data included in prototype system consists of raster, vector and site data layers that provide the geographical reference. The RDBMS enables the fast storage and retrieval of large amounts of information. The interface that is used to insert, manipulate, and extract data is called the Structured Query Language (SQL). In case of the prototype system, the SQL database server has been used to manage the attribute data and multi-media content. The SQL works as an RDBMS, supporting almost all SQL constructs, including sub-selects, transactions, and user-defined types and functions. The database consists of tables that hold all the available attribute data. The attribute table includes fields that can be used to store binary data (images, multi-media contents etc.). Remote update of the database by permitted users is also made possible. An authentication mechanism to check which users can be allowed to enter new data or update the existing attribute data in the database is also provided.



Graph 3: Components and Information Flow within the GIS on the Web

Since a majority of commands can be executed in the command mode, it is quite easy to enhance the Links interface to provide added functionality to the system. Several additional features could be incorporated into the GIS web-interface to tailor the system for its present requirements.

The user could be able to select the data layers from an interactive menu based on which the raster layer is displayed on the web-browser. The user can also select vector maps and site data as overlays for raster map layer. Interactive zoom/pan capability will allow the user to view the displayed maps in greater details or to choose different areas for display. Once the desired area is displayed on the web-browser, the user is allowed to view the attribute table by "clicking" on respective site. The relation database is queried based on the geographical location of the "clicked" site. Attribute data is displayed in two stages. Firstly, a brief summary of the attribute information will be presented. The summary table also includes a hypertext link, which can be followed to view more detailed information including figures and field photographs will be also provided.

The application "search for tourist objects" will implement a geographic search to perform complex geographic queries to search for tourist objects like hotels, restaurants, event location, etc. A hotel search can be a time-based search and extends the map with availability information of rooms. To guarantee a sensible use, the user will have the possibility to zoom in or out to change the scale of the map, to scroll in the map and to print as well. In order to ease the administrative overload in maintaining the database, other options such as edit and delete and update functions will also be added in the final version of the system. Options for using thematic coloring, vector/site data overlay and rendering of animation sequences could also be supported. Apparently, one of the main limitations of the present system is the interoperability and non-compliance with widely accepted Web mapping standards. In using the system described above, access to spatial data requires the information to be stored in the GIS format and the GIS needs to be installed on the server in order to get the system running. The advantage in having a full fledged backend GIS running on the server would be the ability to implement online systems with spatial analytical capabilities rather than providing visualization or portrayal capabilities alone as are commonly available in other web GIS applications.

4 CONCLUSIONS

The explosion of new applications of information system shows that web GIS can be a powerful tool for heritage conservation and valorisation. As the vision of heritage preservation is evolving to consider sites and their context holistically, preservation will inevitably involve a greater use of electronic tools such as GIS. Adoption of this tool among researchers and conservationists will increase in the coming years, particularly for the documentation of larger sites and data. Apparently, one of the main limitations of the present system is the interoperability and non-compliance with widely accepted Web mapping standards. In using the system described above, access to spatial data requires the information to be stored in the GIS format and the GIS needs to be installed on the server in order to get the system running. The advantage in having a full fledged backend GIS running on the server would be the ability to implement online systems with spatial analytical capabilities rather than providing visualization or portrayal capabilities alone as are commonly available in other Web GIS applications.

The purpose of the project was to demonstrate the use of Geographic Information Systems and the Internet to market communities to relocating or expanding tourists nationwide. In the process, the project helped to build local information systems capacity; educate community leaders about cutting-edge information technologies; and boost local economic development strategies with a new tool: the web GIS. The web GIS of the Etna Park can be considered a work-in-progress: the contents of the database could be able to be implemented on line in real time from everywhere by the allowed users as the GIS has been designed to be dynamic and interactive.

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Neuronale Netze und Informationsübertragung in Gebäuden

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ABSTRACT

Wohin mit den Leitungen, Routern und Servern zur Steuerung intelligenter Gebäude ? Diese Arbeit untersucht die Beziehung zwischen der Organisation und Struktur von biologischen neuronalen Netzen und technologischen Netzen zur Informationsübertragung in Gebäuden. Das Ziel dieser Untersuchung ist es, bestimmte Muster in biologischen und technischen Netzen zu erkennen, um Netzwerke zukünftig besser verstehen und planen zu können. Diese Analyse vergleicht biologische und technische Netze nach folgenden Kriterien: Systemverhalten, Organisation, Netzwerkumgebung, Struktur, Funktion und Form. Einige Architekturvisionen skizzieren zuerst verschiedene evolutionäre Stufen technischer Netzwerke zur Informationsübertragung in Gebäuden. Abschließend werden dann zwei strukturelle Netzwerkmodelle vorgestellt: das Modell der ‘komplexen, wuchernden Netze’ und das Modell der ‘organischen Netze mit Rückgrat’. Eine Fallstudie des aktuellen Projekts R 128 von Werner Sobek schließt diesen Beitrag.

1 INTELLIGENTE GEBÄUDE ALS ‘SOZIALE, DENKENDE PFLANZEN’ ?

1.1 Einleitung

Wie intelligent sind unsere intelligenten Häuser ? Automatische Türen öffnen und schließen sich zwar selbständig, wenn wir durchgehen möchten. Bewegungsmelder registrieren die Anwesenheit von Personen und regeln Licht, Klima und Temperatur. Ist das schon Intelligenz ? Türen öffnen und schließen sich oft auch andauernd, wenn wir nur davor stehen und warten. In diesem Fall wagen wir an der vorhandenen Intelligenz dieser automatischen Türen zu zweifeln. Wie manifestiert sich nun Intelligenz und gibt es dabei Parallelen zwischen biologischen und technischen Netzen zum Informationsaustausch ?

1.2 Intelligenz als Summe von ‘übergeordneten Fähigkeiten’

Intelligenz, wie wir sie kennen, ist mit dem organischen Leben untrennbar verbunden. Allgemein anerkannte Kennzeichen von Lebewesen sind: Stoffwechsel, Wachstum, Vermehrung, Reizbarkeit, Regulationsfähigkeit und Bewegung. Mandl [12]. Ernährung (Stoffwechsel) und Fortpflanzung (Vermehrung) zählen dabei zu den primären Systemzielen, Wachstum, Bewegung, Reizbarkeit und Regulationsfähigkeit sind wichtige und notwendige Voraussetzungen (Systemfunktionen), um diese Ziele zu realisieren. Aber auch Phänomene wie Komplexität, Selbstorganisation, Wahrnehmung, Kommunikation, Identifikation oder Mitleid, verbinden wir mit intelligentem Leben.

Intelligenz zu definieren, ist dabei gar nicht so leicht,. Wie wir am Beispiel der automatischen Tür gesehen haben, ist es einfacher zu zeigen, was nicht intelligent ist. „Der Versuch Intelligenz zu definieren, wird umso schwieriger, je genauer man versucht, den Begriff einzukreisen.“ Cruse [4]

Intelligenz ist scheinbar mit dem gleichzeitigen Vorhandensein von folgenden Eigenschaften und Fähigkeiten eines Systems verbunden: 1.) Erkennen einer ‚subjektiven Umwelt’ (Merkraum und Wirkraum v. UEXKÜLL, Anm. d. Verf.), 2.) Effizienz der Lösung eines Problems, 3.) Autonomie des Systems, 4.) Intention (Ziele) und Aufmerksamkeit, 5.) Adaptions- und Lernfähigkeit, 6.) Urteils- und Entscheidungsfähigkeit, 7.) Fähigkeit zur Generalisierung, Kategoriebildung und Vorhersage, 8.) Offenheit gegenüber Umweltveränderungen.

„Dabei wird deutlich, daß das, was uns als Leben erscheint, eben nur zu einem geringen Teil in der äußeren Form begründet ist, sondern vielmehr in der Art des Verhaltens.“ Franke [7]

Das Erkennen einer subjektiven Umwelt, Bewußtsein und Sprache zu besitzen, können als sogenannte ‚emergente’ Eigenschaften eines intelligenten Systems betrachtet werden. Popper [15]. Diese sind ‘übergeordnete Fähigkeiten’, die ‚überraschend’ auftreten und sich nicht allein über die Eigenschaften der physikalischen Struktur des Lebewesens erklären. Allerdings gibt es Wechselwirkungen zwischen diesen emergenten Eigenschaften und dem Aufbau, beziehungsweise der Struktur von intelligenten Netzen. Am Beispiel der Adaptions- und Lernfähigkeit ist heute bewiesen, daß beispielsweise Langzeiterinnerungen sogenannte ‚dynamische Engramme’ (physische Spuren) im menschlichen Gehirn hinterlassen.

„Es wird postuliert, daß dieser Mechanismus auf einer strukturellen Veränderung beruht, die ‚ablesbar’ sein muß, so daß der Code erneut in der neuronalen Operation des Gehirns Ausdruck gewinnt.” Eccles [5]

Ein Beispiel für diese Beziehung ist die Art, wie Synapsen im menschlichen Gehirn mit plastischen Modifikationen auf Gebrauch und Nichtgebrauch reagieren.

1.3 Ist Intelligenz an bestimmte Netzstrukturen gebunden ?

Nun stellt sich die Frage, ob diese Wechselwirkung auch umkehrbar ist. Kann aus bestimmten physikalischen Strukturen auch auf die ‘übergeordneten Fähigkeiten’ eines intelligenten Netzwerks geschlossen werden ? Kann man zum Beispiel, ausgehend von einer gewissen Netzwerkstruktur, auf das Erkennen einer subjektiven Umwelt, das Entstehen eines eigenen Bewußtseins oder die Entwicklung einer eigenen Sprache schließen ? Diese Untersuchung wird sich dieser Frage in der abschließenden Projektanalyse annehmen. Aber versuchen wir zunächst im Folgenden die Kriterien dieser Untersuchung festzulegen.

1.4 Beschreibungsebenen und Untersuchungskriterien

Wie wie gesehen haben, ist eine Beschreibung des Langzeitgedächtnisses auf zwei verschiedenen Beschreibungsebenen möglich. Einerseits als emergente Eigenschaft (als Erinnerung in unserem Bewußtsein), andererseits physikalisch (als Neuronenimpulse in einem bestimmten, momentan vorhandenen Raum-Zeit-Muster). Diese Untersuchung gliedert sich daher in drei unterschiedliche Beschreibungsebenen – die Systemebene, die Strukturebene und die Elementebene.

Auf der Systemebene können ‘übergeordnete Fähigkeiten’ eines Netzwerkes beschrieben warden. Die Strukturebene widmet sich der Topologie und den strukturellen Eigenschaften von Netzwerken. Auf der Elementebene können physikalische Eigenschaften und Funktionen von Elementen eines Netzwerkes beschrieben werden.

Die Untersuchung folgt fünf Untersuchungskriterien (A, B, C, D, E): auf der Elementebene - der logischen Funktion (A) und der physikalischen Form (B) von Elementen eines Netzwerkes, auf der Strukturebene - der Topologie oder Organisation (C) von Netzen und ihrer Netzwerkumgebung (D), auf der Systemebene – den ‘übergeordneten Fähigkeiten’ (E) von intelligenten Netzwerken.

1.5 Häuser als ‚denkende Pflanzen’ oder als autonome Lebewesen ?

Werden intelligente Häuser zukünftig symbiotische Gesellschaften bilden ? Werden sie sich fortpflanzen, wachsen, kommunizieren und womöglich soziales Verhalten entwickeln ? Wie werden sie sich ernähren ? Oder werden sie nicht viel mehr bleiben als einfache, unbewegliche und denkende Pflanzen, die reflexartig auf bestimmte Reize reagieren ?

Wird ein höfliches Haus die Jalousien zu schließen, wenn das Nachbarhaus schläft ? Wie verhalten wir uns dann gegenüber unserer Behausung ? Hat ein Smart Home in Zukunft ein Recht auf selbständige Existenz ? Wäre es Mord, ihm den Strom abzuschalten ? Sollten wir einmal mit dieser Realität konfrontiert werden, dann werden wir uns vermutlich bereits mit unseren Häusern identifizieren, vielleicht sogar Mitleid empfinden. Spätestens dann sollten wir Antworten auf diese Fragen haben.

2 ELEMENTE, STRUKTUR UND VERHALTEN VON INTELLIGENTEN GEBÄUDEN

Der folgende Abschnitt widmet sich einer allgemeinen, vergleichenden Studie von biologischen und technologischen Netzwerken, geordnet nach den fünf verschiedenen Untersuchungskriterien (A, B, C, D, E). Im Folgenden werden dabei die Begriffe ‘gebrauchte’ und ‘nicht gebrauchte’ Elemente eingeführt und die Modelle von ‘harmonischen’, ‘nicht harmonischen’, ‘symmetrischen’ und ‘nicht symmetrischen’ Netzwerken erklärt. ‘Milgram´s Annahme’ und die Begriffe ‘Random Network’ (Zufallsnetz), ‘Scale-Free-Network’ (Maßstabsloses Netz) und ‘Hierarchical Network’ (Hierarchisches Netz) werden erklärt. Abschließend werden die beiden Strukturmodelle der ‘Organischen Rückgratnetze’ und der ‘Komplexen wuchernden Netze’ vorgestellt. Einige Architekturvisionen schließen dieses Kapitel, und präsentieren den aktuellen Fortschritt auf dem Weg zu einem ‘selbstbewußten’, ‘rationalen’ oder ‘prä-rationalen’ intelligenten Gebäude.

2.1 Konstruktion und Gebrauch von Neuronalen Netzen (Elementebene)

Das menschliche Gehirn besteht aus Nervenzellen (Neuronen), die untereinander verbunden sind und sich gegenseitig über elektrische Signale beeinflussen. Ein Neuron sendet seine Signale über sein Axon und empfängt Signale von anderen Neuronen über seine Dendriten. Die Kopplungsstelle zwischen Axonen und Dendriten werden Synapsen genannt.

In der Netzwerktheorie allgemein anerkannt ist heute die Gliederung in Knoten (nodes) und Verbindungen (links). Knoten entsprechen den Neuronen und Synapsen, Verbindungen entsprechen Dendriten und Axonen. Als Verteiler (hub) bezeichnet die Netzwerktheorie einen übergeordneten Knoten, der mehrere übergeordnete Verbindungen (spokes) zusammenfaßt. Im technischen Netzwerk kennen wir Endgeräte als Knoten (nodes), Verstärker und Router als Verteiler (hubs) und Bahnen für die Signalübermittlung (drahtgebunden / per Funk) als Verbindungen (links / spokes).

2.1.1 Funktion (logisch)

In Ergänzung zur physikalischen Form steht die spezifische Nutzung eines Netzes. Höhl [8]. Diese temporäre Organisation bezeichne ich hier als die logische Funktion eines Netzes; sie ist maßgeblich für die selective Nutzung eines physikalischen Netzes und bildet sich in den sogenannten ‚logischen Adressen’ von Endgeräten ab. Es ist bekannt, daß logische Adressen nicht mit den physikalischen Orten von Endgeräten übereinstimmen müssen. Das Verhältnis der Gesamtanzahl zu den aktiven logischen Adressen gibt Auskunft über die Ausnutzung des physikalischen Netzes, beziehungsweise ‘benutzte’ und ‘unbenutzte’ Elemente.

Interessanterweise sind in biologischen Netzwerken die logischen Funktionen festgelegt und bleiben über die Lebensspanne des Systems gleichförmig bestehen. Zum Beispiel bleibt die Funktion und Lage unserer Hände unser Leben lang gleich. Im Gegensatz dazu verändern sich die logischen Funktionen bei technologischen Netzen während der Lebensdauer eines Systems häufig. Üblicherweise unterscheidet man heute vier funktionale Topologien: 1.) Der Stern, 2.) Der Bus, 3.) Der Ring, 4.) Der Baum.

2.1.2 Form (physikalisch)

Das physikalische Netz besteht aus einer bestimmten Anzahl von Elementen und Verbindungen; sie definieren die sogenannte ‚Hardware’ des Netzes. Innerhalb dieser Hardware können verschiedene technische Merkmale unterschieden werden: 1.) Leistungsfähigkeit, 2.) Größe und Anzahl der Elemente, 3.) Konnektivität des Einzelelements (Anzahl der Verbindungen pro Element), sowie 4.) ‘benutzte’ und ‘nicht benutzte’ Elemente.

2.2 Netzwerkorganisation und Netzwerkumgebung (Strukturebene)

Wie sind biologische Netze und technologische Netze organisiert ? In diesem Zusammenhang spricht man oft von den Phänomenen der Selbstorganisation und Komplexität. Der folgende Abschnitt widmet sich daher der Netzwerkorganisation von biologischen und technischen Netzen und den jeweiligen spezifischen Strukturmodellen.

2.2.1 Selbstorganisation und Komplexität

In Analogie zu technischen Netzen ist auch die Struktur menschlicher Nervenbahnen in vollem Umfang hergestellt, bevor sie ihre Funktion übernehmen. „Wo auch immer man die neuronalen Verbindungen untersucht hat, fand man, daß sie in ihrer endgültigen Form angelegt waren, bevor sie benutzt wurden." Eccles [5]

Heute ist allgemein anerkannt, daß die Bildung und Regeneration von biologischen neuronalen Netzen weitgehend selbstorganisierend über elektrochemische Prozesse gesteuert wird (Selbstorganisation). Bei technischen Netzwerken geschieht beides durch äußeren Einfluß, durch externe Planung und Konstruktion. Wie in der Biologie läßt sich allerdings auch bei technischen Netzen eine allgemeine Entwicklung von einfachen zu komplexen Strukturen beobachten.

Ein interessantes ‚selbstorganisierendes' Projekt ist der Entwurf ‚Generator' von Cedric Price. Es handelt sich dabei um einen elementierten Bausatz von Gebäudekomponenten und Montagekränen. Ein Computer simuliert die vorgeschlagenen Änderungen und entwickelt ‚Fahrpläne' für die Kräne; er koordiniert die Änderungswünsche und das verfügbare Material, sammelt und stimuliert die Nutzerwünsche und optimiert das gewünschte Raumprogramm.

„Die eigentliche Architektur des Gebäudes ist nicht die gebaute Form, sondern das Computerprogramm. Erst mit der Nutzung nimmt das Gebäude eine konkrete Form an, die sich ständig verändert." Flusser [6].

Erfolgt lange keine Veränderung durch die Nutzer, ‚langweilt' sich das Programm und nimmt selbständig Veränderungen am Gebäude vor.

Ein anderes Merkmal biologischer und technischer Netze ist deren Komplexität. Sie ist nicht nur ein Maß für die Eigenschaften der Topologie des Netzwerkes (wie zum Beispiel Art und Anzahl der Netzwerkverbindungen), sondern auch für das Verhältnis zu benachbarten Systemen und die Einbindung in den Gesamtorganismus. Anhand dieses Kriteriums können wir unterschiedliche Netztopologien unterscheiden, wie zum Beispiel ‚harmonische' oder ‚disharmonische' Netze.

2.2.2 Netztopologien und Strukturmodelle

In Anlehnung an die üblichen formalen Struktureigenschaften unterscheiden wir sowohl bei biologischen, als auch bei technischen Netzen 'symmetrische' und 'asymmetrische' Netze. Carnap [3]

Allgemein anerkannt ist heute die Annahme, daß biologische Netze drei verschiedenen Strukturmodellen folgen – 1.) Zufallsnetzen (Ramdom Networks), 2.) Maßstabslose Netze (Scale-free Networks) und 3.) Hierarchische Netze (Hierarchical Networks). In Anlehnung an die aktuellen Forschungen von Wuchty et. al. [16] scheinen neuronale Netze generell dem Typus des 'Maßstabslosen Netzes' zu folgen. 'Maßstabslose Netze' unterscheiden sich beispielsweise von 'Hierarchischen Netzen' in der Art der Clusterbildung und im spezifischen Wachstum.

"With the introduction of new nodes, already highly connected nodes are more favoured to be connected to the new one, than less connected nodes." Wuchty et. al. [16]

In dieser Untersuchung wird ebenfalls von Milgrams Annahme [13] ausgegangen, daß zwei beliebige Punkte in einem beliebigen Netzwerk (biologisch und technologisch) über nur sechs dazwischenliegende Punkte verbunden werden können.

2.2.3 'Organische Rückgratnetze' and 'Komplexe wuchernde Netze'

Das menschliche Nervensystem besitzt eine dreiteilige Struktur. Es besteht aus 1.) dem zentralen Nervensystem (Gehirn und Rückenmark), 2.) dem peripheren Nervensystem (afferente und efferente Nervenbahnen für Sensorik und Motorik) und 3.) das vegetative Nervensystem. Das gesamte Nervensystem verhält sich zum Aufbau des Gesamtorganismus ‚harmonisch'. Seine Organisation ist symmetrisch und geschieht immer getrennt von Nachbarsystemen. Beispielsweise durchdringen die Nervenbahnen nie die Knochen oder den Blutkreislauf.

Bei technischen Netzen zur Nachrichtenübertragung unterscheiden wir zwei zunächst zwei Gebäudetypen nach deren Konstruktion – Massivbauten und Skelettbauten. In beiden Gebäudetypen ist übereinstimmend eine Zweiteiligkeit des technischen Netzes zu finden – 1.) Zentrale Steuerung, 2.) Sensorik und Motorik. Bei Skelettbauten greifen die Leitungen des technischen Ausbaues nicht in benachbarte Systeme (wie z. B. die Gebäudekonstruktion) ein und ordnen sich der Gesamtstruktur ‚harmonisch' unter. Im Gegensatz dazu entwickeln sich die Leitungsbahnen des technischen Ausbaus bei Massivbauten eher frei; sie greifen oft in die tragende Substanz ein und entwickeln eine eigene ‚disharmonische' Struktur, unabhängig von der Form des Gebäudes.

Es lassen sich daher zwei grundlegende Strukturmodelle unterscheiden. Bei Skelettbauten beobachten wir oft sogenannte ‚organische Rückgratnetze' (‚organic backbone nets'), ein homogenes und harmonisches Netz mit einem zentralen ‚Rückgrat', bei Massivbauten beobachten wir oft sogenannte ‚komplexe wuchernde Netze' (‚complex exuberant nets'), ein heterogen wachsendes Netz mit unbenutzten Rudimenten.

2.3 Bewußtsein und soziales Verhalten (Systemebene)

2.3.1 'Rationale' and 'prä-rationale' Intelligenz

Oft wird behauptet, daß verschiedene Formen von Intelligenz den Menschen vom Tier unterscheidet. Die Entwicklung von Sprache, rationaler Kritik und eines selbsterkennenden Bewußtseins sind Kernpunkte dieser Unterscheidung. Unbestreitbar zeigen aber auch

Tiere intelligentes Verhalten, das nicht an die Verwendung von Sprache gebunden ist. Allgemein anerkannt ist daher die Unterscheidung zwischen ‚rationaler' (sprachgebundener) und ‚prärationaler' (nicht sprachgebundener) Intelligenz. Cruse [4]. Wir können daher annehmen, daß auch für technologische Netzwerke die Ausbildung von sowohl ‚rationaler' als auch ‚prärationaler' Intelligenz eine Rolle spielen kann.

2.3.2 ‘Organics', ‘Variomatic und ‘The Growing House'

Systemeigenschaften wie Ernährung und Stoffwechsel, Vermehrung und Fortpflanzung, Wachstum, Bewegung, Reizbarkeit und Regulationsfähigkeit sind zentrale Fähigkeiten von biologischen Netzwerken. Technologisch gibt es für diese Fähigkeiten von Gebäuden nur einige Visionen, realisierte Beispiele gibt es bisher keine.

1960 entwickelt William Katavolos [10] die ersten Überlegungen zu seinen ‚Organics'. Häuser aus einer selbstkatalytischen chemischen Substanz, die „... aus großen Kreisen einer öligen Substanz ..." selbst entstehen (Wachstum), sich zu einem „... Netz von Streifen und Scheiben ..." entwickeln und schließlich Hohlräume bilden. Diese Konstruktion ist wandlungsfähig „... in Hinblick auf gewünschte Festigkeiten ...". Deren Wände beinhalten eine Vielfalt von intelligenten chemikalischen Geräten; sie reinigen, heizen und kühlen die Luft, versorgen und entsorgen das biomorphe Gebäude. (Regulationsfähigkeit) Speisen werden chemisch gekühlt, Abfälle chemisch wiederverwertet. (Stoffwechsel) Spontan aus der Gebäudehülle wachsende Stühle und Duschen reagieren auf die Bedürfnisse der Bewohner (Reizbarkeit). Katavolos spricht seiner Vision sogar ein gewisses soziales Verhalten zu.

„Am Morgen könnten sich Vororte zu Städten vereinigen; nachts sieht man sie sich wie Musik nach anderen Orten verlagern, etwa zur Befriedigung kultureller Erfordernisse oder um politische oder soziale Gefüge zu bilden, die das neue Leben verlangt." Katavolos [10]

Zur Zeit beschäftigt sich Katavolos [11] mit dem Projekt der ‚Liquid Villa'. Er experimentiert dabei mit gas- und flüssigkeitsgefüllten Membranen, die stabile Tragwerke entwickeln. Sie könnten zum Beispiel auf Wasser schwimmen oder in Wüstengebieten als Wassertanks dienen.

Weitere Beispiele für bewegliche Konstruktionen (Bewegung) wären die ‚Parascape Structure', der ‚NH-Pavilion' und ‚Variomatic' von Kas Oosterhuis [14], die ‚Walking Cities' von Archigram [1] und das ‚Flexstrut Theatre' von Johansen [9]. In seinen Visionen der ‚Metamorphic Capsule' und des ‚Growing House' erwähnt Johansen ebenfalls die Selbstgenerierung und Selbsterhaltung von Gebäuden (ability to sustain life itself) (Stoffwechsel). Er sieht die Lösung dieser Fähigkeit einerseits im zukünftigen Einsatz von Nanotechnologie und Artificial Intelligence; andererseits nennt er eine genomische Konstruktion in einer Art ‚Fibrovascularem System' aus Carbonfaser. Die Frage, ob diese Gebäude bereits ein erkennendes und bewertendes Bewußtsein besitzen, bleibt bei allen Autoren offen. Gebäude, die eine eigene Sprache (Kommunikation) oder Fähigkeiten von Schwarmverhalten oder Brutpflege entwickelt haben, sind bisher unbekannt.

3 INTELLIGENTE FÄHIGKEITEN VON R 128

Nach vorangegangenen Untersuchungskriterien betrachten wir nun im Folgenden das Projekt R 128 von Werner Sobek in Stuttgart. Blaser [2]

3.1 Vom Bewohner ‘lernen'

Dieses Projekt besitzt einige intelligente Fähigkeiten, sein eigenes Verhalten an das Verhalten der Benutzer anzupassen. Intelligentes Systemverhalten, wie zum Beispiel ein erkennendes Bewußtsein, konnte bisher nicht beobachtet werden.

3.2 Fünf ‘harmonische' und ‘hierachische Netzwerke'

Die haustechnische Installation gliedert sich in fünf verschiedene Steuereungsnetze: 1.) Klima, 2.) Elektro, 3.) Sicherheit, 4.) Sanitär, 5.) Haushalt. Diese fünf Steuerungsnetze verhalten sich zur vorhandenen Stahlkonstruktion und zur Gebäudeform ‚harmonisch'. Nach der Struktur handelt es sich dabei um ein symmetrisches ‚organisches Rückgratnetz'. Interessanterweise wurde diese grundlegende Struktur um sogenannte ‘optionale Schleifen' erweitert. Dies sind zirkuläre Schleifen in jedem Stockwerk, reserviert für die Nachrüstung von Leitungen und Knoten. Unbenutzte Knoten und Verbindungen können einfach entfernt oder ersetzt werden. Daher sind die Netze offen gegenüber funktionalen Veränderungen. Alle diese fünf Netze besitzen eine sehr geringe Komplexität und eine zweiteilige Struktur (Steuerung, Sensorik und Motorik); ihre Struktur entspricht eher einem ‚Hierarchischen Netz' als einem biologischen ‚Maßstabslosen Netz'. Die Annahme Milgrams [13], daß jeder Punkt im Netzwerk nur über sechs andere Punkte miteinander verbinden ist, konnte hier leider nicht nachvollzogen werden. Zu den Elementen des Netzwerks liegt zur Zeit leider keine Information vor.

3.3 ‘Optionale Schleifen' und zukünftige Forschung

Nun, wohin mit den Leitungen und Servern in intelligenten Gebäuden ? ‘Organische Rückgratnetze' mit ‘Optionalen Schleifen' haben sich als praktikable Lösung im Projekt R 128 von Werner Sobek bewährt. Vielleicht ware das eine Lösung für andere technologische Netzwerke in Skelettbauten ?

Besitzen biomorphe Netzwerke, wie ‘Organische Rückgratnetze' mehr intelligentes Potential als ‘Komplexe wuchernde Netze' in anderen intelligenten Gebäuden (wie z. B. im in-haus in Duisburg) ? Würde ein komplexeres Netzwerk (nach Milgrams Annahme) besser funktionieren oder sogar intelligentes Verhalten zeigen ? Welche Vorteile hätten zum Beispiel dreiteilige technologische Netze, ausgerüstet mit einer Art selbsterhaltendem ‘vegetativen Nervensystem' ?

Dies könnten interessante Fragen für eine zukünftige Forschung sein.

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Identifying the necessary information for a spatial decision: Camping for Beginners

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5 ZUSAMMENFASSUNG

Viele der heutigen Informationssysteme überhäufen den Benutzer mit Information. Diese Informationsüberflutung kann Konsequenzen wie geringe Akzeptanz und dadurch bedingte geringe Nutzung der Daten hervorrufen. Vor allem bei geographischer Information fehlt oft eine nützliche Präsentation der Daten. Schlagwörter wie intuitive geographische Informationssysteme, flexible decision support system und leicht zugängliche geographische Daten sind in den letzten Jahren in der Literatur aufgetaucht. Trotzdem ist das Problem, dass eine bestimmte Zusammenstellung an Information zu einem bestimmten Zeitpunkt einem bestimmten Benutzer auf seine spezielle Frage hin nicht präsentiert werden kann, weit verbreitet.

Das Fallbeispiel betrachtet eine Familie, die mit ihrem Camper an einem Campingplatz ankommt. In diesem Fall ist der Campingplatz ein Beispiel für eine geschlossene räumliche Einheit. Diese Einheit besteht aus verschiedenen aber limitierten räumlichen Elementen. Räumliche Entscheidungen werden deshalb nur von einer begrenzten Anzahl von Faktoren beeinflusst. Der Tourist stellt die Frage „Wo ist der beste Platz, um den Camper zu parken?“ Die Auswahl des Standortes hängt von einer Reihe von Kriterien ab. Um eine Entscheidung treffen zu können, müssen diese Kriterien kombiniert und evaluiert werden. Die optimale Lösung bestimmt den passenden Platz auf dem Campingplatz. Dieser Optimierungsprozess ist eine Entscheidungsstrategie die man als *spatial allocation process* bezeichnet. Das Ziel der vorliegenden Arbeit ist anhand eines *spatial allocation process* die notwendige Information für eine räumliche Entscheidung zu ermitteln.

ABSTRACT

Many of today’s information systems overwhelm people with information. This information overload influences the acceptance and thus the usage of the data. Especially, geographic information often lacks a useful presentation. Buzzwords like intuitive Geographic Information Systems, flexible decision support systems and easy accessible geographic data have all appeared in the literature of the last few years. It is still a widespread problem that those looking for geographic data cannot avail themselves of the pertinent information.

We utilize a concrete scenario of a family who arrives with their camper at a campground. In this research the campground represents a closed spatial entity consisting of different but limited spatial elements. Thus, the spatial decision is influenced by a restricted number of factors. The family is confronted with the question “Where is the best spot to park the camper?” The selection of the location depends on a number of criteria. In order to make a decision the criteria have to be combined and evaluated. The optimum solution yields the appropriate spot in the campground. This optimization process is a decision strategy termed *spatial allocation process*. The objective of the present work is to determine the necessary information elements for a spatial decision on the basis of a *spatial allocation process*.

1 INTRODUCTION

When interacting with an information system, have you ever had the feeling that you didn’t receive the right information for your decision? Why does this happen? Are we unable to extract the right information from an information system or is it the system, which does not contain the necessary information? Ordinarily the answer is negative. We are proficient enough to retrieve the information and more than enough information is stored into the system. So where does the problem come from?

Imagine a messy room. Even though you know that a specific item you are looking for is there, it remains hidden. It is impossible to find anything because the placement of items in that room is complex and unorganized. It takes time to locate the desired item. When we use Geographic Information Services we are interested in the answer to our question but not in the structure of the system. The time frame for getting information such as: what is the fastest route from A to B or where is the closest gas station or is a service available within a certain area, is limited. A comparison between the aforementioned messy room and a GIS user interface is instructive: the information is in the system but for most of us it is hard to find.

The purpose of this paper is to introduce a different approach in presenting data within an information system. One gets the impression nowadays that an information system is considered to be powerful if it includes as much data as possible. This can results in user interfaces as complex as messy rooms.

Users often don’t know what they want from a GIS because it is difficult for them to estimate all the possibilities. Thus for the system designer considering the question of “What does each user want to do?” is not a trivial issue. In general, a user wants to take situational spatial decisions on the basis of the information presented in a GIS. The user only requires the necessary information to take this decision. This necessary information will be the central part of this paper. Hence this paper is not about cleaning up the mess in a room but rather circle the information important to answer a specific question.

Circling the necessary information with a marker means providing the user only with the necessary information for the decision. To identify the necessary information it is imperative to analyze the decision process and to point out the individual steps in a decision making process. In the present work I take the approach to investigate a concrete spatial decision. Deciding to park a camper in a campground will serve as a simple case study. The challenge is to investigate an ordinary spatial decision on the basis of a *spatial allocation process*. Spatial allocation is the distribution of spatial resources to a specific task. A *spatial allocation process* can be described as a multi criteria decision strategy (Ekholm and Fridqvist 1996; Eastman, Hong et al. 1998).

The tendency that a huge amount of data is included in an information system and the fact that information systems are often technology driven motivates this work. The paper is structured as follows: The next section shows how users handle information systems, section five will talk about decision making and section six will introduce the case study. At the end there will be a conclusion and an outlook concerning future work.

2 SYSTEM COLLABORATION

What are all these technical things for if we don't know how to use them?(Norman 2004) Correspondingly we could ask what are all these data for if we don't use them? Overall two systems have to work together. The human system that is difficult to model and the computer system that always represents a portion of the real world. When a user wants to take a decision on the basis of an information system, the collaboration between him and the computer system has to work well.

Spatial information systems are based on spatial information theories. The observation is that both the theories and the system are rather machine oriented than towards their users. Instead we need spatial information theories for users of such systems. Reasons for confusion are often insufficient explanation for the actual and the potential behavior of the system they have to cope with. One way of making life easier for a user is finding metaphors, which provide analogies to the real world. This creates structures for systems that appear abstract to the user. Thus they act as sense makers to the user (Kuhn 1993).

The GIS user interfaces people had to deal with, changed over time. Thus the way of interacting with systems changed as well. The evolution of user interfaces has gone from black box systems, where the user interacts through commands with the system to glass box systems up to systems integrating virtual reality. Glass box systems are equipped with a graphical user interface; the user gets the impression that he can witness what is going on in the system. Manipulating, communicating, browsing, playing, seeing or viewing are paradigms that are established by components like the user's role, the system's role, the style of communication, and the channels used. Identifying these components is a step towards reducing the complexity of systems. Kuhn states that we should elaborate more on problems the user actually wants to solve with a system. He suggests a move away from technology to focus on a user oriented GIS (Kuhn 1992; Egenhofer and Kuhn 1999).

When investigating a user's interaction with a spatial information system it is important to investigate the issue of spatial decisions. Nearly every human activity requires space. Still we are not very experienced in dealing with spatial information. Space is a finite and non-renewable resource and its use requires a very careful and thoughtful planning and management. Frank states that the user does not use much of all the data that is available in a system like a GIS. Users cannot discover all of the data because the system's functionality seems to be too complicated. A system is only as useful as the information that a user can gain from it (Frank 1993).

Since data is the most expensive part within a GIS it is important to reduce the amount of necessary data. Data maintenance is an important but expensive part for keeping the GIS up to date. Therefore, it is important to consider what data does the user need for spatial problem solving and what data is less relevant to him.

3 DEPENDING ON THE QUESTION

When people make decisions, they are usually choosing between two or more alternative courses of action (Yntema and Torgerson 1967). An information system should support decisions and a Geographic Information System should support spatial decisions. These decisions can only be sufficiently supported if the user can navigate the system. Thus the system must convince the user that it is useful for solving the problem. It should be easy for the user to find out how it works and the functionality has to be simple enough (Frank 1993).

3.1 Decisions

In order to increase efficiency when dealing with an information system one should pay attention to decision processing. To deal efficiently with information systems the decision process has to be investigated. As stated above the human system and the computer system are very different. It is important to find a common denominator. Thus the computer system can provide the human system with the necessary information at the right moment. No user wants to spend more time than absolutely necessary to find out how a system works. In fact the system should be convenient, easy to use and the information easy to retrieve.

To a user information is useful if it influences his decision. It is important to relate the data included in a system, to a practical situation or decision where it becomes information. Frank states that all the messages that lead to the same action have the same information content for a user. He calls this the pragmatic content of an information.(Frank 2003) In spatial decision situations it is important to consider a person's knowledge of the surrounding physical world. Different environments demand different strategies for finding things. (Mark and Egenhofer 1996)

A decision problem is defined by the available options. Generally speaking, every decision is enclosed by a certain frame. This frame is controlled by the formulation of the problem as well as by the personal characteristics, norms, and habits of the decision maker. The model of rational decision making requires that the preferences between options are not related to the decision frame.(Tversky and Kahnemann 1981)

3.2 Rational Decisions

Rational decision-making is not at all a realistic model of decision-making, but serves very well for the purpose of this paper. Two things are important for a rational decision of the economic man (homo economicus). The economic man is able to put all the available alternatives into an ordering. Thus it is always possible to tell what he prefers. It is important that the economic man makes a choice always in a way to maximize something (Edwards 1967a; Abler, Adams et al. 1971).

In reality, this does not always apply. Decision-making in real life occurs according to Edwards in sequences. Information is constantly gained. It is either available accidentally or due to former problem solving processes. The decision process that is studied in such changing environments is called a dynamic decision, which is much closer to reality than the decision of the economic man (Edwards 1967b). In a sense the act of making a decision can be viewed as a navigation through a context of available alternatives (Fogel 1967).

These assumptions about the decision-making and the behavior might be unrealistic. If we investigate decisions under such simplified conditions we can use the outcomes to measure decisions in reality (Abler, Adams et al. 1971). It is important to mention that people don't optimize but they act as if they do (Gigerenzer in press). This reinforces the introduced approach.

According to Tversky the maximization principle and the decomposition hypothesis are two important concepts which are part of most decision processes. The maximization principle states that people chose the alternative they consider best due to a criterion related to value. The value of an alternative can be decomposed into basic independent components. These components are all part of the emerging maximized function, which is termed a utility function. Generally speaking, the utility function should reflect the choice and preserve the assumed preference space. People are assumed to rank the alternatives according to utility. The utility of a multi criteria alternative equals the sum of the utility of its components (Tversky 1967).

This maximized utility function leads to the paper's main focus. The decision is modelled as a multi criteria decision-making process termed *spatial allocation process*. The components of a utility function represent the requirements of a user. To solve a problem, these components need to be optimized. This leads to the *spatial allocation process*, namely a decision strategy which always leads to the optimum solution according to a set of requirements.

3.3 Spatial allocation process

Allocation in general is to assign some resource to a task. Satisfying some constraints a spatial allocation assigns spatial resources to a task to achieve a certain goal. A *spatial allocation process* is a multi criteria decision strategy. Using this strategy when making a decision means that there is more than one criterion that needs to be evaluated to reach an optimum outcome (Eastman, Hong et al. 1998).

The *spatial allocation process* can be split up into different stages. It starts with the definition of the problem. The second stage is a systematic listing of all the spatial elements, which are involved in the problem. The next step produces solutions through the combination of the listed spatial elements. Here one must identify the feasible solutions and those which are to be excluded. The final state of the process is the choosing of the optimum solution for the spatial problem. Optimizing something can be seen as the search around the boundary of the feasible area (Abler, Adams et al. 1971) (Wright 1983).

Our case study will focus on this strategy. The paper's core is to show that the data extracted of a system is related to the user's question. Currently Geographic Information Systems contain a huge amount of data. The user's questions have to be adjusted to the available data. A reversed process would consider the user's question first and then try to find the data that is needed to answer that question. At best the enclosed data of a system should be adjusted to the user's questions. This would make the system cheaper and at the same time more user oriented. Instead of providing all possible information only necessary information according to the question is presented.

3.4 Criteria

Problem solving changes the initial state through a sequence of operators into a goal state (Anderson 1996). When we want to solve a problem and want to make a decision we have at least one criterion that drives our decision. A criterion can be seen as the basis for a decision and it can be evaluated and measured. It can not be only a factor but also a constraint. Factors or constraints are measured on a continuous scale and can either encourage or distract from the suitability of a specific alternative for the intended activity (Eastman, Hong et al. 1998).

There are decisions that involve more than one criterion. These multi criteria decisions constitute a central part within a GIS. An example would be the determination of a site for a new supermarket in town. Planners have to follow certain criteria when choosing this site. An allocation can be viewed as a kind of multi criteria decisions; when allocating some resources to a task there are many criteria that are either factors or constraints. In the case study we will refer to criteria as requirements.

4 CAMPSITE

A campsite is like a little unknown village. It is a closed spatial entity and consists of a limited number of different spatial elements. When on vacation a tourist has to make different types of spatial decisions in the campground. The spatial decisions are influenced by a limited number of factors. Thus only a limited number of questions can arise.

In this case study a four-member family arrives at a campground. They drive an average size camper, which contains no bathroom and no shower. In front of the camper there is a tent to be pitched up. The family is now located at the campground's reception. The next step is to look for a proper spot to park the camper. Choosing the emplacement for the camper should be done carefully so that the recreation factor is maximized. The family does not want to change the spot during the vacation. This would be connected with lots of work, reorganization and additional stress. All requirements of the family members have to be taken into account when selecting the spot that provides the highest recreation factor. The requirements considered in this paper are not dependent on the tourist's perception abilities. We consider that all average tourists perceive the elements on the campsite equally.

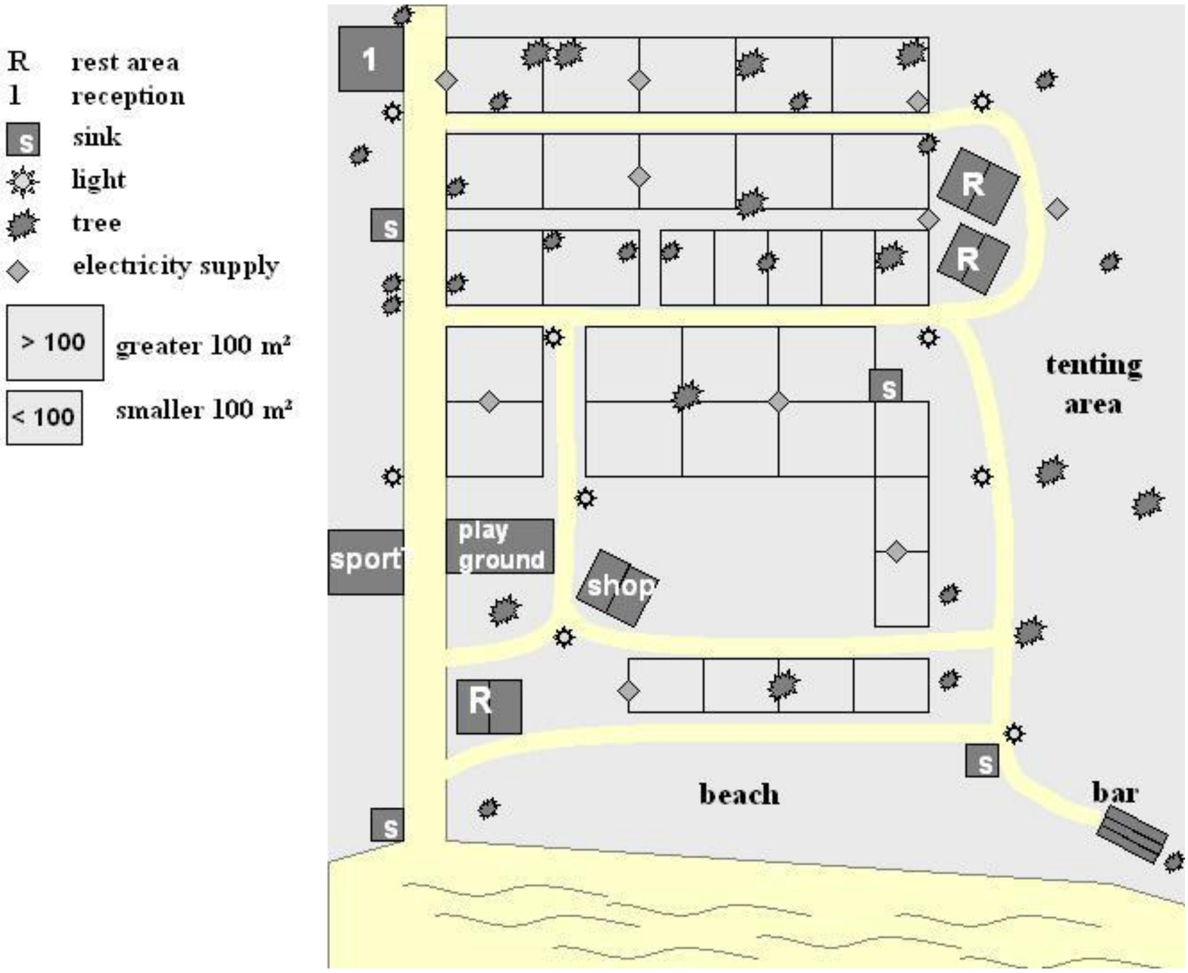

Abb.1: Map of Campsite

4.1 Requirements

The family's different requirements correspond to the criteria or constraints mentioned above. The requirements try to optimize the spot where the family is going to spend their vacation. The family's goal during the vacation is to maximize the amount of recreation during the vacation. In our case the family members know exactly what factors have to be optimized in order to achieve this objective. The question is "Where is the best spot to park the camper" This question always refers to their particular requirements that the optimum spot has to accomplish.

First of all the ideal spot must be vacant. A campground is usually divided into different categories of polygons. At this campground three categories of polygons are available. The family knows that the optimum polygon has to be at least 100m² there will not be enough space for both camper and tent. It must also be easy to access because the camper is quite big. The site should be shady and therefore surrounded by some trees, because otherwise at noon it will get too hot for the kids. Furthermore, there needs to be a source for electricity to run the various appliances in the mobile home. Also, the camper and the rest area should preferably not be right next to each other. The optimum spot must be close to the beach, so that the kids can to go there on their own. To facilitate washing the dishes a sink should be close to the polygon.

Vacant	**a**
Bigger than 100m²	**b**
Easy to access	**c**
Close to the beach	**d**
Shadow	**e**
Provided with electricity	**f**
Not right next to the rest area	**g**
A sink should be close to the polygon	**h**

Tab. 1: Table of requirements

4.2 Acquiring the necessary information

Table 1 shows all the requirements that have to be met. All requirements have to be greater than zero. The next step will identify the information needed to produce possible solutions.

Information Elements

	vacant (a)	Parcel at least 100m² (b)	easy to access (c)	close to beach (d)	shade (e)	electricity supply (f)	no rest area close by (g)	water availability (h)	Sum
street segments	0	0	**1**	0	0	0	0	0	**1**
beach	0	0	0	**1**	0	0	0	0	**1**
trees	0	0	0	0	**1**	0	0	0	**1**
electricity	0	0	0	0	0	**1**	0	0	**1**
rest area	0	0	0	0	0	0	**1**	0	**1**
bar	0	0	0	0	0	0	0	0	0
street lights	0	0	0	0	0	0	0	0	0
size	0	**1**	0	0	0	0	0	0	**1**
shop	0	0	0	0	0	0	0	0	0
reception	0	0	0	0	0	0	0	0	0
sports	0	0	0	0	0	0	0	0	0
sink	0	0	0	0	0	0	0	**1**	**1**
playground	0	0	0	0	0	0	0	0	0
parcel tenant	**1**	0	0	0	0	0	0	0	**1**

Tab. 2: Relation of requirements and available attribute data

Table 2 shows the relation between the requirements and the available information. The family wants to find the optimum spot for their camper. Therefore the needed information is part of the polygons attribute data. The polygon attribute data is listed on the left side of the table above. The rows represent the requirements. All the required information is marked with a 1.

The polygon has to be *vacant* otherwise the family cannot put their camper on the polygon. Therefore we need the attribute *parcel tenant*. If the polygon has already a parcel tenant then it is not available anymore. The attribute size is relevant to the requirement *big*. The requirement *easy to access* needs the information street segments. This information tells the tourist if street segments surround the polygon. Trees are important to fulfil the requirement *shade*. Only those polygons that include trees can be feasible polygons. The information electricity determines the distance between the polygon and the *electricity supply*. This is important because the camper's electricity cable might not reach the electricity supply. The information where the beach is in relation to the polygon is important to satisfy the requirement *close to the beach*. The information *rest area* is important to fulfil the requirement that the demanded polygon is not too close to them. This again is an issue of distance. In order to guarantee the availability of water it is important that a sink is close to the polygon.

Polygon		
	street segments	border of polygon
	Beach	distance polygon to beach
	Trees	trees within polygon
	Electricity	distance polygon to electricity supply
	rest area	distance polygon to rest area
	size	polygon size
	sink	distance polygon to sink

Tab. 3: Needed information to decide where to park the camper

The emerging utility function for the question "Where is the best spot to park the camper" would further be:

$$\boldsymbol{F(polygon)} = a + b + c + d + e + f + g + h$$

If a different person would ask a question then the elements of the utility function would be different. The elements in this function are always greater than zero, because if something is not required it does not influence the function at all. The requirements can be seen as the input and the needed information as the output. Further a certain amount of requirements results in a certain amount of needed information. Thus the output is related to the input. The function is defined in the range of [0, Ea]. *Ea* being all the elements that are available on the campsite. For example the function is not defined for the requirement *close to cinema* because a cinema does not exist on this campsite.

4.3 Producing Results

To produce a result all attributes could be questioned with a conditional clause.

If (polygon tenant = true) then (invalid) else (valid)

If (polygon borders streets) then (valid) else (invalid)

If (distance polygon to beach <150m) then (valid) else (invalid)

If (polygon includes trees) then (valid) else (invalid)

If (distance polygon to electricity supply < 50m) then (valid) else (invalid)

If (distance polygon to rest area >100m) then (valid) else (invalid)

If (polygon >100 m²) then (valid) else (invalid)

The result of this query would be an optimum solution according to the requirements and the question. The purpose of this work is not to actually produce the optimum solution. The focus is to emphasize the relevance of a user's question. The needed information to answer the question is related to the question and the user's requirements.

A step towards a more realistic model would be if we accommodated the requirements with different weights. The user could then indicate how important the requirement shadow compared to the requirement adjacency to the beach is. The result of the optimum polygon would then vary according to the weights the user's preferences.

The result could be calculated as

$$Ni = xi\,\boldsymbol{a} + xi\,\boldsymbol{b} + xi\,\boldsymbol{c} + xi\,\boldsymbol{d} + xi\,\boldsymbol{e} + xi\,\boldsymbol{f} + xi\,\boldsymbol{g}$$

Ni being the optimum output according to the weighted requirements and xi = weight

The concept of an interactive, direct manipulation system is a method to modify weights through the user interface. This interactive display allows the user to experiment with the requirements by changing weights and thresholds. This causes a change in the appearance of the display (Frank and Achatschitz 2004).

Personalized spatial decision-making has been shown for location-based services. The user interface offers possibilities like choosing the decision criteria, setting the importance of criteria, and defining the decision strategies. This example uses the order weight method to calculate the decision strategy (Rinner and Raubal forthcomming 2004).

Various existing applications are personalizing the user interfaces in different ways. Thus there is no doubt that personalization already exists. Accentuating the user's question is something that is the basis for a personalized user interface. It is so to speak foundation of a user interface where the user can set certain criteria or change the weights of those criteria.

5 CONCLUSION AND FUTURE WORK

Here we have shown with a simple example what information a user needs to answer a specific spatial question. In this case the question was where to park the camper. We showed that the user's question and the requirements are the key to obtain the needed information. To achieve this goal a *spatial allocation process* has been employed. This strategy always starts with the user's question. The question and the associated requirements lead to the needed information to answer the question. To find the answer one must consider the necessary information. Next out of the feasible solutions we have to determine the optimum one.

The rational user in our case study knows what the requirements for the optimum spot to park the camper are. The components of the emerging utility function correspond to the needed information to accomplish the requirements. For the requirements of the camper the needed information are the components of the utility function. This shows that according to the question there is only a limited number of needed information to answer a user's question. It is not the solution that is important rather it is the extraction of the needed information out of an information system. Because a GIS enjoys many different users, there arise a multiplicity of questions to answer.

This paper is the first step towards an attempt to determine the amount of necessary data that a GIS has to have to answer the majority of user questions. Future work will include the delete weighting of components of the utility function. This paper is the basis for continuing the research on the central problem how to determine the information a system designer has to put into a system. The maintenance of data is expensive and useless if the data is not used. The system has to provide the data so that the user can get the needed information to answer the question.

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REDUCING LANDSCAPE VALUES UNCERTAINTY

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ABSTRACT

The paper primarily deals with the degree of uncertainty that brings uneasiness when considering a land-use plan that is perceived as the outcome of planning procedure. Specifically, the paper addresses the issue of uncertainties that follow social value systems attached to a landscape. There is no professional consent about the question of value that ought to be attributed to protection. Apart from the usual exception to the rule that intrinsic or predefined values are apparently still firmly entrenched in landscape planning practice, at the pedagogic level of the discipline there is a shift towards extrinsic values. The underlying premise of the paper is that evaluation of natural systems based on predefined values makes consent between developmental and conservational interests impossible. In order to fulfil the key landscape planning principle - "as low as reasonably achievable" (ALARA), the analytical phases of the planning procedure should mandatorily involve or acquire information derived from human relation to nature. Or in other words, in order to be truly socially responsible, a planner should consider multitude of conservational goals and his/her expert knowledge should provide transfer of such conservational goals into different value definitions of the same environmental component or system as whole. That is argued to be prerequisite point of departure for optimisation planning procedures. The paper will begin by brief outline of two fundamentally different value categories. Their reflections or consequences in land use decisions concerning present conservational policy in Croatia will be discussed next. By extension, the "extrinsic vs. predefined landscape value" dispute will be argued from the teaching point of view, especially concerning those elements that invoke difficulties while generating and/or linking the concepts of evaluation models. The paper will finally acknowledge a platform of three value systems as an appropriate mode to cope with the uncertainty within planning process.

1 INTRODUCTION

Any planning activity, therefore environmental planning too, is both future orientated and value laden activity. These professionally widely recognized planning characteristic features contain certain level/s of uncertainty that should be acknowledged when resolving diverse concrete environmental problems. Coping with uncertainties i.e. undefined knowledge that is needed but unavailable, is reflected in present environmental tools such as impact assessment and vulnerability analyses, spatial planning process itself and its output - land use plan. The legislative that brings European Directive on Assessment on the Effects of Certain Plans and Programmes on the Environment, therefore an introduction of strategic impact assessment (SEA), could be seen as an effort to reduce uncertainty that is peculiar to land use plans. Every land use plan is based on a forecast of developmental and conservational requirements, therefore appears with certain uncertainty level. Apart from that, uncertainty is present in the social dimension of environmental planning - value system deployed. Recent publications reveal a considerable emphasis on the issue of public participation in planning ranging from general recognition and urge for research into values attached to a landscape, (Kaltenborn and Bjerke, 2002) to characterization of a planning activity as a social process, (von Haaren, 2002). Expert knowledge on the matters that ought to be protected is no longer sufficient, neither is ethically correct. Indispensable information comprises lay people opinions and attitudes toward a landscape. Such information is prerequisite for analytical phases of planning process that is guided by the "as low as reasonably achievable" (ALARA) principle. Multitude and divergence of social values attached to a landscape should be explicitly disclosed and tested within analytical planning phases. A suitable solution that will assure an environment that is equally pleasant and healthy as human habitat, long term productive and last but not least, as natural as possible is a decision that can be made only if landscape/environmental values are perceived as an interpretation of divergent social attitudes and multitude of social interests toward a landscape, rather than predefined or intrinsic ones. Employing the aforementioned interpretation of divergent social attitudes and multitude of social interests toward a landscape into planning process (extrinsic landscape values), poses some difficulties that should be addressed. The first is the prevailing standardization and/or normative approach to spatial environmental problem solving. The second is the transformation of preference information into the spatial models. Both problem areas are going to be discussed from scholastic perspective.

2 DESIRED FUTURE STATE OF LANDSCAPE: PREDEFINED VS. EXTRINSIC LANDSCAPE VALUES

In order to discuss two different categories of landscape values and differences between them, the terms used must be clarified. Also, a "legitimacy backup" must be provided. To start with former, a value given or attached to landscape prior to actual evaluation stage of the planning process is termed as intrinsic or predefined value. Extrinsic or instrumental value is defined as value of landscape that derives from the synthesis of two parallel lines of analysis: developmental and conservational possibilities. Such value understanding differs considerably from perceptions based on economics background. For example, Pannell and Schilizzi (1997) explicitly claim that intrinsic value of a natural system is a value that exists irrespective of its usefulness or amenity to humans, whereby extrinsic value is defined as a value that arises from the fact that the environment increases the satisfaction of mankind or is useful to them. Extrinsic value is articulated into the existence value (value derived from knowledge of the existence of species, natural habitats and landscape) and option value (value derived from the potential for presently low-value resources to the one becoming higher valued in future). Returning to the aforementioned structural element of sustainability concept, the dimension of economic efficiency still remains an insurmountable obstacle between two professions. Let us consider the following statement: the better the natural conditions for the implementation of technology are – the higher is the value of natural resource in question. If in this hypothetical example the soil is taken as natural resource and agriculture as technology in the broadest sense, then we can agree that natural soil fertility, terrain configuration, exposition, etc. are natural conditions or features that are valuable for agriculture. From the economics point of view, we would be addressing extrinsic landscape value as a value for agriculture. But, if the example given is superimposed with the question: is it right to designate that particular area for agricultural use despite the impacts on landscape that we are aware of?[37] Or, in other words: is this (the agricultural use of a particular area) alternative that is the least harmful to the environment? In that case the answer seems hazy. Inevitably, conservation activities within planning must face that issue. It is believed that additional two suppositions could facilitate the distinction between value types or answer the question. First, a potential change of environment and/or landscape, due to human intervention in it, is the motivation for evaluation. In other words, it is argued that there is no evaluation activity that it is not driven by a possible or envisaged change to be fulfilled in future. Second, advocated characteristics of values from the field of axiology to environmental planning profession, as invoked by Frondisi (1971) are their polarity and hierarchy. The consequence of these value characteristics for the methodology of evaluation we attempt to reveal in this analysis is that values do not have hard boundaries in space. The teaching dimension of this issue relies on the theoretical framework illustrated in Figure 1. At the Zagreb school the diagram serves as a ground were students are introduced to value laden questions such as "what interventions into environment mean to people, to what extent we can reduce them and in what ways we can limit ourselves in using the natural environment"[38], (Marušič, 2002, p.98).

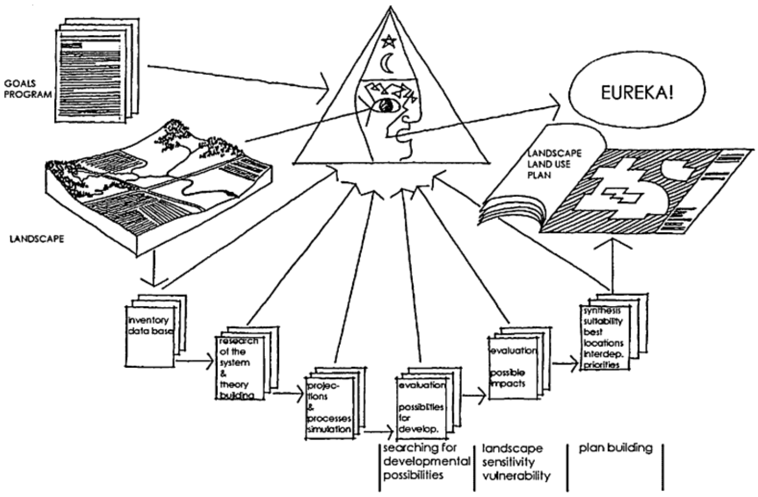

Figure3. Methodology of planning process. Source: Marušič (2002)

Furthermore, within teaching curricula two features of planning process are stressed. First feature emphasised is the identification of the rationality in problem solving as the major paradigm to be followed or at least to what we are striving to in the training. Besides rationality [39], attention is paid to the recognition of the planner's intuition as a complementary approach to the methodology of problem solving. Marušič (2002) reminds that this among other reasons is due to several uncertainty factors. Among different types of uncertainty, uncertainties associated with the value system people attach to environment and/or landscape correlate with the topic of the paper. Finally, at a general level, and without oversimplifying the value dispute, a conscientious landscape planner should be aware of the fact that conservation issues, on the whole, are not as unambiguous as developmental ones.

3 VALUE DISPUTE FROM TEACHING PERSPECTIVE

The reflection of the clash between predefined and extrinsic landscape values is going to be disclosed in the procedure of suitability analysis that is employed as an instrument of spatial optimisation. The focal points are, as seen in Figure 1, the two preceding steps to the plan building: evaluation of possibilities for developmental request/s and evaluation of landscape vulnerability due to a developmental activity. The content of the latter evaluation represents obviously, an assessment of environmental impact. Vulnerability analysis is the point for departure of conservational requests while the results or outcomes of such analyses are providing the stronghold for the use of extrinsic values. The output results should be nothing but the consequences of people conservational interests or requests. The same is true for the outcomes of developmental possibilities assessment as well. When confronted with both lines of analysis, students tend to incline towards the search for developmental possibilities than to vulnerability analyses. Questions of value are here approached directly by asking and thus conceptualising evaluation models: (1) what are the best spatial qualities for the implementation of developmental activity in the given area and (2) what quality systems of the environment would be sensitive due to the developmental activity. Complexity of the latter evaluation model is evident, and this is perhaps not the only factor causing the difficulties that are expressed in the analytical search or difference assessment between existing and desirable qualities in landscape. It may well be that a certain back and forth switch from extrinsic to intrinsic/predefined value of landscape, in environmental quality systems assessed[40], is causing that difficulty. To substantiate this, let us examine student works in evaluation modelling. The evaluation of developmental possibilities (in this example - a golf course) for the planning area was "easily"

[37] Paraphrased ethical principle of respect for nature, Taylor (1986).

[38] Conservation planning task as defined corresponds to the basic planning principle of *as least as reasonably achievable* (ALARA).

[39] By rationality in planning process, understood here is the externalisation of information in a step-by step procedure that leads to the solution of problem.

[40] Landscape vulnerability analysis is performed on standardised three quality systems that originate from three distinctive ethical relations founded in human-nature relationship: qualities of human habitat, qualities/potentials of natural resources and qualities of primordial state of nature. For details see Butula (2003).

conceptualised on the basis of information provided on spatial requests for golf. The concept is transformed into the attractiveness model for golf course, Figure 2. The value appropriation – in this case surveying for golf - is at the information level, dependent on acquired knowledge about this type of recreation activity and scholar “freedom” for activity allocation.

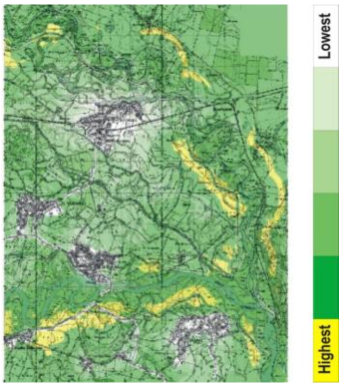

Figure 4. Illustration of the golf course attractiveness model. Source: student landscape planning studio works 2002/2003.

The evaluation of possible impacts - vulnerability analyses - is undertaken on three quality systems, as seen on Figure 3. Conceptual level of models formation consisted of questions: (i) what are human habitat qualities that might be potentially degraded due to activity concerned; (ii) what are qualities for agricultural use of land that might be reduced due to the activity and (iii) what natural habitats are in danger of being anthropogenised due to the activity? The point where the intrinsic/predefined value intrudes into the evaluation is best seen in the vulnerability model of agricultural land-use.

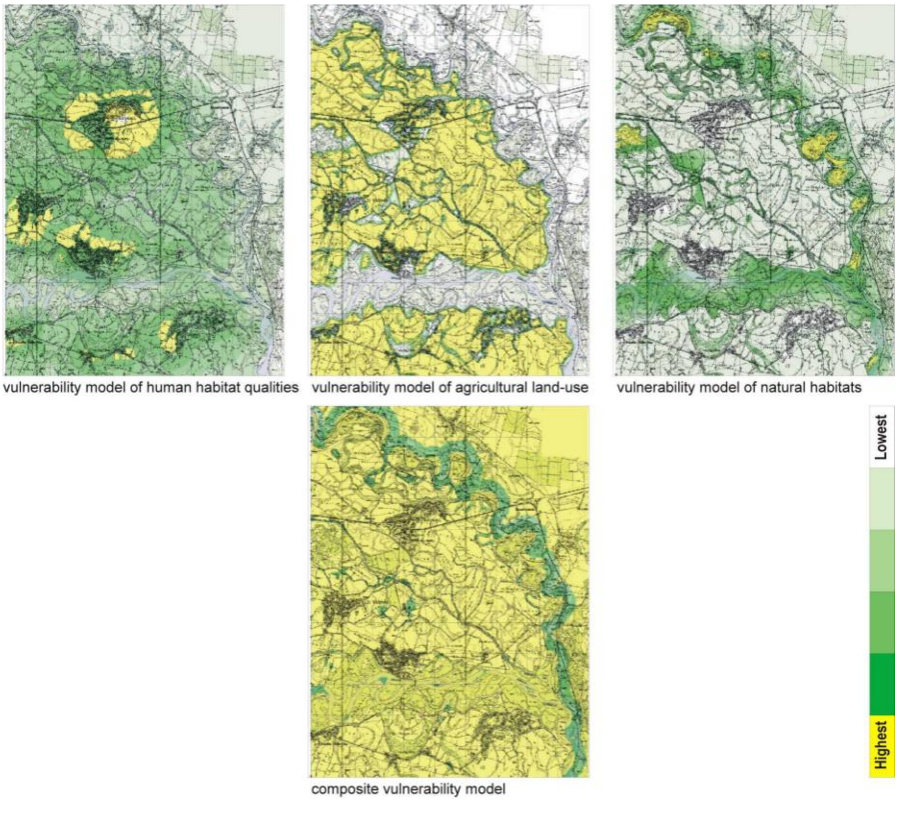

Figure 3. Illustration of the golf course vulnerability models. Source: student landscape planning studio works 2002/2003

It is obvious that model originates from, again at the level of information, the existing agricultural land use. Similar origin of value appropriation is noted in the vulnerability model of human habitat qualities: existing settlements are taken as focal points in value assessment. The third model of nature vulnerability was conceptually oriented to distinct riparian habitats, as shown in Figure 3. This idea was more difficult to accept; instead, students were much more comfortable with the idea that the knowledge of a protected area (ornithological reserve, Figure 4), instantly signalises what is potentially vulnerable if considering naturalness in the area. It should be noted at this point that studio work deployed only the Delfi technique (among students) and short communication with the planning experts as the modes to decrease subjectivity in assessments.

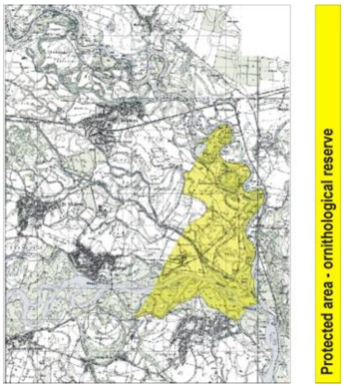

Figure 4. Normative approach to nature conservation.

Nevertheless, two models show that they are, to a certain extent, influenced by predefined values which are observable in "spatial" presumptions that: (i) desirable qualities of human habitat are predefined by existing settlements structures; (ii) desirable potentials for agriculture converge around existing agricultural land. Taking into account envisaged social changes that will be or already are reflected in certain European landscapes, such as Common agricultural policy or effects of information revolution on nature of work, communication and settlements patterns, the desirability criteria listed would not be appropriate. In the formation of the third model, the student group did not initially embrace the instructions given to them as to why vulnerability of naturalness should not be deduced from the predefined value (nature protection area). In the phase of model conceptualisation they argued a need for careful value sift on the base of knowledge derived from conversation with experts and planning documents survey. Unsurprisingly perhaps, the student group was more inclined to the nature vulnerability model than to the other two, identifying it as "subject area" of their future professional orientation. Only at the formation stage of suitability models, they showed understanding of optimisation procedure and preceding value elucidation. They felt comfortable with balancing different people's interests that are illustrated in three distinctive suitability models, Figure 5.

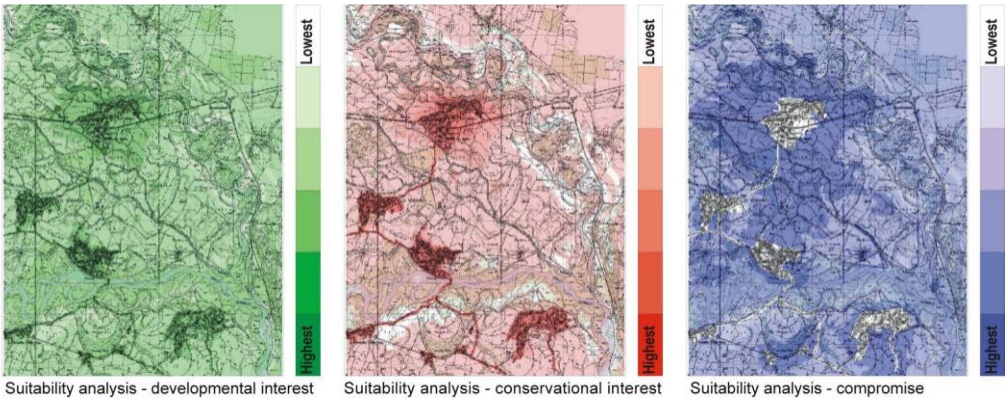

Figure 5. Illustrations of suitability analyses outputs

4 VALUE DISPUTE FROM PRESENT CROATIAN PRACTICE PERSPECTIVE

The specification of Croatian most prominent conservational issues are presented in Table 1. Some of numerous conservation aims and correspondent measures are here depicted in order to illustrate value dispute from the standpoint of active conservational activities within planning. This is used as a tool to get an insight into the actual state of the profession.

PRIORITY THEMES	PROBLEM DETECTED	CONSERVATION AIM	CONSERVATION MEASURE
Waste disposal	Wild deposits Improper allocation	Provide for new locations Restore existing dumps	Site suitability assessment for different categories of waste
Inland waters	Water pollution	Protect unpolluted waters	Categorise sources by use Aquifer pollution danger assessment
Atmosphere	Air and noise pollution	Reduce emission	Categorise territory by degree of air pollution
Adriatic sea, islands and littoral zone	Sea pollution Illegal construction	Protect sea quality Restore and protect spatial identity	Construct and improve sewage system Employ SEA
Agricultural and forestry land	Natural resource loss due to land use change	Prevent land reduction and chemical/physical degradation	Ecological and economical assessment in land loss

Nature conservation	Biological diversity	Habitat lost and pollution Resources overuse	Ecosystem inventory and mapping Integrate sectorial policies	Ecosystem inventory and mapping Vulnerable and/or protected area/ecosystem management plan
	Landscape protection	Irreversible loss of cultural landscapes	Protect and enhance cultural and visual assets	Overall landscape inventory Outstanding landscape evaluation and mapping
	Geological heritage	Uncontrolled mineral exploitation Negative impact from other land uses	Rationalise amount of potential geological degradation	Control over concession permits

Table 1. Conservation activities framework. Adopted from: National Strategy and Action Plan on Environmental Protection (2002)

In order to address the problems listed, they first have to be "translated" in accordance with the planning rule of problem identification, as proposed by Chechile (1991), or needed problem articulation, as introduced by Chadwick (1971): any planning problem equals to obstacles on the way to the goal achievement. Therefore, in general, a task of an analytical phase of conservation planning procedure is to identify the obstacles we may encounter on the way to a planning goal. In particular, and this is within the context of landscape evaluation, value dispute seems to be absent. This observation is based on the character of the envisaged conservation measures. Predefined values, or normative approach to the goal achievement prevail by large with the exception of the Adriatic sea. Here, the envisaged measure of strategic environmental impact assessment (SEA) could be taken as a reflection of optimisation needed. This cross-section of active conservation also shows domination of sectorial approach over comprehensive one. The situation might not be unique for Croatian case only. The discrepancy between educational and practice standpoints are obvious.

5 FINAL REMARKS

Inflexibility of land use plans has been recognised as disadvantageous in the arena of uncertainty. "The plan is the process" was a syntagm frequently used among planning experts about a decade ago. Today, when addressing the uncertainty issue we tend to take the hierarchy concept that could be presented in the sequence: vision - policy management - strategy – land use plan. Such concept of environmental problem solving and, it should be stressed, within the planning process is the manifestation of the need to reduce uncertainty factor. The reduction is possible only if shifting the emphasis away from solely elitist or expert assessment on what values in landscape ought to be protected. That is the reason why values *per se* and/or the process that leads to their elucidation were disclosed as important. The intention was to prompt a more critical look at present situation of landscape evaluation step/s in the procedure of landscape planning and to generate a rethinking process, particularly in the sphere of spatial planning outside urban areas.

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Contribution of local artifacts in assessing spatial experiences
What you keep, what you throw

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ABSTRACT

When we try to utilize a machine, find our way around, or use a service, we look for artifacts which provide us with hints on how to do so. In our paper, we focus on a case scenario, namely, the effort of a traveler to find an underground station. We examine this scenario both from the experienced user's and from the newcomer's perspective. We use agent theory to model the traveler's behavior. We claim that there are similarities in the strategies used by agents when utilizing local artifacts in their effort to perform a spatial task. We differentiate between strategies employed by the experienced and the inexperienced users. We elaborate on the fact that when an experienced user is entering into a new task he utilizes a critical piece of knowledge, stored as resource experience. He has acquired this experience through his involvement in a previous task of similar nature. We examine the aspects used by the novice who does not possess one or more pieces of critical knowledge while seeking to reach his goal. We support that there is a hierarchical array of considerations employed by the agent in his effort to implement the gains of his past experience and we propose a model to assess the artifact's significance and the agents resources experience with a specific spatial task

Wenn wir Maschinen benutzen, uns zu Recht finden wollen oder eine Dienstleistung in Anspruch nehmen wollen, suchen wir nach Artefakten, die uns die bennötigten Hinweise dafür geben. In dieser Arbeit werden wir uns auf einen Fall beschränken, wo ein Reisender eine U-Bahnstation sucht. Wir werden dieses Szenario aus der Perpektive eines erfahrenen Benutzers und eines Neulings untersuchen. Wir verwenden Agent Theorie um das jeweilige Verhalten der Reisenden darzustellen. Wir behaupten, dass es Ähnlichkeiten zwischen den Strategien der betreffenden Personen gibt, wenn sie lokale Artefakte verwenden, um eine räumliche Aufgabenstellung zu bewerkstelligen. Wir unterscheiden zwischen Strategien des erfahrenen und unerfahrenen Benutzers. Wir untersuchen die Tatsache, dass ein erfahrener Benutzer der eine neue räumliche Aufgabe hat, auf Wissen zurückgreifen kann, dass ihm als Erfahrungsquelle dient. Er hat diese Erfahrungen bei vorhergehenden, ähnlichen Aufgabenstellungen erworben. Wir untersuchen andererseits die Situation des Neulings der während er sein Ziel erreichen will kein kritisches Wissen besitzt. Die Überlegungen des Agenten sind hierarchisch aufgebaut Wir stellen ein Modell vor, welches die Signifikanz von diversen Artefakten und Erfahungen des Agenten, bezüglich einer bestimmten räumlichen Aufgabe, bewerten kann.

1 KEYWORDS

Spatial cognition, learning model, artifacts, local artifacts, decision strategy, weighted significance, spatial experience

2 INTRODUCTION

Let us consider the following scenario. A businessman from Vienna is in Paris for a one-day visit and he takes advantage of his free late afternoon hours to visit some of the renowned monuments of the city. Coming from Vienna, he is, as most Viennese, an opera fan and he would like to see the world famous Parisian opera house and, naturally, make all necessary comparisons to the one in his own city. He finds himself in front of the opera house in Paris and he feels very proud to be able to have experienced that moment. It is a warm rainy afternoon with still plenty of daylight. The conditions are not ideal for taking pictures due to dampness, but it is still a must. He would much rather be sited inside and enjoy Carmen, or be given a tour, but as the time is inconvenient for any tour or performance, he decides to move on to visit Notre Dame. After looking at his map which he picked up at the tourist office on his arrival, he is certain that there is an underground station in the vicinity. Given his lack of adequate French, he looks carefully for hints which would point to the entranceway of the station. There is no sign which he could perceive, and he is going through a number of mental processes utilizing locally built elements. We propose in this paper that his special experience is built based on the assessment of these local elements. From this point onwards we will call these elements artifacts. In section 4 we elaborate on the properties of artifacts. Figure 5 shows one type of artifact utilized extensively when moving with public transport, namely signs for the subway stations in four different cities.

Figure 5. Signs for subway stations in different cities

Whether looking for a subway station in a foreign place or trying to find a postal box in an unfamiliar area, we employ very similar strategies based on past experiences and on the affordances embedded into natural and manmade objects which are relevant to our task. Building the new spatial experience is always a composition of both. We use agent theory to model the traveler's behavior when locating the entrance of the subway station. The notion of experience as introduced by Russell (Russel 1921) provides us with a foundation for developing the experience evaluation scheme.

The next section summarizes the agent's properties. Section 5 elaborates on the notion of experiencing the space. In addition, the section provides a distinction between landmarks and artifacts. Section 6 provides a three-class classification scheme for local artifacts based on their components. Section 7 presents the linkage between the importance of the local artifacts and the evaluation of an agent's experience with the spatial task. Finally, Section 8 summarizes the conclusions of this paper and proposes future directions to further this research.

3 THE PARTICIPANT AGENT

We model the participant of the spatial experience as a cognitive agent, namely an agent who cognizes about himself and about his surrounding. The *"agent's architecture characterizes its internal structure, that is the principle of organization which subtends the arrangement of its various components"* (Ferber 1998). Table 2 provides a summary list of features which are possessed by an agent as listed in Ferber.

1. He can act upon the environment.
2. He can communicate with other agents.
3. He is driven by objectives.
4. He possesses resources on his own.
5. He can perceive the environment.
6. He has a partial representation of his environment.
7. He possesses skills and can offer services.
8. He may be able to reproduce himself.
9. He tends to satisfy his objectives using his skills, resources, percepts, representations and output of his communication.

Table 2. Capabilities of the physical or virtual agent –based on (Ferber 1998, pp9)

Our participant in the spatial experience is a goal driven agent. In our scenario, his goal is to locate the entranceway of the subway station. We model his resources based on his level of experience in reference to the local artifacts. We elaborate on the notion of the local artifacts in the following sections of this paper.

4 SPATIAL CONNECTIONS

Talking about space has never been straight forward. From Aristotle to contemporary scientists and philosophers "place" and "space" slides/lingers within a large range of definitions and points of view. For Aristotle "place" holds a large list of quantitative and qualitative properties such as, the replacement, dimensions, enclosure, inclusion, occupation by a separable physical object, characterized by two universal directions namely up and down, forces resulting in motion or rest and as such connected to time, void etc (Aristotle). Couclelis and Gale suggest that an algebraic structure of space can assist in transcending the disarray dominating the scientific community when facing the issue of space. They schematize space looked from six different perspectives namely the Euclidean, physical, sensorimotor, perceptual, cognitive and symbolic and they provide the algebraic axioms and operations that govern each of the above types of space (Couclelis and Gale 1986). Frank proposes algebras as a means for describing spatial features (Frank 1999). The equivocal notion of space is transduced to all its semantically related derivatives, "spatial" being one of them. "Spatial" is defined as pertaining to or involving and having the nature of space (Merriam-Webster 2003).

Experience is linked to gaining knowledge through direct observation or participation (Merriam-Webster 2003). For Russell, experience is an occurrence which could affect the participant's subsequent behavior (Russel 1921). The generation of spatial experience is linked to hierarchical reasoning which occurs in more than one level. Newcombe and Huttenlocher propose a comprehensive scheme of spatial coding colligated to external landmarks and to one's self. In the first category, they differentiate between "cue learning" and "place learning". "Cue learning" provides an association between the physical object which is to be located and an external landmark often linked to habitual placing, such as coding the resting location of someone's car keys at his home. "Place learning" renders coding of distances and directions in relation to external landmarks such as the coding required to search for one's key thought to be dropped in the park at a certain distance from a tree and at a certain direction compared to the zero angle direction between the tree and the playground door for example. In the category of one's self referenced spatial coding Newcombe and Huttenlocher distinguish between "response learning" and "dead reckoning". "Response learning" often mentioned as sensorimotor coding is the codification of a location or of a path through an assemblage of body movements such as the spatial coding required to walk around a familiar place in the dark. Lastly, they propose that "dead reckoning" is the coding which takes place when a location is linked to distance and direction relevant to someone's current position and to subsequent movement. They attribute this spatial coding to animals when foraging in a apparently unvarying terrain (Newcombe and Huttenlocher 2000).

In this paper, we propose that the coding of a spatial experience is also attributed to stationary, moving, and dynamic local artifacts. We suggest that the level of the user's experience influences the utilization strategies of the local artifacts which are pertinent to a task. We propose a simple evaluation model for measuring a user's experience for a certain task linked to the user's ease with local artifacts.

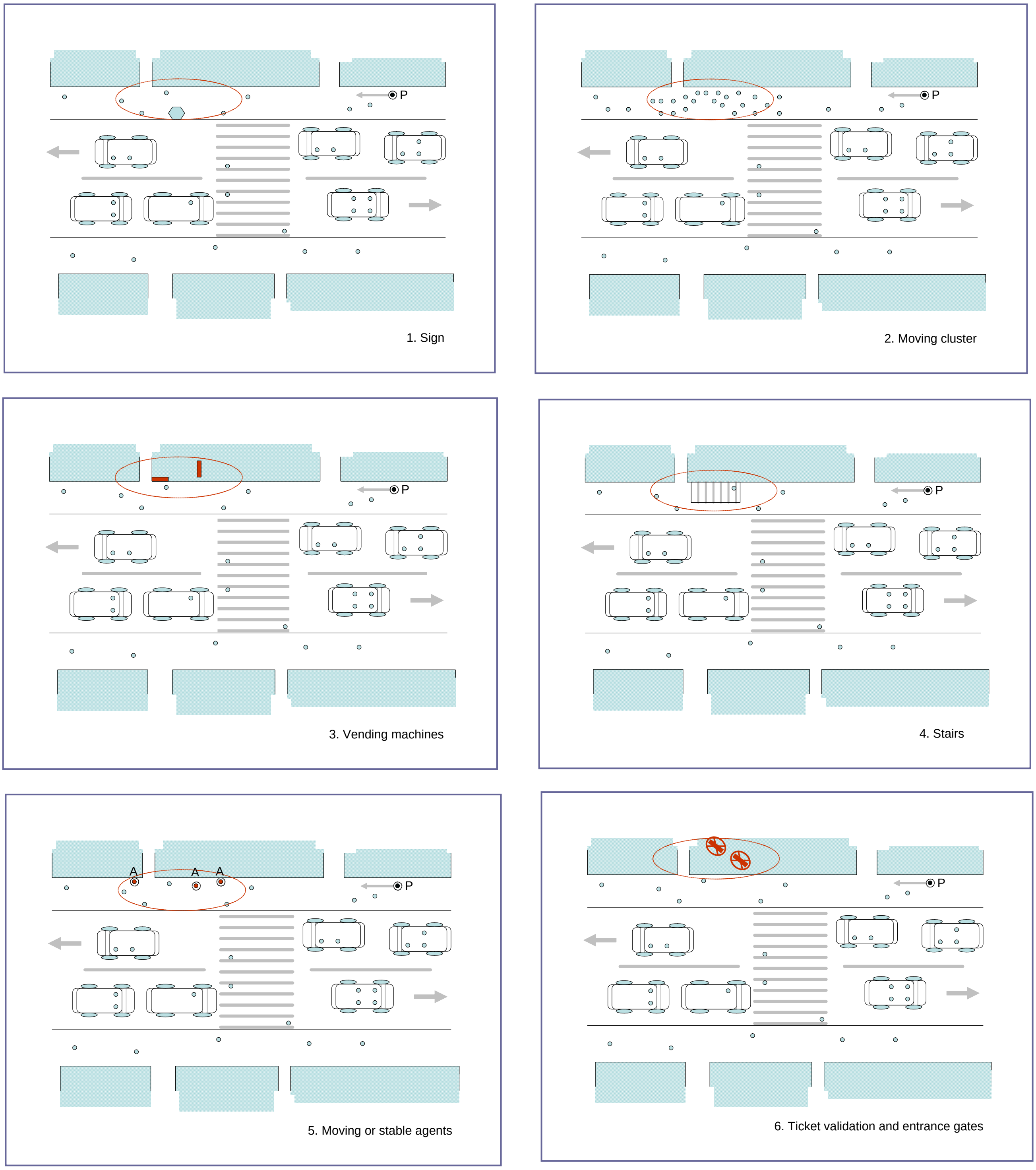

Figure 6. Artifacts used when searching for the entrance of an underground station

4.1 Spatial landmarks and local artifacts

Landmarks or better *spatial landmarks* –as opposed to temporal landmarks referring to certain point of time in the past or a potential time in the future—are defined as fixed markers or prominent and identifying features of a landscape (Morris 1973) and as a point of structure used for referencing (Merriam-Webster 2003). In addition, Lynch ascribes the property of singularity to a landmark bound to stand out from its surroundings (Lynch 1960). We observe here an analogy to the property of distraction of attention which Dewey attributes to natural signs (Dewey 1938). Furthermore, Sorrows and Hirtle distinguish three types of landmarks based on their predominant quality, namely visual, structural, and cognitive landmarks (Sorrows and Hirtle 1999). Nothegger et al. proceed to utilize this categorization in calculating a feature's salience (Nothegger, Winter et al. 2004). We remark, based on the literature, that the two most prominent properties of a landmark is that it is fixed feature, therefore not moving, and that it has the capacity to be used for spatial referencing.

Artifacts are defined as manmade or artificial objects as opposed to natural objects – a distinction for objects provided by Aristotle in his Physics (Aristotle)—which are bound by intentionality (Hilpinen 2004). As a product of a human action, artifacts have a maker or author, author in a generalized sense. Local artifacts are those which carry a significance pertinent to a location thus, their intentionality employs a spatial aspect. Hilpinen proposes an evaluation scheme based on the intended character of an artifact, its actual character and a predefined purpose. He calculates three measures for identifying intensions and purposes namely a) the degree of fit between intended and actual character of an object, b) the degree of fit between intended character of the object and the purpose and c) the degree of fit between the actual character and the purpose.

5 COMPONENTS OF LOCAL ARTIFACTS

We expand the above qualities of an artifact to include movement and changes. We consider that the author of an artifact can be more than a human maker as we will present subsequently. We consider that artifacts carry by default the property of affordance in the same sense as Gibson describes it in the case of a chair which affords sitting and of a handle which affords turning (Gibson 1986) and, as we are expanding, of a coin slot which affords to have a coin dropped in. Concluding here we see that the notion of affordance is embedded into the very definition of artifacts.

Figure 6 demonstrates six different cases of artifacts used by the participant P in his effort to yield the spatial experience of locating the entrance of an underground station in a city setting. The first tile demonstrates a perceivable sign of the subway station. The subway station sign constitutes a *stationary artifact* made by the designer to convey the location of the station to the potential passengers. It is the most commonly used artifact by passengers who can perceive and decipher it. It adheres to semiotic theory as introduced by Pierce and encompasses the elements of a sign's triad (Pierce 1992). The sign-triad consists of the a) likeness which represents the mapping of icons, sounds, gestures of pictures, b) indication which connects to the portion of experience and differentiates between experience and inexperience and c) symbol which connects the idea to the world (Pierce 1992). The formation of the spatial experience is based on referencing in relation to an external landmark as described in Section 4 of this paper.

The second tile of Figure 6 depicts the situation of a participant perceiving a dynamic cluster of people exiting and entering a building. We consider this cluster of people as a *dynamic artifact*. The author in this case is the design of the station. Its characteristic dynamic form, due to the bottleneck phenomenon caused at the door of the building, indicates this cluster's intentionality, namely to exit or enter the station. A spatial experience is codified in this case based on a dynamic artifact. Similar experiences are formed by observing ants moving towards a grain of food on the ground or by connecting a flooded area to a location.

The third tile of Figure 6 presents the case of perceivable ticket vending machines which indicate the existence of a station. The vending machines are considered as *stationary artifacts* created by the transport authority in order to facilitate ticket purchasing. The purchasing of the proof of payment for transport, namely the ticket purchasing constitutes one of the four building block of transport (Pontikakis 2004). Ticket vending machines employ affordances indicative to their intended use in the sense which affordances and knowledge in the world are described by (Gibson 1986) and by (Norman 1993). The spatial experience is again built based on external referencing to a fixed feature.

Similarly, the fourth tile of Figure 6 depicts the situation where a stairway is perceived. We regard the staircase or the periodically moving escalator as a *stationary artifact* made by the engineer to enable the access to a lower level of a facility, in our case the subway station. An escalator affords to be used for descending or ascending and constitutes an external area for referencing a spatial experience.

The fifth tile of Figure 6 depicts a typical situation of moving agents in the vicinity of the entrance of a subway station. Vendors of newspapers and beggars constitute representative types of these agents. We regard these agents as *moving artifacts*. Similarly to the case demonstrated in the first tile of Figure 6, we consider that the design of the station is their author and that their intentionality is bound by their role. Here, the spatial experience is coded based on a moving artifact. Similarly, spatial experiences of an accident, a hospital or a burning area are formed based on an ambulance or a fire truck in duty.

Finally, the sixth tile of Figure 6 presents the employment of ticket validation gates as a means for entering the station. When perceivable, the gates represent a strong indication of the entrance to a station. Particularly in case where the subway station is part of a large indoor complex such as in commercial areas, the entrance gates are sometimes the only artifact which can be used. In such cases, the subway signs and escalators blend in with the rest of the signs and escalators of the surroundings. Similarly to the case of an escalator, we regard the gates as a *stationary artifact* produced by the transport authority to screen the legitimating of the passengers. Ticket validation constitutes a component of the business aspect of a trip with public transport (Pontikakis 2004). The gates afford to be used for passing and screening and contribute to the formation of a spatial experience based on referencing in relation to an external fixed feature.

Figure 7. The entrance of the subway station in Paris across the Parisian opera house

Additional artifacts based on cultural elements can be possibly found in the vicinity of an entrance of a subway station. Figure 6 presents six major ones classified in three major categories, namely, stationary, dynamic and moving artifacts. Often, artifacts are present but are not perceivable due to obstructions. Figure 7 presents the entrance of the subway station across the opera house in Paris. The signs are only perceivable after someone has reached point A or has descended a few steps. The artifacts of the moving clusters and stairways are utilized here to construct the spatial experience. In other cases, artifacts are perceivable but are not decipherable. Figure 8 presents a street car stop in Vienna. Ordinarily, the frame of such a stop is blue, however the one shown here is red. Very few Viennese can tell you what it means to wait at a red framed stop. These type of stops indicate that the transportation vehicle always makes a mandatory stop, independent of the demand of passengers in or out of the vehicle. These stops are named "safety stops". Naturally, this information is of no use to those who are not familiar with this concept.

Figure 8. Street car stop in Vienna

In this section, we discussed three types of artifacts which are utilized when trying to locate the entrance of a subway station, namely *stationary*, *dynamic* and *moving* artifacts. We indicated that the construction of a spatial experience is connected not only to external fixed features, but also to dynamic and moving artifacts.

6 LEVELS OF EXPERIENCE WITH LOCAL ARTIFACTS

In the previous section, we pointed out that not all artifacts which are placed in the vicinity of the entrance of a subway station can be utilized by a participant to build a spatial experience. Some of these artifacts are either not visible because of obstractions or are not perceivable because they blend in with the rest of the environment. There are cases, however, where an artifact is perceivable but is not decipherable such, as the artifact depicted in Figure 8. In this section, we discuss the evaluation of local artifacts for a certain task and we relate this evaluation to the participant's experience.

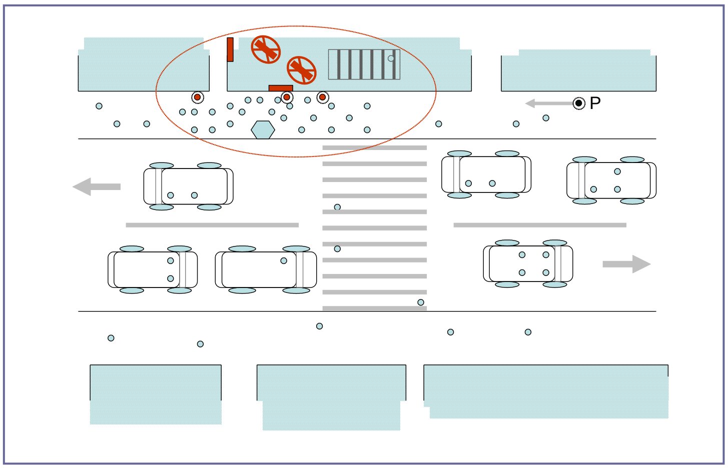

Figure 9. Assemblage of artifacts

Our passenger arrives at the vicinity of the subway either by consulting a map or by asking someone else. We consider this as the base level of the participant's experience. From this level onwards, every artifact which he utilizes is added to his resource experience. We refer to Russell's notion of experience as occurrences which can affect subsequent behavior (Russel 1921). We discriminate here between the resource experience already possessed by the participant and the experience gained through his involvement with the current spatial task. In this paper, we evaluate the relevant experience he already possesses when entering the task.

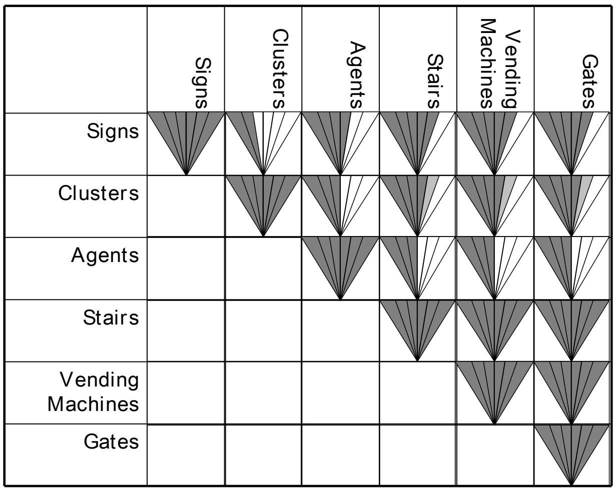

Figure 10. Evaluation mosaic of local artifacts

6.1 Artifact evaluation scheme

We grade each artifact based on a weighting scheme with integers ranging from 1 through 6. The weighting is based on the artifact's *presence* and *visibility*, and it can vary from station to station. The artifact's presence is a boolean value while the artifact's visibility is an enumerated list of integers ranging between 0 and 2, where 0 indicates non visible, 1 indicates partially obstructed, and 2 indicates fully visible. The construction of such schemes is case specific and they can be used by system designers to evaluate different scenaria of the intended use of space based on built-in artifacts. The development of algorithms which can yield case specific results for assisting the evaluation of space by its intended functionality is the subject of subsequent research.

	Presence (*p*)	Visibility (*v*)	Weight (*w*)
Signs	True	2	6
Clusters	True	2	4
Agents	True	2	2
Stairs	True	1	1

Vending Machines	True	1	1
Gates	True	1	1

Table 3. Example of artifact evaluation scheme

Table 3 presents one example of an evaluation scheme where all artifacts are present but they vary in visibility. We can apply this scheme to evaluate the artifacts shown in Figure 9. In this case, all artifacts discussed in section 5 are present, but the ticket vending machines, validation gates, and escalator are located in partially obstructed areas. According to this evaluation scheme, the sign of the subway station employs a higher significance than the moving cluster of passengers, the moving newspaper vendors and other commonly found moving agents.

The "input-output" chart presented in Figure 10 provides a graphical representation of the relevant weights between two artifacts under the current weighting scheme. The larger the shaded area of the triangle, the heavier the weight of the artifact in the corresponding row. This graph assists in quickly visualizing the relative importance of the considered artifacts. Naturally, a change in presence or visibility yields a different weighting scheme for each of the local artifacts.

6.2 Resource experience evaluation scheme

In the case of a passenger who has previously used a subway system and tries to locate the entrance of a subway station perceiving and deciphering the appropriate signs is most likely the first thing he does. At first, we evaluate the participant's experience with an artifact without reckoning the artifact's weight. This is referred to as the participant's *pre-weighted experience* (pre_wE_i), and it ranges between 0 and 1. We attribute the value of "0" pre-weighted experience to the novice and the value of "1" to the experienced participant with the specific artifact. If the sign is present and visible but the passenger can not perceive it, then his pre-weighted experience with this artifact is considered zero. Similarly, if the sign is present and visible and the participant perceives it, but he is unable to interpret it, his pre-weighted experience with the sign is again zero. In the cases where the artifact is present, but it is partially obstructed, if it is perceived and deciphered, then the participant's pre-weighted experience is considered "1". If it is not deciphered, it is the result of a probabilistic calculation, which is a topic of subsequent research. If, however, the sign is present, but it is not visible or if the sign is not present at all, then his pre-weighted experience is independent of the sign, namely non applicable (N/A) for inclusion into the evaluation of a participant's overall experience with the spatial task.

Table 4 provides a summary of the above reasoning.

Presence	Visibility	Perceived	Deciphered	Pre-Weight Experience
True	2	True	True	1
True	2	True	False	0
True	2	False		0
True	1	True	True	1
True	1	True	False	Probabilistic Algorithm
True	0			N/A
False				N/A

Table 4. Artifact's pre-weighted experience evaluation scheme

Although this binary scheme for evaluating the pre-weighted experience may seem coarse, it reduces the complexity which a more refined scheme would cause. We can assign for example a higher pre-weighted experience for a partially obstructed artifact based on the level of obstruction. The evaluation of the effects of such schemes requires further research. We expand the above reasoning to include all of the local artifacts which are pertinent to the spatial task.

We calculate the participant's *weighted experience* with each artifact (wE_i) as a function of his pre-weighted experience with the artifact (pre_wE_i) and the artifact's weight (w_i), $wE_i = f(pre\_wE_i, w_i)$.

His overall experience with the task, namely his overall *spatial experience* (sE) is the sum of his weighted experiences with all pertinent artifacts, $sE = \sum_i wE_i$.

In this section, we discussed the artifact weighted evaluation scheme linked to presence and visibility of each artifact. We proposed a model for calculating the resource spatial experience based on the pre-weighted experience with each artifact related to the spatial task. We utilized the task of locating the entrance of the subway station as an example of building a spatial experience. We observe that there is a hierarchical strategy followed by the participant when he builds a spatial experience. This strategy is connected to his resource experience and to the available artifacts. Similar strategies are employed by a participant in building other spatial experiences.

As shown, the model presented here can be utilized by space designers to evaluate artifacts for their intended use. It can also be used by human resource managers to evaluate a participant's experience with a task. Finally, physiologists and sociologists can utilize the model when studying social behaviors.

7 CONCLUSIONS AND FUTURE WORK

In this paper, we introduce the notion of spatial referencing in relation to three types of local artifacts pertinent to a spatial task, namely stationary, dynamic and moving artifacts in addition to the categories of spatial referencing proposed by others (Newcombe and Huttenlocher 2000). We indicate that the construction of a spatial experience is connected not only to external fixed features, but also to dynamic and moving artifacts.

We propose a scheme to assess the significance of local artifacts which are embedded in the environment and are relevant to a specific spatial task. We propose a model to evaluate the resource experience of a participant who is engaged in solving the task in relation to the assessment of the local artifacts. We introduce an artifact weighting scheme which we relate to the participant's weighted spatial experience. The concrete case of a tourist who is locating the entrance of a subway station is used to formulate our proposed scheme. Our participant in the spatial experience is a goal driven agent rendering a resource experience. We differentiate between a novice and an experienced participant in reference to a specific local artifact.

This paper provides the foundation for further research in the area of local artifacts and a participant's resource experience pertinent to the use of space. The following points will provide an enriched insight into these issues and they are the subjects of subsequent research:

1. A higher pre-weighted experience for a partially obstructed artifact which is perceived and deciphered based on the level of obstruction may yield a more fair evaluation of a participant's resource experience.
2. A probabilistic algorithm can be utilized to produce a more sensitive pre-weighted experience in the case of a partially obstructed artifact, which is not perceived by the participant.
3. The concept of the artifact weighting scheme can be extended beyond the realm of subway stations and transportation.
4. An algorithm can be developed to yield case specific results for assisting the evaluation of space by its intended functionality.

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Sustainability Scenarios for Spatial Planning: Ideal or Real?

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A SPATIAL APPROACH TO SUSTAINABILITY

The local dimension as related to a universal discourse finds its manifest representation even in remote Chinese rural villages: this is the final thesis of the "SUCCESS" study in China. The spatial approach was one of the preconditions for the interdisciplinary work, and this paper presents two disciplinary results that digest findings from the other disciplines: on the one hand the social glance at the spatial conditions, on the other the urbanistic approach that searches to include findings form the sociological discipline.

The SUCCESS project – Sustainable Users Concepts for China Engaging Scientific Scenarios[41] – develops and carries out seven case- studies of peri-urban and rural settlements in six different provinces in China. This interdisciplinary project combines the disciplines of socio culture and architecture with economy and ecology and works out sustainable future scenarios for the Chinese villages. The basic question of the research is: What to maintain and what to change in the selected villages? The three-year-study initiates a process that leads from the proto-sustainable Chinese villages to contemporary sustainable settlement systems - a process which supports an emergent future, respecting human needs combined with the needs of nature.

The project studied seven villages, in different architectural and social situations with a case study methodology based on the local situation. By developing the future scenarios, the disciplines analysed the local precondition and the change within the years of the project time. We will introduce some preliminary data and experiences from this project describing the necessities and potentials of the local village situation. By applying the case study approach, SUCCESS considers the local place in the village as the basic starting point for the balance seeking process between ideal and real, between non sustainability versus sustainability oriented future images. The basic research question "What to change ? What to maintain?" can be treated starting from the conditions existing in a given concrete place, namely the seven villages.
Thereby, spatiality is the basic condition for our interdisciplinary research approach; it is also a condition for the definition of sustainability used as basic guideline for the research. This definition gives the basis for the combination of spatial and societal approaches by binding the sustainability approach to a local place within its actual or abstract territory.

"Sustainability is a local, informed, participatory balance-seeking process, operating within a Sustainable Area Budget, exporting no negative imbalances beyond its territory or into the future, thus opening the spaces of opportunity and possibility."

-local: it happens at a specific place – the living environment of a settlement within its region, including living patterns and creativity of the tenants
-informed: it benefits from the tools of the global scientific community and requires an interdisciplinary approach which provides cause and effect feedback
-participatory: it needs informed, empowered, gender sensitive human actors who are the stakeholders in the sustainability negotiation process
-a balance-seeking process: it models alternative future scenarios, taking into account the classical triad of sustainability: economy, ecology, socio culture , complemented by the context of built environment
-spaces of possibilities : sustainability considers the future as an open space where socio cultural life quality, economic equity, and ecological needs converge towards balance
(copy right Dumreicher, Levine, Yanarella)

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41 ICA4-CT-2002-10007, www.china-eu-success.org

SOCIAL DIMENSIONS OF SPATIAL PLANNING

In our approach, the social aspects of planning take the community as a whole into account, respecting the inner community relations and the social interactions between the corpus of people living on a specific place. In the studied villages we show the social dimension and its spatial equivalent. The sociological team is working with the specific methodology of the photo interview (Harper 1987, Wuggenig 1990) to investigate the local life quality. The photo interview is one of the rare sociological methods able to create a relationship between spatial and societal realms. Selected people in the village take photos of their view of their own home village and give an interview where they make a narrative about the sites which they photograph. The photo interview as an active participatory process in visual sociology, generating empirical data for the photo and text analyses (Oevermann 1993), is the basis for our interpretation that figures manifest as well as latent aspects and creates the scientific hypothesis building process.

The sociological approach specially serves by providing specific results that support the building up of spaces of possibilities within the village groups. They also support the emergence of the sustainable future scenarios in the interdisciplinary research process. In order to answer the specific needs of intercultural research and of the problems of communication between European researchers and Chinese village dwellers, we have applied two different methods: the photo interview specified above, and the participatory video. Both methods introduced instruments of new media in the daily life of the Chinese case study village by the SUCCESS study. This participatory approach also contributes to the experience with high tech instruments and enriches the scientific results with the dwellers view.

Participatory video can be described as a “group based activity that develops participants’ abilities by involving them in using video equipment creatively, to record themselves and the world around them, and to produce their own videos”(Shaw and Robertson 1997). Within the SUCCESS project, participatory video workshops were held in three of the case study villages in order to initiate the use of new media in the villages with regard to empowerment, especially women’s empowerment; to support the view of local people, to provide information for the pool of experts with a focus on community organization and gender issues and to develop new approaches to Participatory Action Research (PAR).
The experience with participatory video within the SUCCESS project showed that the use of new media such as video and editing equipment can serve as an empowerment tool especially for women and young people. The video workshops initiated discussions between the participants and the other village inhabitants on specific issues (such as gender inequalities, future visions, life quality), and strengthened solidarity amongst the participants. By teaching modern media skills to women and young people, the video workshops strengthened their self-esteem and at the same time their overall position within the community.
The films produced by the workshop participants show the meaning of both private and public spaces within the villages. With relation to space, the analysis of the films supports the following results, especially with regard to the importance of public space in the villages.

COMMUNICATION CIRCLES IN THE VILLAGE: OVERLAPPING OF SOCIAL AND SPATIAL DIMENSIONS

The horizon of the spatial and social experience for the local village dwellers is present in seven spatial interconnections. The study describes the village as a whole, starting from the following correspondences and relationships between social and spatial:

1. To the smallest spatial context present is “my body”, the social context shows up as the individual “Me”.
2. The somewhat larger spatial context is “my house with its inner courtyard”. This corresponds to the social context for “ My relatives and my family”
3. The spatial village context like the shops, the school, the public space and the public streets is occupied by the social context of “My neighbours”
4. The spatial context present as the edge of the village prevail the social context of the “In between” as the place for more formalized community relations.
5. The spatial context formed by the surrounding landscape has the social context “Our village as a place of identity”
6. The spatial context where political and influential scale are still congruent is the whole country of VR China, including the government in Beijing, which corresponds to the social context of “The Me as a part of the nation”
7. The largest spatial context influencing the village is the terrestrial globe which relates to the social context „Me and the globe, me and the world society“

This paper concentrates on the third circle. The village spaces like the public streets with their shops, the school, the public squares in the village represent the local dimension for social activities in the community of the dwellers. This circle seems especially convenient for the implementation of sustainability in the local village.

VILLAGE SPACES

People within the village and within the village community and their spatial equivalents constitute the communications circle that we call „village spaces“ – places in the middle between the individual spaces, the home and the courtyard, on the one side, the regional, national and global spaces on the other (for the juxtaposition of local and global see our contribution to the CORP conference 2004; Dumreicher, Kolb 2004)

In the local studies of the photo interview the dwellers presents their local daily life and where it is happening. The dwellers, in our photo interviews, show that the public spaces have a meaning for their life in the village. These are for instance the streets and furniture along them, meeting places under a tree of even a square that shows a tree and a newly built Buddhist - Daoist altar. Often the motives represents a walk and a story telling through the village: first entering the house, showing for instance the housewife, in a next step leaving the house where the photographer meets the neighbours and later a walk to the next village square in order to take the next photo under the tree. When the dwellers are describing the village, the street becomes “our street”, the Huai Shu tree serves as a help for orientation relating to the own house as well as to the friend’s house; and the interviewee makes a link of all of this with her or his own house.

When the interviewees choose the places that they consider of interest, they make their choice according to their own intuition. In the village Bei Suzha, they have chosen the following places for communication: The village street, the primary school, the villages square and the greenhouse. All these spaces have sets of meanings for the different sexes and for the different generations, but they have also sets of meanings that are common for the whole population: they stand for the integrity of the whole village and they all represent spaces for communication – the shops along the street just as well as the party center, and they are all considered important for the whole village. The flow of communication and information within the villages seems to present an abstract value, but within the villages, these abstract flows are carried by spatial patterns. The role of these material artifacts may change as it is the case right now, the house as well as the school, the street or the village square – but what remains is the fact that these places represent the integrity of the village – as well in the inner direction (for the dwellers) as in the outside directions (for the outsiders). The village as the built environment of the farmers is in direct link with the “emotional co ownership” of the village (Dumreicher/Kolb: 2001).

This is our street - 这是在我们街道上

村: 这是在我们街道上，这是大槐树. 大槐树北面，他在第三排，他的房子在我后面，我的房子在他的前面.	This is on our street. This is the big Huai Shu tree. This is north from the Huai Shu tree. His (my friend‘s) house is in the third line, behind my house, my own house is in front of his house.

Interview men group, Zhou, Xia Foutou, 04/2003, paragraph house

If well constructed the public space – the street, the square around a tree –represents the meeting space for the traditional village. People meet to eat in common, to play, to look after their children or to proceed to day-to-day-work like weaving carpets or cleaning the corn. The street is a place for producing – the shoemakers repairs the shoes, the soup cook cooks her noodle soup – and for selling and buying, the vegetable seller offers her cherry tomatoes, the iceman sells green pee lollypops. The public space is where people get to talk to one another and where neighbors and others exchange the latest informations. In the contemporary society, the public space which so far was dedicated for human activities gives in to the achievements of the modern era and to the motorcycles, the cars, the lorries and in general to the transport systems which enhances the economy but appropriates the public space.

Even the SUCCESS research activities showed the village dwellers in a stringent way how the researchers leave their parking cars in the street as a symbol of progress in front of the party center. So far, traffic is a singular event in the village, so far, the visit of foreigners in the village is an outrageous event. The SUCCCESS team has seen lots of different streets in the villages: dusty streets, narrow streets, asphalt streets, concrete streets, large streets, no streets at all. The building of streets and roads is discussed in all the villages. And whatever the level of modernization, the village dwellers will always look out for better street: if the street is an earth street, they hope for asphalt, if the street looks like a walking path, they hope for an urban boulevard. In all villages, the street is a symbol of modernization and shows the development stage of the settlement. The photos of the villages spaces are welcome artifacts for the interviews with researchers who, according to their discipline, relate in very different ways to these photos. From the photos, they can give their appreciation of the whole Chinese development. One economist, looking at the photo of a modern, clean but rather boring street, sees in this street the effects of modernization, development and amelioration of the environment which corresponds superficially to the needs of the people, but this development goes past the people and leads to a lifeless human environment. This cannot be the scope“. *(”Zwar gibt es eine Art von Modernisierung, Entwicklung und Verbesserung der Umwelt, die zwar oberflächlich gesehen den Bedürfnissen der Menschen entspricht, die aber an den Leuten vorbei geht und zu einer etwas leblosen menschlichen Umgebung führt. Also das kann nicht das Ziel sein“* (04/2002, Economist, paragraph the street).

The same street, for the expert sinologist, is a “deterrent example- a sterile wall to the left and the right, plus concrete soil. (05/2002, Sinologist, paragraph the street).„Functional, cheap, quick, built during the cultural revolution, not nice to live but providing cleanness“ *(Funktional, billig, Schnellbauweise, während der Kulturrevolution gebaut, steril, funktional, nicht angenehm einladend zum Wohnen aber wahrscheinlich eine gewisse Sauberkeit wurde damit gewährleistet“* (05/2002, Sinologist, paragraph the street*)*. A street of urban emptiness instead of rural slowness. „obviously not a place to stay, but to get across quickly and without looking*“ („Das ist offensichtlich kein Platz zum Verweilen, sondern dass man hier schnell und beliebig durchgeht“* (05/2002, Sinologist, paragraph the street). The woman specialized in the question of participation imagines „people who go from A to B. But nobody would sit here“.(*“Da sieht man Leute, und die gehen von A nach B. Und es sitzt niemand da“* (04/2002, Partizipation/Social worker, paragraph the street). If the village atmosphere only consist of this kind of streets, where could people sit? Where could they meet? The architect who comes form the west finds a „not uninteresting pattern” among the tiles.”(06/2002, Architect, paragraph the street). But his critique points out that someone was at work who did not take into account the village and its singularities: ”It appears to be that the houses and the street are designed by one person. It is a lot newer, than the rest of the town. Also brick, they street and the buildings around they don’t seem to have the advantage to got through any sort of process or settling into any sort of local culture”(06/2002, Architect, paragraph the street). You do not see a contact with the existing village, nor with its history, nor with the people who might be willing to live here “Someone is not in tune with the town which existed or with the people maybe occupying this place. It doesn’t seem that this is a sort of street and walls, that have been adjusted and modified through several generations”(06/2002, Architect, paragraph the street).

SITTING UNDER THE TREE

Old big trees have a prominent place in the history of the villages, often a tree is a family tree belonging to one specific house, being part of the family's history and taken care by them. Just as well as the family, in the Chinese village, is the one social structure that carries the village community, the family trees are visible, readable and living icons for the family within the overall system of the dwelling. The dwellers meet under the tree for chatting, eating and discussing about their daily life. The tree gives the people shadow against the sun, but also the special fruits for example from the Hua Shu tree. This fruit is a valuable one, because it can not only be used for salty, but also for sweet cooking, which is a very rare flavor in the Chinese kitchen.

Huai Shu Tree – Village Square in Xia Futou, 2000, Photo LÜ Hongy

The photo shows an old tree up on the hill in the village Xia Futou (Henan province). The tree has a social value: it is the meeting place for the whole neighborhood, shaping their social life. A wall with a whole through which a tree is growing – a rather unusual landmark and spatial icon: the dwellers have constructed this with a window for the tree, thereby expressing their will for well observing the small scale of the village spaces It also shows that in Chinese context, nature does not remain natural – nature is integrated into the human domain. Instead of killing the tree or letting it grow as I can, people give it a very special care and have even put special ornaments on it. They also use the wall as an information center where they put calligraphies about actual events in the village.

Nature, at large scale, has a bad standing in the modernization process of the PR China; but in the near communication circle that we are describing, nature has a very special standing. The photo gives a view on the traditional rural atmosphere that is under big stress in the urbanization wave that is reaching even the village we are describing. In the process of the SUCCESS future scenario making, the place and the people around the tree made a starting point for the hope to maintain some of the societal and spatial in the Chinese village and yet proceeding to an upgrading of the rural life quality. It is inspiring for the urbanists, architects and spatial planners who take into account that the public squares around the trees are part of the ancient Chinese rural village pattern system. The public place under the tree is important, because the dwellers meet there. "This is very interesting. The most interesting tree in this village. We always saw a lot of people, the neighbors getting together, not only for the shape of the tree and the wall between the tree, but for the people, the way they like it and gather together attracts me a lot. It attracted almost all the researchers. They felt very happy for this finding" (06/2002, Chinese , the tree). For the architect LÜ Hongyi, the tree fits into the whole setting: the contorted street as well as the natural stones building the wall for sitting. In the other local village case studies, we could observe a similar process where dwellers revive old places again. They build new religious locations for the public and spiritual living in the village. The old culture is re-integrated in the current life. This process contributes to an interesting cultural procedure: after years of prohibition, now the old culture comes back, but as something new. The recently built altar representing an old tradition in the village thereby contributes to the current public and social life.

THE WASHING PLACE

Washing the clothes is still a public issue in Chinese villages, and the villages offer different local systems for doing this work. In Du Jia, province Yünnan, women carry the cloth baskets to the river and wash the clothes on specially arranged big stones on the river bank. These stones present a little comfort for doing this hard work. In Xia Futou province Henan, the river bank is adapted with stone stairs, to make it easier for the women to come down to the river.

下到，到那河边去。我们这儿不方便。水可以畅着用，要有排水机，水流在这儿，可软，可颠，不好走。	I go down to the river. It is not very comfortable here with us. We have more water than necessary, but we need a pumping device. The water flows on the earth street and the soil can become slippery, you can fall and it is hard to walk.

Young woman, Xia Futou 2000, paragraph washing

The women consider water a natural constituency of their life quality and are happy that –to the difference of other places in PR China where water is a scarcity or very polluted – their villages has a lot of water: 畅着用 – more than necessary, and this constitutes one of the richness of the village. In San Yuan, province Yünnan, there is a specific water system in the village: in the middle of the village is a public space – a platform of concrete and a series of small water pools – with running water. Nearly every family of the village – women and also young children are washing the clothes on this place. Here, the social contact seems to be very important: different generations meet other dwellers to chat and discuss. In San Yuan, the water system is a cascade system which uses the water in an efficient way and guarantees the adequate water quality- for worshiping gods for washing vegetables, for washing clothes and for irrigating the fields. In a sustainability scenario, these results lead to the following idea: The village can base its future water image on the existing tradition that shows the importance of this good; and the existing patterns can serve as a source of inspiration for the way in which the water service will be upgraded to new standards.

IN THE SHOPS

Another places of interests in the village are the shops. In the beginning of the SUCCESS projects only a small number of shops were in the villages. Mostly the dwellers went to the weekly markets, which are following the calendar of moon, exchanging goods and also information. At the present time more and more in the beginning small shops are opening: first the refrigerator in the entrance of the house, offering a modest assortment of goods, Chinese ice of green beans for half a Yuan, sunflower seeds, cheap canned lychee juice. After a little time the assortment is expanded. In Bei Suzha, Anjing described the running system as a half professional exchange system.

The shops are also currently places for selling products but the business people are also producing Chinese Bread – the Manto bread. This service is mostly done when the dwellers have to do with their crop, and families save time. Then the farmers go to buy their meals in the shops. The small shops represent a new form of service for the village. New shops are a symbol for more comfort and convenience. Talking about service in the city shops are basic element for public infrastructure in a modern settlement. (Dumreicher/Kolb 2000, Service, 7 Theses of town). In the village the shops represent the modern life with comfort and convenience. Not only the prime requirement of food and basic needs, but also the desire for aesthetic and new life makes the shops successful. The whole village recognises the shop of a hair dresser as a symbol of prosperity. The Chinese village owning a bakery or a hair cutter demonstrates its wealthy community life to the surrounding. The shops are meeting points in the villages, are part of the social life and communication system and they also represent the modern lifetime.

PUBLIC GOODS IN THE VILLAGE

In the Chinese village the community of the dwellers - the neighbours all together - organizes the public services for the inhabitants. This services – the street, the school, the local bus, the community centre and the library make the village attractive for the dwellers. In the SUCCESS project, we studied different forms of organisations to build the street, to rebuild the school or to construct the water pipes. Sometimes the village committee organises the necessary work with the labour force of the dwellers. In some provinces, the local administration arranges the water supply and the electricity. The different organisation systems of the villages is an outcome of the permanent situation of transformation. The money is often not available, the dwellers are mostly ready to invest their labour force. Sometimes the basic infrastructure is a common effort of both systems, the administration systems donates the money and the village community contributes with their labour work.

Photointerview 04;Jiang Jiazhai 04/2003, paragraph women

THE SCHOOL

The school is a very important side for the Chinese village. Since the education system is changing, some middle schools are closed down in the country side, other are built in the small cities. In this case, the pupils get a higher education standard, but they have to leave the village for their education, which contributes to the social impoverishment of the villages. Therefore, the village cadres fight for maintaining the schools in the village: "Xia Futou is an important village for the territory. I hope to rebuild the school in the coming two or three years. I want to buy two computers, so that the students can work with them. The computer can open the students eyes to know the international (Interview headmaster, XFT, 04/2003)". Similarly, the village Bei Suzha (Hebei province) considers the school an asset of their village performance.

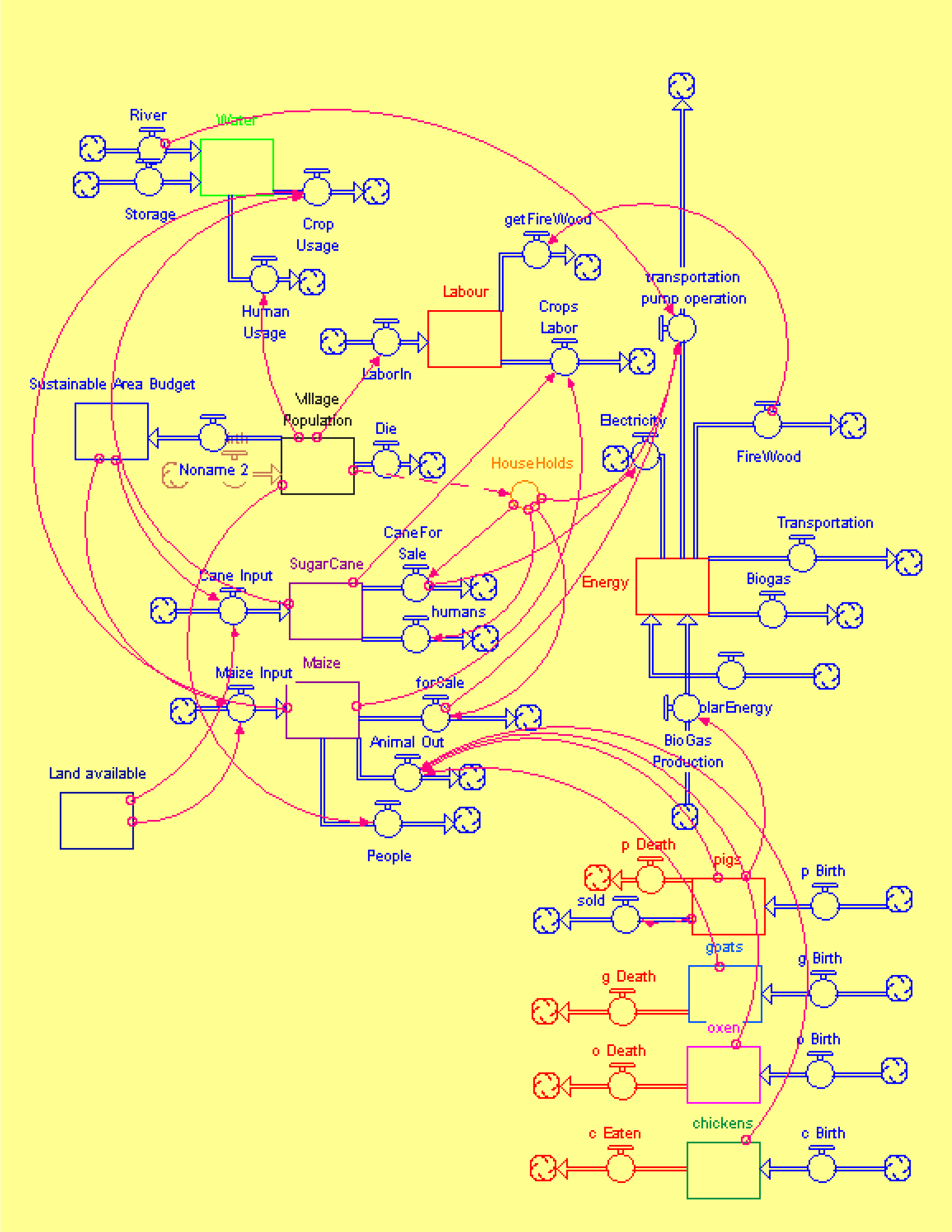
这个最有历史意义，我们的学校。我们村很穷，学校的房子都要倒了，下雨恐怕砸到学生，我们村干部动员，老党员老干部，我一年的工资都都里头了，一年没挣钱，盖上学校，孩子在这里学习，培养下一代。这很重要。	This has a mostly historic significance. Our school. Our village was very poor; all the houses of the school nearly broke down. We were afraid, when it rains; it would fall on the students. The cadres of our village mobilized the old party members, the old cadres. My whole one year salary was put in it. One year making no money. For building up the school, so children study in it. Educating the next generation. This is very important.

Zhang Fan, Bei Suzha 9/2002, paragraph school

Depending on the social experience in the village, the cadres develop different strategies in order to get the dwellers to contribute for the village upgrading, from the school to the street or to the water supply system. The wealthy director of a rubber company, the party secretary, the village dweller – they all give their monetary contribution. Our example shows that a woman dedicated a one-year-salary to the school. Often people who come from the village and have made carrier outside considerate their duty to contribute to their home village.
Based on this traditional combination of the notion of voluntary work with the notion of communitarian duty, every village finds its own system for expressing the obligation of the "we" to maintain the community.

Preliminary Sample Diagram for a User-Friendly, Interactive Sustainable Village Systems Model: The Village Du Jia, Yünnan

The interactive systems model of the village Du Jia in Yünnan represents some key aspects of the material, energy and time and money economies of the village. The diagram shows a variety of linkages with different aspects of that economy and thereby presents a tool capable of accompanying the What-if-Scenarios that form the balance seeking process between ideal and real, showing the user which consequences a specific decision taken by the player may have on other parts of the villages system (see diagram).



Initial recommendations by both researchers as well as villagers are likely to involve individual incremental interventions in different specialized areas (agriculture, dwellings, energy, diversity of economic activities, social and cultural support.) These sustainability oriented "wish lists" represent what in SUCCESS are regarded as being on the "weak sustainability" level and are a necessary starting point in a comprehensive sustainability process. This would be followed by a strong sustainability approach, which would need to experiment with the interactions of combinations of a variety of different interventions and their effects upon the life and economy of the overall village, within a variety of different scenarios. In order for either researchers or ultimately villagers to do this with any degree of accuracy, complexity, efficiency or confidence, the employment of a user-friendly systems modelling tool is essential. This diagram shows what such a systems model might look like. The diagram roughly represents some key aspects of the material, energy and time and money economies of the village of Du Jia in Yünnan province. The diagram shows a variety of linkages with different aspects of that economy. One of the things to be found in that diagram are a symbol that represents the number of people currently living in the village ("village population"). That "stock" is connected on one side to "births" defined by an assumed or historic (or regulated) birth rate and on the other side by a death rate. A more detailed model would also include in and out migration rates. Population is related (connected) to a variety of other things that are also represented in the diagram. People supply "labour" which in this simplified model is used for getting fire wood and for growing crops. They consume water both for growing crops (from the river) and for domestic use (from the mountain). They consume energy in the form of fire wood (which is being phased out), biogas for (cooking and lighting), solar energy (for water heating), diesel fuel and petrol (which would be replaced by renewable in a sustainability oriented transformation of the existing model) and imported electricity. The biogas comes from family-scaled biogas digesters that are fuelled by pig manure and human excrement. The digested manure is fertilizer for the maize, sugar cane (and other crops to be added later). The pigs eat some of the maize and agricultural wastes. Some of the maize is eaten by the people while most of the maize is exported as a cash crop. Some of the pigs are eaten and some of the pigs are sold in the town market. There are other animals that are raised in the village: some as draft animals and others as family food, export income and as pets. There is a finite amount of “useable” land available in the village which is allocated to the different families and for different uses, which limits the various capacities of the village activities; economic, environmental, and socio-cultural. Another limit that may be superimposed on the model is the Sustainable Area Budget, which may be either larger or smaller than the actual available land area.

Although this appears to be just a diagram of village relationships, it is also a computer program that can embody actual relationships and data. That is to say that such a diagram can be put together to show the general relationships of typical villages in the abstract, or it can be an actual “working model”. In the working model the symbols are not just pictures, but they have intelligence, information and actual relationships behind them. So actual populations, birth and death rates can be represented as well as figures on food consumption, allotment areas, land productivity, consumption of water, food consumed and biogas produced per pig, biogas necessary per person, market price for maize, pigs and sugar cane, and so on. Data may be in the form of numbers, graphs, or equations.

With this sort of model, which may be easily added to or changed, researchers or ultimately villagers can experiment with many different possible futures. In the SUCCESS conception of strong sustainability, activities within a specific village to be modelled that could not be part of a sustainability regime, would be replaced with Sustainability Oriented Means or Methods. That is to say, diesel, petrol, pesticides, chemical fertilizers, coal, and other unsustainable material and energy sources and commercial products would be replaced by their sustainability oriented equivalents; bio-fuels, organic farming, renewable energy, etc. Then a great variety of “what-if” scenarios may be and run on the model. What if we double the amount of pigs we raise! The effects of such a proposition would reverberate through the entire system. More manure is produced making more biogas. A larger pigsty is needed taking more land and requiring more material (lumber, concrete, tile), consuming labour and export income. The pigs need more maize to eat reducing the amount of maize for export, thus lowering export income (how much). More pigs are available to sell in the market thus raising export income (how much). Amount of required labour is changed. Water use is changed. Land use is changed. As the effects of this what-if intervention reverberate through the village system many unanticipated effects occur – some opening new opportunities while others create new problems. Researchers can pursue these new opportunity/problems with new what-if interventions. It would be in the interest of researchers to make the modelling system and the relationships and the data to support them more accurate and more robust. Eventually villagers would be able to use these systems models to explore opportunities for increasing the quality of life in their common future. Such a process opens spaces of opportunity for both the rational and the irrational; the cultural as well as the scientific. It will be limited by the world of the possible, but will be driven by the interests, biases, cultural background, traditions, hopes and desires, of the villagers through a scenario-building, Sustainable Civil Society negotiation process. The systems model will provide this process with the feedback to inform the villager-stakeholders of the consequences of their ideas and proposals. It will tell them whether a given intervention would increase or decrease the productivity, the availability of more free time, the creation or distribution of more wealth, or the mutual satisfaction of a variety of different needs. It will also tell them whether interventions are driving the village system towards balance or away from balance and thus would be a guide for suggesting further interventions that would preserve the positive aspects of a previous what-if model while compensating for the imbalances it may have introduced.

China in its old tradition has a long experience with balanced situation in nature and society. In the local village we still can find traditional patterns, which contribute to this balanced situation. A lesson we can learn from the point of architecture:

LESSONS FROM CHINESE VILLAGE PATTERNS

In the tremendous speed of the actual Chinese urbanisation and transformation process that tends to establish a stereotyped concept of modernisation and raised living quality, the study has gone back to the existing traditional patterns still present in some of the villages and representing the ancient Chinese principle of Tian Ren He Yi – Coexisting of the Nature and Human beings.

1. FENGSHUI AND ITS IDEAL PATTERN IN THE VILLAGE

One of the most important methodologies that carry out the concepts of Tian Ren He Yi a spatial pattern in towns and villages in China is Fengshui. According to Fengshui, there exists special energy (and integrative information between the nature and human beings), which is called “Qi” in Chinese, between the human dwellings and the landscape around it. Only when “Qi” moves fluently in a specific environment can it bring infinite harmony and happiness to the whole settlement. So an ideal settlement pattern for Chinese people is not only a matter of building up a good living quality to the people of one generation, but a matter of setting up a good relationship with the universe which will bring them happiness and wealth to all the generations in the place. The material spatial elements of an ideal village pattern in China are the mountain (back), the human dwelling (middle) and the river (front) and abstract spatial factor is the infinite movement of “Qi” around among them. From some existing traditional patterns in our case study villages, we can see clearly the integrative communication between the human dwellings and the nature around it. Most of time, the ideal village pattern making starts from site choosing, closely working with a Fengshui expert and the most respectful people of the village. To some villages that didn’t have such ideal environment, the villagers would reset the environment and location (i.e. build a big pond in front or sometimes small hill or a big tower at the back) to complete the ideal pattern of a village. As soon as the ideal overall pattern of the village is decided, every family can adjust its house through some special material spatial structure like the location of the house and Zhaobi in front of the house as the village grows.

2. DAOISM AND CONFUCIANISM AND SPIRITUAL SPATIAL SPACES IN THE VILLAGE PATTERN

In many Chinese villages, especially villages of Han majority, the dominant religions that influence s the village pattern making is the combination of Daoism, Buddhism and Confucianism, which relates the essential factors or supporting factors, the spiritual spatial space, in the village pattern. In general, we can conclude two kinds of spiritual spatial space in the village pattern, Nature Spiritual Space relating to Daoism and Socio-culture Spiritual Spaces relating to Confucianism.

2.1 Daoism and Nature Spiritual Spaces

Daoism, the philosophy of the law of nature, strengthens that people should follow the law of nature and worship the power of the nature being (i.e. Mountain, Water, Big tree). A lot of traditional villages have several special nature spiritual space which play the role of uniting the nature landscape into the village pattern and creating diverse public spaces in the socio pattern of the village.
Different to other grave religions place (i.e. Temples or Church), most of the nature spiritual spaces in the rural area in China carry out the function of "open public space" which imports daily life of the villagers with a happy atmosphere. To most villages, equivocality and diversity are the distinct characteristics of the nature spiritual spaces in the traditional Chinese village pattern.

2.2 Confucianism and Socio-culture Spiritual Spaces in the village

Confucianism, the philosophy of the principles of the society, paid a lot of attention to deal with different relationships in a society that was built up by blood relationship. In a rural area like a Chinese traditional village, the blood relationship chain is very strong even today. Many villages consist of two or three big clans, which sometimes can even date back to the beginning of the villages.
In order to unite all the people together in a clan, people built up ancestral temple to manage social affairs in their clan. Therefore the socio-culture spiritual spaces came into being in the village pattern and built up the special socio structure in it. In a traditional village the ancestral temple is more important than some religions site to the villagers in the past. The village centre and Party centre took place of the ancestral temple after l949 and became the new socio-culture centre in a village.
In a nature evolution village pattern, the ancestral temple is kind of self-organized socio-culture spiritual spaces with the participatory of people while the current village centre is an organized socio-culture centre made by the country or the government. Today a lot of ancestor temples are rebuilt by the donation of villagers and regain their status in the village pattern.

3. Yin Yang Zhong He and its ideal pattern of a house

Yin Yang Zhong He, balance seeking between Yin and Yang, was regarded as an important characteristic of the nature as well as the human beings. So only when a person reaches the balance between Yin and Yang does he reach the law of the nature, that is, Tian Ren He Yi. So does the human society and human dwellings. As the oldest Chinese architecture book, Zhai Jing, said in its first paragraph: a house, is a pivot of Yin and Yang, and it is a module of human society.
In Chinese traditional concepts, a courtyard represents Yin where a building represents Yang in a house series. If a courtyard is too spacious compare to the buildings around it, there are too much Yin in the environment; If the building is too huge compare to the courtyard nearby, there are too much Yang in the environment. Both are not good for health because they don't follow the law of the nature.
Siheyuar or Sanheyuan, an appropriate size courtyard with four separate or three separate houses surrounding it, was regarded as an ideal house pattern that reflect the balance of Yin and Yang. In this pattern, the courtyard is the centre in both the social structure and house structure in a family and it is in charge of the overall arrangement of the space of a house pattern. The house styles are diverse in different place in the rural area in China, but the courtyard which works as a positive "open living space" as well as an active socio centre in the house is always a dominant factor in a house pattern in a Chinese traditional village, even in a very free growth pattern of a nature evolution village.
In a word, Chinese traditional villages and vernacular houses show diverse possibilities of the human dwellings under different nature environment and local carrying capacities. But at the same time, they reunite together under the traditional concepts of Tian Ren He Yi which closely working with the ancient concepts of Fengshui, Daoism and Confucianism.

CONCLUSION: VILLAGE SPACES AND THEIR ROLE FOR A SUSTAINABLE FUTURE

The common results of the study show the participatory approaches from the SUCCESS project: The future scenarios developed in cooperation with the village's dwellers show conflict lines between the real and the ideal representations among the scientists on the one hand, the village dwellers on the other. The common results, future scenarios of sustainability, take into account the spatial as well as the social dimensions and include them into the overall sustainability approach.

The village spaces as communication circle are the place for the social interaction, where an informed and interested community has the opportunity to establish sustainable action fields. This is the background for management systems of separating or avoiding waste, this is the place for a planning concept for the usage of public space; this is the place for a weekly or monthly market where economic, ecological and social dimensions can find a common space for human activities. The photo interview and the participatory video show how such a space can become a meeting place for the researchers and the dwellers, the systems model shows a draft of how these activities can be integrated through a new technological planning tool that can serve in a top-down-approach for the planners as well as in a bottom-up-approach for the village dwellers. Based on the traditional Chinese patterns this scientific approach is a potential for a sustainable future. The theory of communication circles delivers the basis for the field of action to choose for a specific sustainability intervention. The communication circle "village spaces" is the frame for the organisational and societal learning as a common societal task for a sustainable village. In the question of how sustainability can come about, this paper shows that a combination of disciplines and a combination of high tech tools between paradigmatical and social sciences can lead to a future concept that makes the bridge between traditional and contemporaneous values.

NOTE

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Survey of soil sealing on the basis of the ATKIS basic DLM − feasibilities and limits

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1 PROBLEM

Despite of a decreasing population there is still an alarming demand for space because of settlement. Therefore the growing volume of settlement and traffic is the most urgent environmental problem of Germany according to the environmental barometer within the German Environment Index (Deutscher Umweltindex DUX). We are far away from reaching the set goal of reducing the demand for soil from momentarily 119 ha/d to 30 ha/d till 2020. In 2003 the settlement area in Germany grew by 1.0 % and the traffic area by 0.4 % (altogether 341 km² or 0.8 % of Germany's total area) (Federal Statistical Office Germany, 2004). Since the first all-German soil elevation, in reference to the actual use in 1993, the settlement area and the traffic area grew by 11,9 %! In average approximately 50 % of the settlement area is a built-up or sealed area; regarding the traffic area the soil sealing rate is considerably higher (Environmental Authority, 2003).

Beside the direct and indirect resulting environmental problems of the demand for space by settlement and traffic like soil sealing as well as traffic connected with noise, exhaust fumes and higher energy consumption, inclusive carbon dioxide emission causing climatic damages, economically and socially serious consequences will be expected. Economical consequences because the growing settlement and traffic areas lead to continually increasing fixed costs which are charged to the private economy as well as to the public and private households for maintenance and the running of this even less used infrastructure and social consequences because the growth of settlement areas comes along with social separation and the development of ghettos in cities. The tendency of many households to move away from cities shows that the quality of housing, especially for families with children, has serious deficiencies (Environmental Authority, 2003).

The soil sealing is a basic indicator of the urban ecology because of its negative effect on the soil water balance, microclimate, flora and fauna (destruction of habitats), noise and the urban heating. Only with a survey of the temporal and the local development (monitoring) of the total and partly urban soil sealing, one is able to measure and judge the real success of a sustainable coordinated land use policy.

For monitoring the development of the soil sealing it is necessary to map these areas. This has to be done in different spatial resolutions in dependency on the type of problem. A highly exact determination of the soil sealing (the plot must be seen clearly) is necessary within the framework of introducing splitted rainfall and waste water charges and has already been realised by some cities in Germany. This very complicated mapping of soil sealing is carried out on the basis of aerial image data on a scale of 1 : 5 000 with manual mapping of built-up areas and completely or partly sealed grounds.

A spatial less resolved elevation of the soil sealing is sufficient for city planning, urban environment observation and provision. Here, either a visual evaluation of the degree of soil sealing can be carried out for each urban block of residential buildings on the basis of relevant satellite or aerial images (Meinel, 2000) or with an automatic processing of multispectral information (including the infrared channel) of satellite image data (Meinel, 1996) or with scanner (Meinel, 1997). A rather indirect determination of soil sealing from the "area survey in reference to the actual use" is insufficient for local authority districts because it leads to a very inexact urban total number since the data are only available for these local districts.

Finally it has to be noticed that a partly spatial, efficient and inexpensive survey of the soil sealing is an insoluble problem at present for city planning and environmental provision. But on the other side local authority districts do need accumulated as well as relevant soil sealing data and three-dimensional overall representation of the sealed areas within the framework of their environmental monitoring. A highly exact mapping on the basis of aerial images is neither necessary for this area of application nor possible because of the cost question. The main focus is more an efficient survey and update method. Thus the more obvious course is to use existing basic topographic data set and to derive mean soil sealing values from these data. At the same time the problem of updating the data can be solved with this method since one has always access to the latest topographical basic data.

The most important Topographic-cartographic basic data set in Germany is the "ATKIS basic DLM (ATKIS-DLM25)" which is also available to the local authority districts via the land survey offices. The main focus of this paper is the development of a method for survey of soil sealing on the basis of sealing profiles (especially the mean of soil sealing) of ATKIS basic DLM feature types. The sealing profiles (histograms) have been elaborated on the basis of a highly exact soil sealing mapping of Dresden supported by aerial images (1 : 5 000) with a GIS technical overlay with the "ATKIS basic DLM" (scale of 1 : 25 000). This process is followed by a statistical analysis for every ATKIS feature type. By applying the mean soil sealing value of the feature types it is possible to get overall maps of the sealing just on the basis of ATKIS data and three-dimensionally accumulated sealing data can be determined efficiently and with a reasonable exactness.

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2 INITIAL DATA AND METHOD

2.1 Reference data – soil sealing mapping from the urban drainage system

Dresden is one of the cities in Germany where the former waste water charge has been changed to a separate waste water and rainfall charge (the second one is also called soil sealing charge). The principle of splitting the charges is fairer towards the households since the costs are paid where they are actually caused. That means that the owner of a property with a larger sealed area overstretches the canalisation with rain water more than someone with a less sealed property and therefore has to pay a higher rain water charge (unless he got something to seep the rain water). The splitting of charges leads in the end to a sharpened awareness concerning the topic “soil sealing” among the population. More and more local authority districts practice the splitting of charges and it has been supported by various judgements that established this principle (e.g. Supreme Administrative Court, 1985).

The prerequisite to levy split charges is a property-related database with exact facts about tectorial (including roof overhang!), sealed (completely and partly sealed) and non-sealed property areas. This database can include facts from interviews with property owners or aerial image mapping. The results of the interviews, which had been carried out first, were neither very exact nor satisfying. Thus the office for urban drainage system gave the order to capture the sealed area data by aerial image mapping. For this purpose they orthorectified aerial images on a scale of 1 : 5 000 and digitalized them in a stereoscopic view according to a “capture and evaluation directive”.

The geometric data of this survey including the soil sealing values for each type of area were available for the present studies extensive to the whole city of Dresden. We got the data from the office of urban drainage system in DXF-format [Drawing Exchange Format] (220 partial sections with a total of about 300,000 polygons!). Table 1 shows the applied classification key and the corresponding soil sealing value of the survey.

Tab. 1: classification key of the soil sealing data

feature type	definition/feature	soil sealing value
roofs	all shapes of roofs except green roofs	100 %
green roofs	flat roof; clearly identified as green roof	50 %
impermeable areas	concrete, asphalt, flagging	100 %
semi-permeable areas	paving stone, flagging with seep able joints (semi-permeable)	70 %
low flow off areas	water-absorbing areas like gravel and crushed stones (semi-permeable)	50 %
residual areas	non-fixed areas like grass, garden, meadow, etc.	0 %

The mapping was carried out with a position accuracy of <0.2 m. So there were highly exact soil sealing data for the survey available which can be applied to the development of sealing reference profiles.

2.2 ATKIS basic DLM

The Authoritative Topographic Cartographic Information System ATKIS is the fundamental Digital Topographic Database in Germany. With the purpose of providing a standardized topographic description of the territory of the Federal Republic of Germany the German land survey offices are setting up - within the framework of the ATKIS project (www.atkis.de) - landscape models with varying information density: basic DLM (former DLM25), DLM50, DLM250 and DLM1000.

The DLM describe the topographic features of the landscape and the relief of the earth's surface in a vector format. The features are assigned to a specific feature type and defined by their position, their geometry type, descriptive attributes and relations to other features. Each feature has a unique identification number (identifier) applicable for the whole territory of Germany. The ATKIS feature catalogue (ATKIS-Objektartenkatalog) specifies the feature types to be included in a DLM and the way the features are to be created.

The basic DLM is the only relevant factor for the idea of a sealing survey derived from ATKIS data. This fact has been worked out during the initial survey (DLM/1) on the basis of DTK5 (German Topographic Map 1 : 5 000) in Western German and of TK10 (Topographic Map 1 : 10 000) in Eastern German. The updating (DLM/2) is usually carried out on the basis of digital orthophotos on a scale of 1 : 10 000. The update of the ATKIS DLM is guaranteed in future by the land survey offices because of the importance of this geobasic data. This guaranteed updating is a significant fact for a continuing usage of data to get single special data. A detailed description of the ATKIS basic DLM as well as an overview of the survey data is shown on the website www.atkis.de/metainfo.

During the first implementation stage of the Basic DLM (DLM/1) only 61 features types have been captured which belong to the five categories settlement, traffic, vegetation, inshore waters and terrain and there are already 116 feature types within the second implementation stage (DLM25/2) and in addition the feature category field relief. The third implementation stage (DLM25/3) includes 189 feature types divided into seven feature categories. The feature types are then topographically and technically more detailed determined by attribute values. Because of this development the geometrical quality as well as the quality related to the subject digital geobasic data is further increasing after the very extensive initial survey.

Although ATKIS users still criticize the correctness and topicality of ATKIS data there is an ongoing improvement of the records. Present errors are gradually corrected in the updated versions and therefore lead to a continuous improvement of the database. The topicality of ATKIS will be increased as proofed by the definition of a high topicality (<1 year) for high dynamic feature categories like for example traffic.

2.3 Method

The determination of mean soil sealing values per each ATKIS category was carried out with a GIS specific overlay of both initial records. Information about position and attributes of both layers remained stored. Figure 1 is a part of the soil sealing mapping (reference) overlaid with the boundaries of the ATKIS basic DLM.

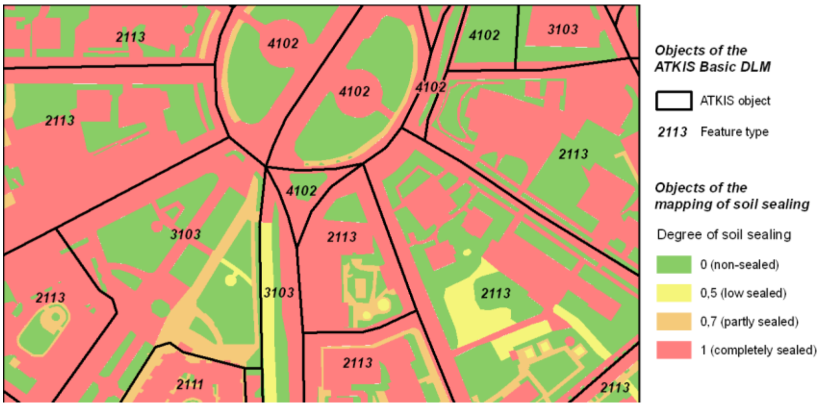

Fig. 1: soil sealing mapping (reference) overlaid with the boundaries of the ATKIS basic DLM (part of the city centre Dresden)

The result of the overlay is a polygon layer with approximately 330.000 features. Every polygon includes all attributes of the entry data (size of the area, ATKIS feature type, soil sealing value). By consulting the polygon attribute table of the union layer, the statistical analysis was carried out for each ATKIS feature type. First a mean sealing value for each ATKIS feature type was determined. Then it was possible to determine the mean total sealing value from all features of one ATKIS feature type for this specific feature type by calculating all objects weighted by their size.

3 SOIL SEALING PROFILES OF THE ATKIS FEATURE TYPES

By this method a mean sealing value has been determined for each feature type which is included in the Dresden ATKIS basic DLM. Figure 2 shows the soil sealing profiles (histogram, mean and standard deviation) of the dominant, related to their size, and most frequent feature types: residential areas (2111), industrial areas (2112), mixed areas (2113) and forest (4107).

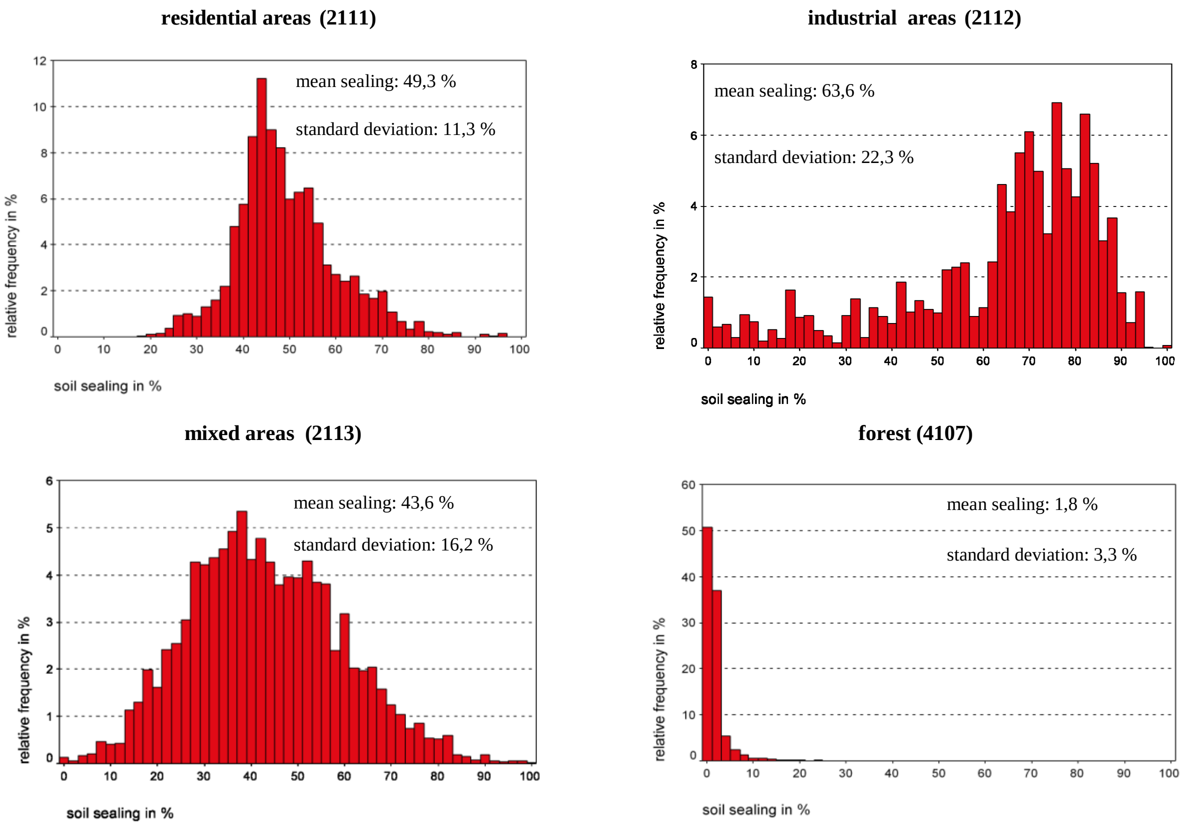

Fig. 2: soil sealing profiles of important ATKIS basic DLM feature types

Some feature types (e. g. forest, agricultural land, rivers) show a very low dispersion of soil sealing values of single features despite a high number of features which implies that the mean of the soil sealing of these feature types can be considered reliable. Concerning the feature types of the feature category settlement like residential development zone (2111), industrial areas (2112) and mixed areas (2113), which considerably dominate the degree of soil sealing, there is a broad dispersion of sealing values (fig. 2) because of a lack of differentiation of structure types. Comparing the determined mean sealing values for soil sealing of urban structure types from other studies (e. g. Heber 1993), a notable correspondence between these data can be found.

4 ANALYSIS RESULTS

Whether the use of these means leads to reliable results for the total or partly urban soil sealing surveys was to be tested by a comparison with further surveys. For that the total and partly urban sealing values were calculated on the basis of the total area sum of the single ATKIS feature types and a following multiplication of the parts of areas with the corresponding mean soil sealing value of the ATKIS feature types. These calculated values were then compared with sealing values surveyed with visual interpretation. Berlin had been chosen for the studies since there were both the ATKIS basic DLM as well as data of a soil sealing survey available. The latter had been worked out on the basis of Landsat TM satellite images and additional CIR aerial image data on a scale of 1 : 4 000 (West Berlin) and 1 : 6 000 (East Berlin) from 1990 with the help of digital building layout maps on a scale of 1 : 5 000 (Berlin Digital Environmental Atlas).

Tab. 2: soil sealing values determined from ATKIS in comparison with the Berlin reference survey on the basis of CIR aerial image data[42]

municipal district	reference value of soil sealing [%]	soil sealing [%] determined from ATKIS	mean deviation [%]
Charlottenburg-Wilmersdorf	36.3	28.7	7.6
Friedrichshain-Kreuzberg	62.7	41.6	21.1
Lichtenberg	42.1	36.3	5.8
Mitte	59.1	43.0	16.1
Neukölln	43.0	40.4	2.6
Pankow	29.6	27.6	2.0
Reinickendorf	28.0	32.0	4.0
Spandau	24.0	26.9	2.9
Steglitz-Zehlendorf	25.7	29.4	3.7
Tempelhof-Schöneberg	45.9	43.9	2.0
Berlin total (10 out of 12 districts)	34.6	32.7	1.9

As the comparison in table 2 shows there is in average a satisfying correspondence of the ATKIS based soil sealing survey with the more exact sealing survey data which had been determined by visual image interpretation. There is a clearly recognizable strong underestimation of the soil sealing at the ATKIS based survey method regarding municipal districts with a high density (Friedrichshain-Kreuzberg, centre). The reason for this underestimation is the use of too low (mean) sealing values of the ATKIS reference profiles of the categories “residential development zone” (2111), “industrial areas” (2112), “mixed areas” (2113) and “areas with special functional features” (2114). By balancing out the errors via the total area the deviation of the degree of sealing is only 1.9 % in Berlin.

In the future, the errors could be even more decreased by using attribute data in ATKIS basic DLM 3. The attributes “open or closed coverage type (BEB)”, function (FKT), function of the building (GFF) and surface material (OFM) can be very useful for a further differentiation of areas. A further improvement is possible by using the attribute “width of streets“ (BRF) within the category traffic (3100). Here the streets are captured only in lines and are buffered with the width of the streets and are separated by the ATKIS polygons which reach to the middle of the street at present. Since streets are in general completely sealed surfaces and therefore are significantly higher than the mean sealing value of settlement feature types in ATKIS the exactness in calculation can be increased. (The attribute “width of streets“ (BRF) of the feature category traffic is only partly applicable for Saxony in the basic DLM/2 and is therefore not included in the survey).

By using the mean sealing value of the ATKIS feature types it’s possible to create overall maps of soil sealing. (please compare fig. 3 for the city of Dresden)

[42] The municipal districts Marzahn-Hellersdorf and Treptow-Köpenick are not included since there isn’t an overall ATKIS basic DLM for these districts.

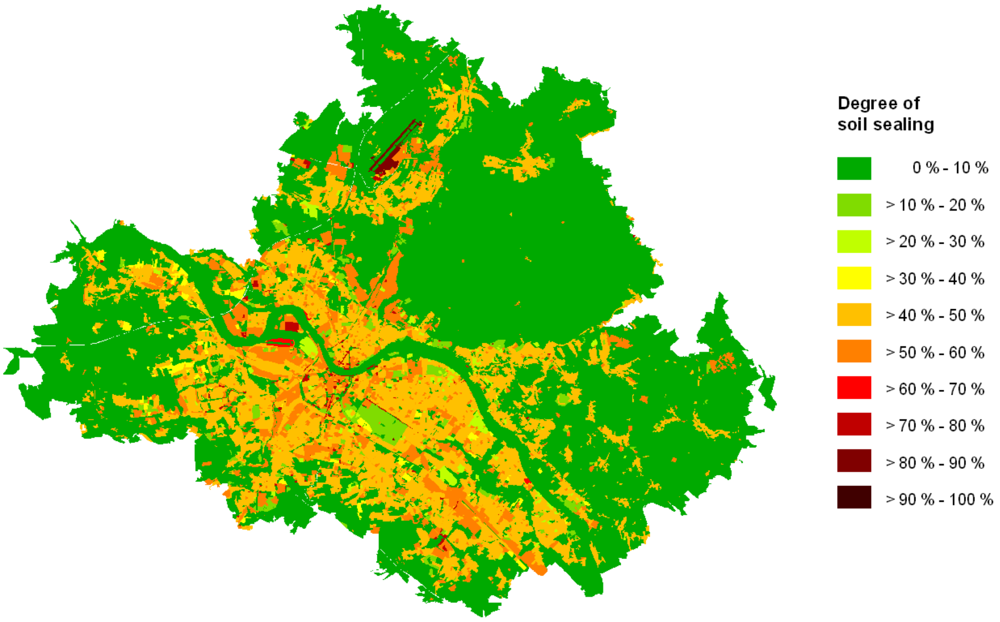

Fig 3: map of soil sealing in Dresden on the basis of ATKIS basic DLM

5 CONCLUSIONS AND PROSPECT

The study shows that the application of geobasic data for determining special data is very useful. It is possible to carry out an approximate determination on the basis of ATKIS basic DLM of the total and partly urban area sealing values (e.g. municipal district, Urban Office). Concerning the smaller reference units like statistical districts and blocks of residential buildings the ATKIS based sealing survey has a much higher error rate. For example the sealing value of highly sealed urban districts is partly underestimated by using the ATKIS mean value (maximum up to 15 %!). The exactness of sealing surveys can be further improved by using attributes which are already defined in ATKIS basic DLM/3. Finally the organization and structure of the ATKIS feature catalogue allows the addition of further feature types and attributes on the topographical and technical part.

With this described method the urban Environment Authorities can determine soil sealing values in a highly efficient way. By using geobasic data the problem of updating the data is solved at the same time since it is permanently provided by the land survey offices. In addition it is possible to set the geobasic data, which have been surveyed and maintained very costly, into additional value.

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City of Pixels
experimental imaging of postmodern *other* urban spaces

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1 INTRODUCTION

By splashing virtuality onto the real world, representation of digital culture has put people into a space of 'total flow', with juxtaposition of their mental images calling to attention the nature of those other (unconscious) and (hidden) spaces within postmodern cities (Thrift 2000). Virtual representation being a transmutation of the known, are thus interwoven into real urban life, thus symbiotically celebrating the new informational needs of our media – polis (Leach 2002). This gives the new face of our cities a phantasmagoric character (Huang 2000) wherein the global and local, the familiar and strange, the real and the virtual become inextricably intertwined, whilst creating a 'transnational urban experience' as the ideal of boundless and undefined spatiality predominates a digital age of fragmented post modernity.

Under late capitalism characterized by space and time compression (Harvey 1989; Jameson 1991), alternative representational methods of postmodern city landscapes are required with respect to production of architectural signs and images (Bermudez 1995), and with respect to consumption of contested city fabric that enact a variety of (re) (de) constructed local identities within emerging global urban spaces. A fruitful avenue of exploration may well lie in the current article's proposed experimental interfaces, within emerging networked environment, for intervening in postmodern cities' future developments, whilst examining potentials of digital technologies' representation of emerging urban spaces. The experimental procedure views postmodern urban landscape, as an arena for (re)(de)constructing spatial metaphors (Fahmi and Howe 2003), challenging the stable institutionalized construction of space in terms of production of a new 'hyper-real' urbanity (Baudrillard 1993). A series of spatial transformations simultaneously emerge as a simulation of urban experimentation in_between the local and global (glocal), imaginary and reality (Patton 1995).

Accordingly the paper presents Urban Experimental Imaging Model (UEIM) with the camera's eye to grasp the psychogeography of postmodern cit(y)(ies) spatial fragments, whilst considering the proliferation and fragmentation in production and consumption of phantasmagoric other ('unconscious' and 'hidden') urban spaces. The Model emphasizes aspects of spatial representation of 'other' urban spaces in terms of digital collages (disjunction- juxtaposition-assemblage) (Tschumi 1996), and experimental diagrams (superimposition-layering-fragmentation)(Eisenman 1999). Diagrams and collages create a virtual cut through the heterogeneous assemblage of physical spaces, urban imaging and individual experiences.

Whilst attempting to capture the 'hidden and unconscious' urban, digital fragments and diagrams will bring cit(y)(ies) images into sharp juxtaposition, thus 'de-solidifying' the physical and dissolving spatial distinctions between reality and mythical spaces, between the screen and the imagination, between the virtual urbanity of the information machine and the actual urbanity of the city. Urban Experimental Imaging Model (UEIM) will call into play the possibility of a coterminous and dialectic merging of very real city of bricks and a conceptually experienced 'city of pixels ' .

Key words: postmodern other urban spaces- spatial representation – deconstruction - experimentation – digital Images- diagrams

2 GLOBAL NETWORKS

In late/post modern societies local/global (glocal) tensions, with collision of signs and images (Sassen 1991), have created a 'transnational imaginary'(Dovey 1999). The intersection of local and global (glocal) spatio-temporal (dis)orders , regarded as mutually exclusive conditions, has resulted in the formation of new economic dynamics/opportunities of newly produced and newly unbundled spatialities that drive and constitute economic globalization and can be thought of as transnational process of partly de-nationalized temporalities (Sassen 2000). The ideal of boundless and undefined spatiality predominated an age of fragmented supermodernity (Ibelings 1998). This has led to a loss of sense of place, with non-places proliferating transit and informational spaces. With increased mobility and telecommunications, with the rise of new media, and with the emergence of cyberspace, the experience of time, space and place identity has changed (Auge 1995).

Castells (1998) provides an analysis to interpreting global politics and the transition to informationalism through the shift from the nation-state to an emergent form of governance, the "network state." Yet the growth of a global network society has intensified the unevenness of capitalist development, leading to the rise of the "Fourth World", and to growing economic and social polarization which has resulted in pockets of systematic social exclusion which Castells (1998) terms black holes of informational capitalism. Moreover economic globalization and telecommunications have produced a space for the urban that pivots on de-territorialized cross-border networks, institutional space and territorial locations with massive concentrations of resources. Cities and the new strategic geographies that connect them and bypass national states can be seen as constituting part of the infrastructure for global domains, including powerful global imaginaries enabling aspirations to trans-boundary political practice even when the actors involved are basically localized The local now transacts directly with the global --the global installs itself in locals and the global is itself constituted through a multiplicity of locals (Sassen 2003).

The centrality of place in a context of global processes engenders a transnational economic and political opening in the formation of new claims and hence in the constitution of entitlements, notably rights to place, and in the constitution of new diverse forms of 'citizenship' practices (Sassen 2001). Cultural identity has nevertheless experienced the contradictions between increased placelessness and reflexivity (in cognitive and aesthetic sense) (Lash and Urry 1994); and increased place-bound identities and tribalism as reactions to globalization (Castells 1996) .Castells (1997) demonstrates that identity issues are so critical to personal development in the information age in terms of the widespread surge of powerful expressions of collective identity that challenge economic globalization and cultural cosmopolitanism on behalf of cultural singularity and people's struggle to maintain (or reclaim) a degree of control over their lives and environment. Meanwhile, caught between the opposing trends of techno-economic forces and transformative socio-cultural movements, founding social institutions have been called into question.Taking the argument further, Castells also mentions the socio-psychological perspective, as information systems and networking subvert the traditional western concept of a separate, independent subject, built on the notions of sovereignty and self-sufficiency that have provided an ideological anchoring for individual identity (Castells 1996 p 23).

3 REPRESENTATION AND SPATIALITY

Accordingly visions and myths of the city (globalization, homogenization, (in)authenticity and universalism) have been instructive in terms of 'other cities' (the embodied, the learning, the unjust), thus 'Begin to provide a sense of a city that is constantly changing, that does not necessarily hold together' , and the city is regarded as 'a partially connected multiplicity which we can only ever know partially and from multiple places' (Thrift 1996, 2000). Moreover Harvey (1989) viewed collage/montage as the primary form of post modern discourse on spatiality, with the notion of consumption as assemblage, bricolage, or pastiche, largely replacing that of the functional city of modernism (Rowe and Koetter, 1978). For architects and designers, this collage, consisting of space-time, dimensions, is no longer modeled after nature or the machine, but after cities of the past which Vidler has described as "the third typology" (Vidler 1978, cited in Ellin 1996).

With ethical aspects of experiencing cities referring to questions of difference and other in urban environment, the argument was to abandon the city as a neutral space following its textual signification (Kymalainen 2000). Accordingly, the text and collage metaphors have been central to the re-conception of culture of consumption (Geertz 1980), asserting that the world is constituted symbolically, that people organize various aspects of their lives into a coherent assemblage through the medium of culture and consumption. More recently, Boyer (1994) attempts to read space as a "text", following Barthes' (1976 cited in Harvey 1989) earlier proposition that ‘spatial experience is a discourse and this discourse is truly a language' and that 'architecture of signifiers with no signifieds, is considered a pure play of language'. . Castells claims that 'we do not see reality as 'it' is, but as our languages are. And our languages are our media. Our media are our metaphors. Our metaphors create the content of our culture...'. Cultures are made up of communication processes and thus there are no separation between 'reality' and symbolic representation (Castells 1996 p 328, 372-73, 375)

Lefebvre (1991) distinguishes between ‘representations of space’ engaged in by planners and cartographers, and symbolic ‘representational spaces’ in cities, drawing on shared experiences and interpretations of everyday ‘spatial practices’ of people, where making space is very much a way of making meaning . According to Foucault (1986), the meanings of representational spaces or discourses are never absolute, but always subject to translation and interpretation. Therefore a postmodern urbanism is conscious of the power of discoursive production of urban representational spaces where “people not only live their space "through its associated images and symbols" (Lefebvre 1991:39), they actively construct its meaning through cognitive and hermeneutical processes.

Discourses express human thought, fantasy, and desire and thereby represents human ontology's (beliefs, fantasies, values, and desires about how the world is) and epistemologies (how better understandings of the world might be achieved). Therefore the meaning of representational spaces or discourses are never absolute, but always subject to translation and interpretation. Accordingly, Derrida's (1976) work was modeled after literary criticism with the (double) reading of the text and interpreting the meaning of culture, and with the need to read spatial ’text’ in terms of the rhythmic occurrence of events.

According to Ellin (1996), a new urbanity, in the information age, is emerging where boundaries between reality and virtuality are blurring, nothing prevailing but discourses, texts, language games, images. Therefore designers' task has shifted, becoming the collection and assembling of urban elements in Foucault's museum of knowledge, with emphasis on creating legibility and a sense of place. Postmodern era implies a need to re-appropriate the urban in terms of our consumption practices and spatial tactics, and sites of exchanges and encounters (Leach 2002). The postmodern age is characterized by the commodification of place, privatization of public space (mallification), fragmentation of spatial experience , globalization of local culture .

3.1 Urban Semiotics and Space-Time Compression

Barthes’ (1976) semiotic approach is concerned with the how of representation, with how language produces meaning- poetics of space in terms of a system of signs. These Systems of signification (semiotics) encompass denotative signs and meta-linguistic systems in relation to culturally specific systems of connotative codes. Such universe of signs includes: the non-physiological part of perception; conception; scientific modes of discourse; and the value systems, or the socially constituted world views of social subjects, . . . " According to Gottdiener and Lagopoulos (1986) urban space is not a text but a "pseudo-text," because it is produced by non-semiotic processes as well as semiotic and socio-semiotic ones.

The postmodern phrase 'The presence of the past' (T.S. Eliot, in Venturi 1977 p.13), "...tends instead to draw our attention to the contextual and linear relations of new architectural forms as they relate to past urban images, rather than stressing the differences, the rupture between then and now, here and there, and the memory of things and events that have never and can reoccur in the present" (Boyer 1994 p. 374) The past returns to urban space in its fragmented and imaginary form and creates the city of deconstructed spaces and images which fractures our sense of urban totality.

Furthermore urban Images/screens (or architecture of images) (Bermudez 1995), with hybrid interface between electronic and built media (Pile 1996), is considered the natural extension of mediatecture (Riewoldt 1997, Mitchell 1996) and mediascape (Christensen 1993) offering (un)built forms with virtual layers, challenging concepts of presence, distance, and time. Additionally media culture has nevertheless put people into a space of 'total flow' (heterotopias- places outside of all places'), with the juxtapositioning of their mental images calling to attention a line of conflict (Jameson 1991). This is concerned with the nature of those other (unconscious) spaces, which have become invisible, with the virtual city being a transmutation of the known, being interwoven into real urban life.

"Here we are in Robert Venturi's [post]modern city, not just Las Vegas but any [post]modern city, a mediascape of office buildings and stores transformed by their corporate identities into the new language of consciousness: the sign molded in glass and light, splashed over with the insignia or characters of logos. Buildings are no longer mass and weight, stone and iron, but an array of sentences spelling out the consciousness of a city, what a city means when we enter it and use its services, consume its goods. The city's language of buildings and streets, of glass and light, is a declaration of ideals . . .which the city achieves by transforming things into words, objects into signs, the dark of nature into neon abstraction and codes. . . the mediascape devours the literal materiality around it" (Christensen 1993, p.9-10) .

Baudrillard (1993) claims, "There is no real and no imaginary, except at a certain distance. Because 'reality' or the world now seems to be cybernetically organized continuum of kinetic images, information, and technological artifacts, it appears that value and meaning also have been lost in the transformation" (Boyer 1994 p.492).

Urban Semiotics compress space and time under late capitalism (Harvey 1989), as representation of urban experience to produce multifunctional hybrid spaces (Jameson 1991). This has called for a new aesthetic of cognitive mapping of a city with multiple meanings and images (Lynch 1960). Cognitive mapping approaches arrive at the signification of the city through the perception of its inhabitants rather than their conception with the urban environment being reduced to a perceptual knowledge of physical form. Whilst perception is conceived as passive or receptive, Urban Imagery, being stimulated by urban structure, generates representational methods and narrative systems (Calvino 1979). People perform various roles to (re)construct their urban imageries as conjuring up of various impressions 'in the mind', which may be 'visual', as well as auditory, olfactory, verbal, textual, or of a notational, or symbolic score (Liddament 2000) .

"…that this latest mutation in space — postmodern hyperspace — has finally succeeded in transcending the capacities of the human body to locate itself, to organize its immediate surroundings perceptually, and cognitively to map its position in a mappable external world" (Jameson 1988). The postmodern context is however semiologically represented as a theatrical space, implying a multiplicity of signs (deferred and never fixed), as signified (context and meaning) and signifiers (forms and urban elements) (Leach 2002), and as imaginary in a deconstructive sense.

With hypermobility and space/time compression, the city has indeed emerged as a site for new claims and contestation: by global capital which uses the city as an "organizational commodity", and by disadvantaged sectors of the urban population. The denationalizing of urban space and the formation of new claims centred in transnational actors and involving contestation constitute the global city as a frontier zone for a new type of engagement (Sassen 2003). Compression of time and space under late capitalism has created a situation where people as consumers overcome spatial barriers , with the central value system being dematerialized , and with shifting time horizons collapsing inwards upon us. The interweaving of simulacra in daily life brings together different worlds (of commodities) in the same space and time. But it does so in such a way as to conceal almost perfectly any trace of origin, of the labour processes that produced them, or of the social relations implicated in their production.

"…the history of capitalism as being characterized by speed-up in the pace of life, while so overcoming spatial barriers that the world sometimes seems to collapse inwards upon us'. (Harvey 1989 p. 240).

" The central value system . . . is dematerialized and shifting, time horizons are collapsing, and it is hard to tell exactly what space we are in when it comes to assessing causes and effects, meanings or values" (Harvey 1989 p. 298).

"Capitalist hegemony over space puts the aesthetics of place very much back on the agenda . . . The construction of such places, the fashioning of some localized aesthetic image, allows the construction of some limited and limiting sense of identity in the midst of a collapse of imploding spatialities" (Harvey 1989 p. 303).

There is no coincidence however that global networks appear simultaneously with the postmodern literary movement. Every major intellectual field and academic discipline has taken a postmodern turn in recent years, challenging or overthrowing modern paradigms and establishing new ones. In fields ranging from the life sciences to business organization , provocative arguments are being developed that we are emerging into a new global economy, an innovative high-tech society and culture, and novel postmodern ways of life and identities. In postmodernism, there is no central authority, no universal dogma, no foundational ethic .For Harvey (1989) the postmodern turn results in fragmentation, instability, indeterminacy, and uncertainty. Network principles renounce rigidity, closed structure, universal schemes, central authority. Instead networks offer up plurality, differences, ambiguity, incompleteness, contingency, and multiplicity.

"The relatively stable aesthetic of Fordist modernism has given way to all the ferment, instability, and fleeting qualities of a postmodernist aesthetic that celebrates difference, ephemerality, spectacle, fashion, and the commodifications of cultural forms" (Harvey 1989 p.156). Postmodern developments are therefore directly related to "the more flexible motion of capital [which] emphasizes the new, the fleeting, the ephemeral, the fugitive, and the contingent in modern life, rather than the more solid values implanted under Fordism" (Harvey 1989 p.171).

Furthermore in a world of ever-faster change and growing abstraction the process of reflexivity opens up possibilities for the recasting of meaning in work and in leisure and for the heterogeneity and complexity of space and everyday life. Confronted with the increasing cultural content of flows reflexivity becomes aesthetic - a notion for which Lash and Urry argue (1994). They state that postmodernity produces 'semiotic' rather than industrial goods. The mobility of these objects or goods in flows changes their nature - they are progressively emptied out of both symbolic and material content and thus of their traditional local meaning. What increasingly is being produced are no longer material objects but signs. Goods often take on the properties of sign value through the process of 'branding', in which marketers and advertisers attach images to goods." (Lash and Urry 1994 p.15). This reflexivity is partly based on aesthetic judgments and stems from the proliferation of many forms of real and simulated mobility Thus aesthetic reflexivity raises the critical awareness and concern of people for their own environment and consequently contributes to economically relevant innovation which can occur in relation to urban form and functions. These " fields comprise:

The introduction of new types of urban place or space for producing, servicing, working, consuming, living, etc. Recent examples include technopoles, intelligent cities, cross-border cities, multicultural cities and cities organized around integrated transport and sustainable development;

New methods of space or place production to create location-specific" advantages for producing goods/services or other urban activities. Recent examples include the installation of new physical, social and cybernetic infrastructures, the promotion of scale and agglomeration economies, regulatory undercutting or creating new forms of labour market relation;

Opening new markets—whether by place marketing specific cities in new areas and/or modifying the spatial division of consumption through enhancing the quality of life for residents, commuters or visitors (for example, culture, entertainment, spectacles, new cityscapes, Yuppie quarters, gentrification).

Whilst sociologists maintain that postmodern society is becoming increasingly fragmented as community groups become less clearly defined, global companies - through sales and branding have developed a new analysis of community based on consumption. Society's dependence on image and the perceived value of goods has created unprecedented control over people's choices. Accordingly themes of aestheticization in today's postmodern society reflect the increasing role of consumption as an art form. A new consumer type - the 'fluxus' consumer - has emerged. Multiple selection and combination of 'products' allows a unique spatial experience- the architecture of the postmodern commercial take-away.

3.2 Imaginary Cities and Heterotopias

Past decades have seen the rise of 'a new society of the image' in which consumerism and market frenzy are not the issue so much as 'consumption by the eyes' (Jameson 1991). As postmodern society becomes increasingly fragmented, with community groups becoming less clearly defined, global companies - through sales and branding - have developed a new niche of 'fluxus' community based on image consumption. It is not simply that urban life has become more superficial, more image- and consumption-based under conditions of late capitalism, but rather that the city in itself has become an imaginary space. The city itself is 'soft', in the sense that it is a type of reality for which the boundary between imagination and fact is not absolute (Raban 1974).

"Cities, unlike villages and small towns, are plastic by nature. We mould them in our images: they, in their turn, shape us by the resistance they offer when we try to impose a personal form on them"…. (Raban 1974 p.10) And "…the city as we might imagine it, the soft city of illusion, myth, aspiration, nightmare, is as real, maybe more real, than the hard city one can locate in maps and statistics, in monographs on urban sociology and demography and architecture".(Raban 1974 p. 10).

However, this dynamic has affected our sense of ourselves and our lives, with the self being collapsed into its manner of (re)presentation with the border between the 'self' and city becoming fluid. An alternative reading of the structure and meaning of contemporary and past urban spaces was nonetheless provided by Soja (1989), in his 'reassertion of spatiality' using Foucault's concept of heterotopia (which are places outside of all places). Heterotopias could nonetheless lead to a more fruitful unpacking of the epistemological and logical factors relating to imagery and semiotics. Two categories however are identified by Soja (1995); sacred or forbidden spaces and modern heterotopias of deviation which can change in function and meaning over time. Gennochio's (1995) interpretation revealed two different kinds of heterotopias: the extra-discursive one which is the absolutely Other, 'external' spaces' and 'heterogeneous site' capable of juxtaposing in a single real place (with several spaces that are in themselves incompatible); and the discursive other coexisting in an 'impossible space' of a large number of fragmentary, possible, though incommensurable orders or worlds.

Patton (1995) draws attention to the ways in which imaginary cities are written with respect to 'reality'. For some writers real conditions of urban existence underlie the signs they describe, for others there is no distinction between the imaginary and the real (Burgin 1996). What is of co ncern is the possibility that a reading of cities (the production of further signs, or urban imageries), rather than the excavation of a foundational real city (the decoding of the urban imaginary), might enhance our capacity to live in urban relations which are unoppressive. The experiment of reading and decoding postmodern cities is based on a number of actual cities, with differing enabling effects and representational methods .Moreover images of the city play a crucial role in accounts of the postmodern condition and in the description of the experience of contemporary urban life (Patton 1995). We propose that we are dealing with imaginary cities; not simply the products of memory or desire, but rather complex objects which include both realities and their description: cities confused with the words used to describe them (Calvino 1979 p. 51). Whilst a city cannot be created out of nothing. Elements of this city-imaginary have in turn affected the development of real cities .

Furthermore cognitive mapping of the post modern city of pixels takes on the characteristic of a Baudelairean (neo)flâneur whilst approaching the reality of the vast terrain of city spaces with his investigative gaze. There is tendency to capture the "logic of the place" in the post modern city, where spatial changes often outpace the revisions of maps due to its constant space-time compression (Harvey 1989) . Whilst investigating possibilities for (re)(de)constructing the meaning of postmodern space, in terms of Foucault's (1986) heterotopias (places 'outside of all places') (Soja 1995), the conceptual approach tackles inscriptions of difference, belonging and sensory experience of navigating a metropolis under transition attempts at weaving anecdotal observations, encounters and reflections oriented by the metaphor of shifting images, recalling dialectics in post-socialist contexts.

An attempt to conceptualize the Baudelairean flâneur (Benjamin 1973) as a multi-layered narrative in post modern conditions will enable us to a reflexive (and cognitive) understanding of epistemologies .The flâneur as an alternative 'vision' and an image of movement through the urban spectacle of (post)modernity is the "botanist of the asphalt" who walks through the city while exploring shifting social space. More importantly are the attempts at adapting the nineteenth-century figure of the flâneur to a postmodern context (neo-flâneur), as being engulfed in the signs and stimuli of the global flows, whilst witnessing the fetishism of commodification and aestheticization of postmodern consumption in post modern metropolis . Such neo-flâneur is a type that is out to take its artistic or aesthetical distance from its consumerist urban surroundings. Postmodern images of the urban self do more than entail an increase in the distancing defense strategies; they paradoxically also involve the postmodern phantasmagoria of an absence of distance. In the aestheticized perception of consumers, no form of distance imposes itself.

The fate of the flâneur constantly invites us to consider whether or not the era of globalization allows the kind of walking space that might liberate the contemporary (neo) flâneur from traditionally defined social space and social relations. To grasp the interaction between urban planners' spatial theories and individuals' perceptions of the lived space of the urban, for a critical reading of the utopian discourse, it is essential to examine the way our flâneur's gaze and cognitive mapping mediates the walker's experience of post modern spaces of the city of pixels.The metropolitan flâneur has also been relocated, for much of the time, to the inside of buildings and malls (the aesthetic cocoon (Leach 2001) with the 'outside' being a traffic-flow-support-nexus". The flâneur has been displaced by the post pedestrian type of driver, with the vehicle (metro, bus, tram) serving as a cocoon in which the individual finds protection from the dangers of the urban jungle and the phenomenon of "fried urban nerves'. Vehicles have helped reduce the urban experience to a visual spectacle, with the cinematographic experience conferring on perceived objects a certain plasticity. In this sense, the neo- flâneur becomes an absorbent recipients of post modern imageries which can be layered onto the concrete surfaces of the overpasses and transmitted from the immense constructions of neon light which tower over the buildings of post modern city's intersections, squares and boulevards.

City's imageries invest representation with texture, multiplicity, intricacy whilst collecting and moving along its principal arteries an immense flux of trajectories, a vivid generation of visual life focused in the depth of its boulevards and avenues, and enclosed within the façade of its buildings. In the peripheral world of the highway, the complexity of the building mass is imperceptible as it fades into a faint image which hardly persists in our memory .The speed of driving creates a cinematographic effect that results in a loss of sensible referents and a decay of architectonic markers .

4 CONCEPTUAL FRAMEWORK

4.1 Urban Experimentation

Urban experimentation views proliferation and fragmentation in production and consumption of spatiality as being regarded as series of superimposed layers of spatial programmes, whilst combining material and perceptual (de)constructive urban images. There is a need to propose tangible forms for a wider understanding of the space which mediates overlapping urban images, fields, networks (where built and unbuilt environments intertwine). This procedure aims at producing images of new space configurations which are never geometrical nor predictable, but are rather collections, aggregations, accumulations of patched-up, extendable, overlapping and developing forms. The experiment(s) acknowledges the conflict between imagination and realization as a driving force for creating and structuring virtual spatial orders, thus operating on the boundaries between virtuality and reality. The task is to materialize spatial paradox to accentuate the experienced qualities of design of the built environment. There is an attempt to replace the neutral, homogenous conception of modernist space with the post modernist figuration of form as a theatrical construction that is highly orchestrated through relations and instructions, and subjected to functions of (trans)forming, (in)forming and (per)forming (Eisenman 1999). Because of the component of sign value or aesthetic image in postmodern cities, experimentation becomes a more important aspect in producing spatial possibilities.

Therefore the proposed procedure will provide potentials for flexibility and imageability to generate new dynamic forms of urban images, with added layers of history being superimposed, with fabric being opened and randomness being valued. However the experimental procedure will allow for (re)(de)construction of new spatiality, disrupting its meaning, whilst identifying the relationship between cognitive imaging and virtual forms. There is a need to read deconstructively such internal struggle between deconstruction of institutional consumption and institutionalization of spatial deconstruction, a resistance that would provide more incentive for further deconstruction (Wigley 1995), ranging from visionary ideas to electronic agora and virtual spaces (Graham and Marvin 1996).

The current postmodern (de(re)constructive) experimentation will deal with urban images which represent multiple and continuously changing interfaces that transcend the nature of physicality by offering built forms of multi-dimensional virtual layers. The immediateness and multiplicity of these (hyper) environments challenge the traditional concepts of presence, distance, and time, whilst delivering an architecture of singular simultaneity, that is an architectural version of Auges' (1995) non-place where anything and everything is (re)present(ed) at least in theory. Urban images can be seen as both the celebration and critique of the media/information postmodern society . Accordingly importing, sustaining, and 'splashing' virtuality (e.g. art work, cinema, daily news, environmental scenes, video-games, virtual worlds) onto the real world will nevertheless lead to hybrid interface between electronic media (broadcast or wired) and built media (encoded in the urban environment).

In addition to a symbolic equivalence between the physical and the virtual, there is an ontological equivalence, with "digital-space" being made commensurate with "real-space." Not only physical axioms, but also metaphysical axioms are sustained, ensuring that the same epistemological system governing Western thought will continue to operate. Metaphors of cities, of electronic spheres imply that Cyberspace is more than a space, it is "a place and a mode of being."" As such, cyberspace prompts humans to "be" differently. Often couched in evolutionary terms, the inhabitants of cyberspace are described as developing nonphysical qualities, qualities that pertain to their non-embodiment, and that suit the demands of virtual architecture and virtual physics.

Urban images are therefore the natural symbiotic result of the new material and information needs of our environments, with hybrid interface between electronic media (broadcast or wired) and built media (encoded in the urban environment). Although media may conjure up almost anything into presence, virtuality can only displace but not replace reality, whilst seeking to reaffirm the true meaning of being embodied. New spaces emerge and disappear, they overlap and interpenetrate one another, with the virtual city being at once a transmutation of the known, whilst standing alongside and being interwoven into real urban life. However with information technology bringing various areas into proximity of one another, spaces constantly juxtapose themselves one against the other, similar to Lefebvre's (1991) image of interpenetrating spaces. In turn this will invite a refocusing of spatial design, bringing together the material and the informational, the tectonic and the abstract, the real and the virtual whilst re-inscribing these motifs within new practices, new forms, the parameters of which are the ingredients (materials and images), consuming methods (production techniques and spatial diagrams) - the architecture of the postmodern commercial take-away.

4.2 Urban Disjunction

Eisenman (1999), and Tschumi (1988) both dismantle the conventions of architecture by using concepts derived from cinema, literary criticism, philosophy and psychoanalysis (Fahmi 2001). In Cinegramme Folie at the Parc de La Villette, Tschumi (1989) dislocates, de-regulates the idea of meaning as emerging from built form, as constantly 'deferred, differed, rendered irresolute' , displaced by 'superimposition and transformations'. 'Presence is postponed and closure deferred as each permutation or combination form shifts the image one step ahead' (Tschumi 1988) .

Urban Disjunction rejects the notion of "synthesis" in favour of juxtaposition of contradictory forces (Tschumi 1996), thus producing dissociation which Derrida (1982) would call differrance in space and time, with architectural elements only functioning by colliding with programmatic elements (Cross-programming- Trans-programming- Dis-programming). A Deconstructive procedure further reengages analytically in city imaging and new urban installations in public spaces. Lebbeus Woods' visionary work considered with analogous comparison of virtual space and , '… produces daring visual effects, suggests enigmatic purposes, and evokes a new sense of time space,' and suggests that people can create their own world with reference to their collective memory, with the ability to draw upon their own experiences (Noever 1991). The aim is to produce hybrid situations for consumption of a conflation of various commodities and urban images, including built and unbuilt elements, as influenced by history, human experience and contemporary culture, and being mapped into fictional terrain of perceptive imagery and virtual reality.

Nevertheless Urban Disjunction overcomes aesthetic borderlines and familiar structural principles, a change in visual habits, creation of a new aesthetic, experimentation, link between visionary architecture and electronic media of the real and virtual space (Cooke 1989). Urban Disjunction emancipates architectural thinking from the hegemony of functionality, from its traditional elements such as harmony, unity, symmetry..), and re-inscribes these motifs within new spaces, new forms, to shape new spatial experiences and representations .

4.3 Urban Experimental Imaging Model (UEIM)

A (de)(re)constructive reading is proposed of the city of pixels as intermediary (in-between) spaces, similar to Tschumi's event city (1994) and Coates' ecstacity (2000), a conflation of existing real cities (Shanghai 2000, Helsinki 2000, Cairo 2000, London 2002, Berlin 2003, Moscow 2003, Barcelona 2004, Manchester 2004, Cairo 2004), with urban spaces being mapped into fictional terrain of imagery and virtuality. Conceptualizing the post modern city as a collective collage or a "theatre of memory' is based upon Harvey's (1989) diagnosis of postmodern representation of urban experience, with the city being a theatrical space, 'a series of stages', where individuals can assume different identities under space-time compression . Urban experimentation will employ representational techniques identified by Pile and Thrift (2000) such as collages (Rowe and Koetter 1978), diagrams (Eisenman 1999); montage and flâneurie's narratives (Benjamin 1979, 1985); screens (Deleuze 1997, Lefebvre 1991).

Accordingly city of pixels is understood as a collection of urban fragments being (re)sorted, (re)assembled and (re)connected continually unsettling and disturbing established spatial orders, whilst implying superimposition and interchange. Urban Experimentation, by means of texts, digital images, digital video stills and diagrams, creates symbolic representations, and fantasies to signify an identifiable or/and imaginary (sense of) place identity, whilst emphasizing the use of spatio-temporal mapping, narratives, and people's cognitive mechanisms within urban spaces . The postmodern Urban Experience is thus being represented as consisting of series of superimposed layers of programmes (functions, geometries, infrastructures, buildings) (Tschumi 1988,1989), influencing, modifying, changing city's structural concept whilst producing fragmentary urban patterns, with historical and topographical factors generating contradictions and tensions (Fahmi 2000). The current experiment suggests tangible forms for understanding spaces in-between, mediating overlapping images, fields, networks (where built and unbuilt environments are revealed). With the need to suture elements of the splintered postmodern urban, the experiment acknowledges the conflict between imagination and reality as a driving force for creating and structuring virtual spatial orders, producing images of the city as collections, aggregations, accumulations of patched-up, extendable, overlapping and developing forms.

Furthermore the experiment's intention is to unsettle 'memory and context' by rejecting both 'contextualist' and 'continualist' approaches, and favouring conflict over synthesis, fragmentation over unity, madness and play over careful management. The experiment opens into prior images and earlier signs, representing a different and autonomous system (a text), presenting 'urban montage', which had been applied in Tschumi's (1989) Parc de La Villette and developed as part of film technique by Eisenstein . In 'montage' independent urban fragments are juxtaposed thus permitting 'a multiplicity of combinations', together with repetitions, substitutions, and insertions.

4.4 Representation of City of Pixels

4.4.1 Urban Screens, Collages and Fragments

Urban images/screens (Bermudez 1995) offer multiple and continuously changing interfaces whilst transcends physicality by offering buildings of multi-dimensional character , and by accessing a hyper-environment , with layers of (virtual) environments overlapping. Screen interfaces are seen as indices of possibility, with their proliferation enriching our imaginative experience of the city, by producing psychic echoes and reverberations that enliven the senses. Deleuze's (1997) screens become a means of expressing affects of the city by placing images together, mirroring the way in which the city juxtaposes many different possibilities, emotions, sensations, and perceptions. They make these qualities into dialectical forces which are actualized in determinate space-times, geographical and historical milieus, and individual people's lives (Smith 1992) . (Figure 1a: Screen – Interface).

This stage of the experiment pulls together a spatial narrative evoking journeys to ‘ the other cities, with such juxtapositions being a montage of urban images, revealing the fragmented nature of postmodern space (Harvey 1989), with its souvenirs and its myriad connections to ‘other’ places . In accordance with Benjamin (1985), there is an attempt to recuperate and reassemble from the fragments, a different picture of the post modern city , through the flow and distribution of images. This is similar to Tschumi's (1989) follies at Parc de La Villette, where cinematography was exploited to offer new perspective on the city, by bringing many images into sharp juxtaposition, by being able to establish connections between apparently disconnected elements, and by using multimedia to capture the urban experience (Benjamin 1985) . (Figure 1b: [spacez] and [connectionz].

Box 1: Notational Interaction in Space and Time (Figure1)

The theme for this stage of the experiment focuses on developing algorithms that formulate spatial and temporal relationships with a common (dis/ cross/ trans- programming) narrative. Uncertainty prevails as new post modern spatiality emerges using a series of collage- images and screen interfaces. Collage-images investigate the free-space construction of the newly –hidden city of pixels through the meeting of both virtual and real worlds (Figure1).

a- **Screen – Interface** (Figure 1 a)

Screen Interface reconfigures the external surface of real built space, in response to the saturation of media in the city. The real city facades are replaced with a fluid, interactive 'blankspace', upon which all forms of digital display and advertising operate .

b- **[spacez] and [connectionz]** (Figure 1b)

Collages and Fragments represent the interface between actualised landscape and the deconstructive experience within (virtual and real) city as constantly negotiated and redefined by peoples’ movement around, through and inside main public spaces

4.4.2 Urban Semiotics

The semiotic matrix of city of pixels ’at night’ forms a text of aesthetic representation, with an exhibition of images actively permeating and flexibly saturating the real city. where signs coagulate, logos deliquesce, thus creating a hybrid identity for its inhabitants. The blurred tracks of the semiotic matrix of post modern spaces of the night city’s articulation represent a spatial memory (Boyer, 1994), whilst being regarded as arenas for urban experimentation in_between the local and global (glocal), the imaginary and reality (Fahmi and Howe, 2003) Inevitably, cities will increasingly be seen as landscapes, where each building markets itself as a distinct sign, or billboard, representing the corporate identity of and globalization. The notion of the branded landmark is explored as a major public structure. These buildings will mark place as well as represent chosen brand identities. (Figure 2: Brandscape)

Box 2: Interactive BRANDING Systems (Figure 2)

brand-segment targets zones of interactive surfaces for display-information and promotion of brandscapes, and is assembled as display devices adjustable to spatial changes . Utilizing a system of smart surface segments, an interactive surface is created for display, information and promotion of brandscapes.

Brand-nets extend the ways in which space is used to brand lifestyles. The scripted, thematic experience of the city of pixels is formulated by the installation of changeable surfaces that transform identities: a spatial mechanism/metaphor that tests the capacity of spatial radicalization of the city of pixels .

4.4.3 Diagrams between Reality and Virtuality

Drawing upon Eisenman’s Romeo and Juliet project for Venice Biennale (1985), methods of diagrammatical layering, scaling, superimposition, is being employed in the experiment, producing a fractal representation of the built environment, with literary narratives being used to dramatize the meeting of the ‘fictional’ and the ‘real’. Such Image diagrammatic technique lies between spatial and structural analysis and assumes a language founded on the articulation and contradiction of dialectics (centre-periphery, vertical-horizontal, inside-outside, solid-void, point-plane). Such technique detaches form from its programmatic concerns, and displaces it from its relationship to function, meaning and aesthetics whilst being subjected to functions of (trans)forming, (in)forming and (per)forming (Eisenman 1999). Diagrams offer experimental interfaces for intervening in complex urban processes within emerging networked environment, not only to develop advanced tools for the design of (un)built environments, but to refresh 'ways of seeing' through the design (creation) of imaginative (virtual) environments involving metaphorical (re) (de) construction of space, cognitive codes, and visual elements within urban systems. (Figure 3: Mindspace and Dreamscape)

Box 3: Mind Mapping (Figure 3)

This is fictional space or a moment in time lies somewhere between documentary and fiction. A sequence of diagrams are traced that will try to record what takes place between the moment of looking and the moment of drawing a line. Observing, analyzing and imagining a film space through drawing, in order to test and realize the possibilities of transforming a space through processes of construction: layering, adding, subtracting, cutting and distorting. A sequence of multi-view spatial diagrams are formulated with different types of projections (orthogonal, perspectives) and collages processes. The result is an operating system of different aspects of virtual, simulated, personal, imaginary spaces - a structured, multi-author, multi-threaded narrative space for consumption of the city of pixels

4.4.4 Urban Narratives

Narratives have formulated architectural fiction whilst binding together stories, myths, and fantasies through plot formation and characterization within fictional landscapes that reflect a knowledge of the culture producing them. Narrative inquiry uses stories to describe how people construct the meanings of their lives (Bruner 1986; Polkinghorne 1995) lead storied lives and tell stories of their lives, whilst combining to make fluid interchanges between fiction and, potential architectural production. However Boyer (1994) has pointed out that the postmodern aesthetic claimed to return to narrative forms, searching for design language that communicates with the public, that manipulates simple combinations and patterns that are part of our collective memory . With the text remaining central, our environments grow increasingly hyper-real, with people generally exchanging their role as users and becoming readers and consumers (Bergum, 1990). (Figure 4a: EventSpaces; Figure 4b: TranS-system and URBA-NETworks)

Box 4: EventSpaces (Figure 4)

a- **EventSpaces**- Figure 4a represents a spatial metaphor for re(de)constructing dynamic, constantly changing scenarios of hyperlinked texts and images which will provide the possibility of a more situational or flexible location of the self, as means of orientation within the emerging meta-spaces of global mobility. This will allow the urban consumer to manipulate and express spatial meaning, structure and aesthetics, thus enabling spatial representation to become part of the individual urban experience

b- **TranS-system and URBA-NETworks** Figure 4b

TranS-system has put people into a space of 'total flow', with the juxtapositioning of their mental images, and with possibility of re-mapping a real city through locating the hidden spaces in the "unconscious" of the city of pixels.

*URBA-NET*works of 'third spaces' at major existing infrastructural sites reflecting mobility, time and interconnected network facilities . These spatial networks imply immersion, habitation, being-there., drifting between reality and mythical spaces, between the screen and the imagery of transit spaces and experience of space- time compression (Harvey 1989).

4.4.5 Urban Installations

Urban interfaces are introduced, including (un)built environment and image diagrams as inserted within or superimposed on the fabric of the city of pixels . These installations/icons or urban interfaces then cast the experiential tools to explore the city as an individual construct (flâneur), considering the complex centripetal-centrifugal space which everybody experiences physically and perceptually. They respond to events and initiatives to formulate hyper-spatial conditions which are multi-dimensional , multi-physical, flipping and compressing both virtual and real experiences in the city.(Baudrillard, 1993). (Figure 5 OtherSide Digital territory)

Box 5: OtherSide Digital territory (Figure 5)

This stage incorporates urban /art installations designed to experiment with new possibilities of virtual space, whilst exploring metaphors of urban life and human experience, weaving into existing fabric of the real city and becoming a city of pixels, that functions as a dynamic experimental incubator, enclosing various concepts.

5 CONCLUSION

5.1 Virtuality and Postmodern Spatiality

Castells(1996) argues that power resides in the net as places cannot exist outside of flows of information, transactions, people, and goods. Places do not disappear, but their logic and their meaning become absorbed in the network. However the proliferation of "non-places"; the bland shopping malls, indistinguishable airports, office blocks, gated communities, theme parks, old-worldly villages, and managed and coifed "wilderness" areas that, functioning as signs rather than places, immerse the user in a self-conscious form of ritual bearing little relation to any actual time or location. Alongside the built environment, the global reach of television networks saturates world screens with a homogenous stream of images, sounds, rhythms, flows, nuances of light, color, and location. Cultural difference is absorbed, and an intense uniformity is produced via the rigorous programming that commercial interests demand . Sassen (2003) focused on digital information and communication structures that arise out of the intersection of technology and society, whilst using the construct "digital formation" to capture this outcome, one shaped both by endogenous technical properties and by endogenized social logics. However growing digitalization of economic activities has not eliminated the need for major international business and financial centers and all the material resources they concentrate, from state of the art telematics infrastructure to brain talents.

In the familiar characterizations of cultural discourse, screen culture inhabits neither place nor ground: it is fragmented and dislocated, it operates on a surface that is ephemeral and mediated, it has a four second attention span. With the accouterments of telecommunications—faxes, modems, mobile phones, beepers, these tendencies are amplified. The ever-expanding, continuously on-call individual, becomes another kind of interface, for ever screening, filtering, ignoring, accepting, and repressing the plethora of inputs, information and demands for action that absorb his or her private space and individual time. While this appropriation of personal time and actual place may once have been viewed as a surreptitious lengthening of working hours and (mostly) unremunerated use of an individual's major asset; the home, for work purposes, it is now applauded as evidence of the collapse of borders, the process of globalization that is manifested on a national and individual level as everyone becomes his or her own small business.

Reflecting trends in poststructuralist theory, this exchange between the individual and the electronic media and telecommunications environment is discursively represented as the achievement of a polymorphous, heterogeneous subjectivity, a "liquid identity," a "post" human freed from the bonds of the autonomous subject. Subjectivity is performed as a new kind of text while the body becomes a permeable surface, adorned with signs and riddled with the inscriptions and prescriptions of culture. In this context, the hinge between cyber and space conveniently slides between ontology and postmodern "body-as-text" . This belief in the body-as-text runs across theoretical discourse within the humanities, information theory, and information technologies. Cyberspace is established as an "other" place to enact the deconstructed self: a self whose multiplicity and ambiguity is continually reinforced as the body seems to increasingly inhabit the dematerialized world that technology creates.

Seeing, and the poststructuralist framework dominated by the mediated image, is replaced by being, and the supposedly unmediated experience of immersion. Despite the fact that most cyber experience occurs via the screen, or more contemporaneously, as flows of data, the body-as-text elides the distinction between the screen and its viewer by ignoring the actuality of the screen and elaborating instead the metaphor of virtual "space." The "as if you are there" is truncated to a "you are there." One is in cyberspace, not watching it, one is a navigator, not a viewer, with this shift being in line with modernist ambitions of eliding the gap between signifier and signified, viewer and viewed, real and representation. In the high modernism of virtual rhetoric this ambition travels with its own ideology: the "being-in" of cyberspace which does not allow the subject-object distinction to interfere with the cybernaut's mythic immersion in what is often represented as a mystical space, thus shifting from a mode of manipulating representation to manipulating ontology.

The boundaries between urban conditions, between private and public space, natural and urban space, are blurring whilst being influenced by forces of global capitalism. Contemporary technologies are expanding cities horizontally through new systems of digital and physical infrastructure. Beckman (1998) argued that globalized liquid 'soft architectures' of digital media flow over, under and through the local concrete and 'hard architectures' of our contemporary cities , creating an indeterminate , 'floating' environment, an interface between public and private , collective and subjective, provincial and planetary. Architecture of cities needs no longer be generated through the static conventions of plan, section and elevation. Instead, buildings can now be fully formed in three-dimensional modeling, profiling, proto-tying and manufacturing software, interfaces and hardware, thus collapsing the stages between conceptualization and fabrication, production and construction. Iconographic assemblies are absorbed, reworked, and distributed globally in various forms and embodiments . The icons that comprise this new landscape of difference are essentially mediated reflexes of similarity and diversification (constructs that are mirrored endlessly over computer networks, home pages, televised imagery, advertising campaigns).

According to Castells (1996) such emergent dimensions and new communication system radically transforms space and time. Localities become disembodied from their cultural, historical, geographic meaning, and reintegrated into functional networks, or into image collages inducing a space of flows that substitutes for a space of places. In the information society the dominant form of social time is what Castells (1996) calls timeless time, "the annihilation and manipulation of time by electronically managed global capital markets" The reactions to this globalization, this seeming tyranny of flows is manifested in many people's desires for neo-traditional places that are more self-contained, as well as to environments where nature is reconstructed as an ideal cultural form.

Today, in a post-industrial age, technologies of communication and computation, real-time connectivity and interface, represent an ever-accelerating world (Beckman 1998). As the city of pixels represent interfaces to the net, the appearance of solid permanent buildings is challenged by virtual representation of abstract systems (electronic images) . Whilst a non-local trans-urbanism is in the making, freed from a fixed geometry, the virtual city will not be the post-physical city, but a transmutation and a transgression of the known, interwoven into real urban life. We tend to operate in topographies that weave between actual and digital space, as we are increasingly relocating activities to digital spaces and locating digital capacities in the human body (Sassen 2003) .

5.2 Cognitive Imaging and the Notion of Being

The experimental procedure has allowed for the virtual deconstruction of public spaces and for the presentation of diagrams that identify the relationships between cognitive image and virtual forms (Fahmi 2001, Fahmi 2002). As based on appeals to ontology rather than epistemology, to authentic being rather than mediated seeing, virtuality rhetorically expand ever outwards, encompassing an infinity of spaces, times, mythologies, and modes of transcendence, they also close in on the individual, appropriating innerspace . There is a need to revisit that postmodern subject, whose corporeality' and environment has been literally infiltrated by cyberspace.

The use of image diagrams, collage sketches and screen installations led to 'de-solidifying' things and dissolving spatial distinctions, to (de)constructing perceptual shifting between figure and ground, near and far, inside and outside, with these evocative diagrams intensifying the cognitive process. The experiment therefore intended to unsettle ‘memory and context’ by rejecting both ‘contextualist’ and ‘continualist’ approaches, and favouring conflict over synthesis, fragmentation over unity, madness and play over careful management, indicating the change in the notion of collage images by the multiplication of screen installations, with these representations being products of particular notions of spatiality.

With navigation into a trans-urbanism in terms of turning-inside-out of cyberspace, these experimental diagrams promise to occupy the coterminous territories of the real and the virtual. Zelner (1999) illustrated that in (re)(de) construction of the virtual and the real, everyday experience is mirrored in another reality, between the virtual urbanity of the information machine and the actual urbanity of the city, calling into play the possibility of a coterminous and dialectic merging of very real city of bricks and a conceptually experienced 'city of bits ' (Mitchell 1996). In addition there is a need to revisit the post modern subject, where corporeality and environment has been literally infiltrated by cyberspace, which is repositioned as the locus of techno-institutional forces, pushing and pulling to achieve maximal efficiencies.

As based on appeals to ontology rather than epistemology, to authentic being rather than mediated seeing, virtuality rhetorically expands ever outwards, encompassing an infinity of spaces, times, mythologies, and modes of transcendence, whilst closing in on the individually appropriating inner space. Virtuality is considered a psychological mechanism and cognitive adaptation in a less 'user-friendly' living environment, with imaginative space being used as a medium for 'bringing forth' or manifesting abstract ideas into the realm of virtual place (Heidegger 1977). Being as expressed, within the critiques of Western metaphysics that have been erupting for the last twenty years, is a complex assignation which nevertheless argues the ontological status of virtuality (Davies 1998). As a central metaphor within the notion of being, "space" provides a means of negotiating such a dilemma, having sufficient ambiguity to enable the discourse to drift between reality and mythic spaces, between the "space of the screen," the "space of the imagination," "outerspace," "cosmic space," and literal, three-dimensional physical "space." The power of "space" lies in the possibilities it implies: immersion, habitation, "being-there," unmediated presence, all fall within its domain. Without "space" there can be no concept of presence within an environment, nor, more importantly, can there be the possibility for authenticity that "being-in-the-world" allows.

Heidegger (1977) writes that "the essence of modern technology is by no means anything technological," the issues he raises are fundamentally ontological, dealing with the "being" of being human as much as the being of technology (cited in Dyson 1998). This link between two "essences", the human and the technological, is articulated in the popular discourse on cyberspace, thus constantly mapping and regulating perceptions of new communications technologies such as the Internet and the "information superhighway," and new media forms such as virtual reality (VR). Thus the "ontology" of cyberspace signals the attempts to assign being as an attribute to these new forms of media and communications, a play within the field of metaphor, fantasy, and what Gibson (1989), in coining the terms "cyberspace," identifies as "consensual hallucination." Cyberspace is nonetheless a nihilistic, debt ridden, impossible space, a space that, in denying the "reality" of the physical, tacitly acknowledges its hostility to "being" and its incommensurability with corporeality. Imaginative virtual space is used as a medium for "bringing forth" or "manifesting" abstract ideas into the realm of virtual "place" so that they can be kinesthetically explored and bodily lived in real events, suggesting alternative ways of seeing and being in the world.

5.3 Urban Future between Virtuality and Reality

Utilizing complexity theory and concepts fashioned on the paradigmatic logic of biological systems, Kelly (1995) envisions a technologically deterministic future with radically different forms of social and organizational control, which regards technology as the agency of a new economy, culminating in a transition from a hierarchical social order to a 'network culture based on counter-intuitive principles. . Accordingly he demonstrates a paradigm shift whereas everything ranging from literary texts to market institutions are seen as "complex" and/or "self-organizing" systems (Kelly 1998). Negroponte (1996) presents his vision of the post-information age or the future digital life of mediating technologies in terms of bits, interface and digital life.With decentralization, globalization, and harmonization, Digital Spatiality has emerged with five forces of change transforming culture, infrastructure, and economy and lifestyles: global imperatives; size polarities; redefined time; egalitarian energy; and meaningless territory.Negroponte's (1996) description of the growth of digital technologies as "almost genetic in its nature" evokes the organic metaphor of exponential growth to describe the dynamic rate and self-organizing character of change. Thus, not only is Negroponte's future here and now, in some regards, it is already past. Nevertheless forms of knowledge for the present and future demand critical theories of power, as well as normative and utopian visions that contextualize technology within a social, political, and economic framework, and that assess implications of new technologies in terms of their potential to enhance or restrict freedom and democracy, and to promote or undermine environmental sustainability and social justice

Furthermore urbsanists are in conflict between the permanent requirements of organizing and constructing real space, with its land problems, the geometric and geographic constraints of the center and the periphery, and the new requirements of managing the real time of immediacy and ubiquity.' Nevertheless the virtual is real but not actual, ideal but never abstract. Indeed, the two sides of this purported dialectic, the real-actual and the virtual-imaginary are akin to oscillating forces in a shifting field, existing not side by side but through and across each other. If they are entities at all, they share functions and space over coterminous territories, or overlapping regions of nonexclusivity. An architecture capable of addressing and choreographing - the dance between the doubled worlds of the real-actual and the virtual-potential is beginning to present itself. Instead of trying to guarantee the eternal life of an existing architecture in a different medium, our strategy today should be the contamination of that architecture with other media and disciplines in order to produce a new and more robust urban experience. Whether "hypersurface," with investigations into a topology of relational, mediated human , or "trans-architectures," in terms of turning-inside-out of cyberspace, these experimental forms promise to occupy the coterminous territories of the real and the virtual. In them, we may begin to experience a world no longer divided by virtuality but one made rich with spaces of animated potentials and realities.

There are organizing metaphors that make virtual environments places to be. These virtual 'spaces" are concerned with being elsewhere and being other in an evolutionary, in the same powerful conflation of real space and simulation, of real life and virtuality. Returning to the futurism from which the neo-futurism of cyber-architecture has developed, the virtual future is laden with the dark nihilism that the visionary dreams of new, futurist cities produced. Contemporary cyberspace, with its emphasis on the future, re-enacts the nihilistic logic of early futurism in so far as the fulfillment of its dreams are necessarily deferred to a time that one can never witness. Since one cannot "be" in the future, one cannot comfortably "be" in the fiction that is cyberspace. Attempting to do so is like attempting to inhabit any dream or vision. And if the present is already lacking, the future is represented as already spent, mortgaged through national deficits and environmental destruction.

Finally, according to Boyer (1994) a 'crisis of collective memory", a shared disjunction of our relations to the past, is linked to rapid urban change as modernism and industrialization disrupts the myriad of ways in which cities house a collective sense of history. The crisis of collective memory provokes a desire to reframe the past in urban scenography. Such scenographic representations repress the mystery and disorder of urban life which is collapsed into 'scenes', as seen in the shopping malls and housing enclaves, where history becomes a product which is packaged and consumed. The deconstructive task leads to a play of formal imagery, whilst aiming to unpack and reconstruct the lifeworld and its spatial programs. Such a programmatic deconstruction would entail a systematic engagement with the ways in which the lifeworld has been sliced, its functions categorized, coded. juxtaposed and omitted. And in a decentred, disoriented and fragmented world the shock value may come from a reintegration and reorientation. The key role of future city designers is to deploy creative imagination in the public interest, yet it must be divorced from Plato's ideal "forms' and authoritarian politics.

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The Iron Curtain Approach: Methodology and toolset for integrated regional development planning in heterogeneous transboundary regions

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1 INTRODUCTION

The goal of the EU-5th framework funded IRON CURTAIN project (IC) is the development of a tool set that supports decision making in planning and development processes on a local and regional level. In this context it is important for the project to establish a regional model representing the typical characteristics of rural and remote areas, typical for those along the former Iron Curtain. This IC model should finally be used to explore regional development options within the framework of scenario testing. Special attention is given to the compliance with the principles of sustainable development, democracy (UN-Agenda 21) and Territorial Competitiveness (TC) [8].

As there is only limited scientific and almost no practical experience with this type of trans-border regions, "simple" top-down planning concepts, which are available for more homogeneous regions or in national contexts, do not accommodate the complexity of this type of region. Instead new and proven tools should be combined in an innovative bottom-up planning approach, thus following the recommendations of AGENDA21 for participatory development planning. One of the main challenges was the consensus building about common goals among local actors and end users working under different administrative and legal conditions with a diverging historical background and value system. The project is implemented in 6 Reference Areas (RAs) via partnerships with local and regional transboundary plattforms (e.g. EUREGIO, MAB Biospherereserves etc.). The RAs, attended by 8 project partners (INTERCONSULT, UNI-JENA, GEO, UNI-SALZBURG, UNI-MISCOLC, GEONARDO, UNI-LEOBEN, UNI-THESSALONIKI) are located in *Norway-Russia* – Svanvik/Nikl; *Germany-Germany* – Rhön Mountains; *Germany-Czech Republic* – Sumava/Bayerischer Wald*;* *Austria-Czech Republic* – Waldviertel/Trebon Basin; *Austria-Hungary* – Central Burgenland/Sopron and finally between *Greece-Bulgaria* – Macedonia/Rodopes Mountains.

2 DESCRIPTION OF THE TOOLS

The project embarked on a bottom-up planning approach in which different tools were applied and tested. Together with a local stakeholder working group the following steps were taken: As in integrated problem solving [11] the starting point was the detailed and structured identification of problems followed by an analysis of their interrelationship. A desired future situation was formulated and options for problem solutions were collected and combined with scenarios to formulate strategies. Indicators were developed and tested in order to measure achievements. In one Reference Area the implementation of solution strategies was simulated and the results were assessed leading to a recommendation. Figure 1 gives an overview of the interplay and mutual dependency of the tools used. The reason for working along a sequence starting with the analysis of problems and ending at data models originates from the necessity to develop a consistent system where models are logically linked to specific problems. The European rural intervention strategy LEADER and its program perspectives (e.g. Territorial Competitiveness) are providing the directives according to which model and indicator parameters are aligned. Leader is one of four initiatives financed by EU structural funds and is designed to help rural actors consider the long-term potential of their local region. Encouraging the implementation of integrated, high-quality and original strategies for sustainable development, it has a strong focus on partnership and networks of exchange of experience[12].

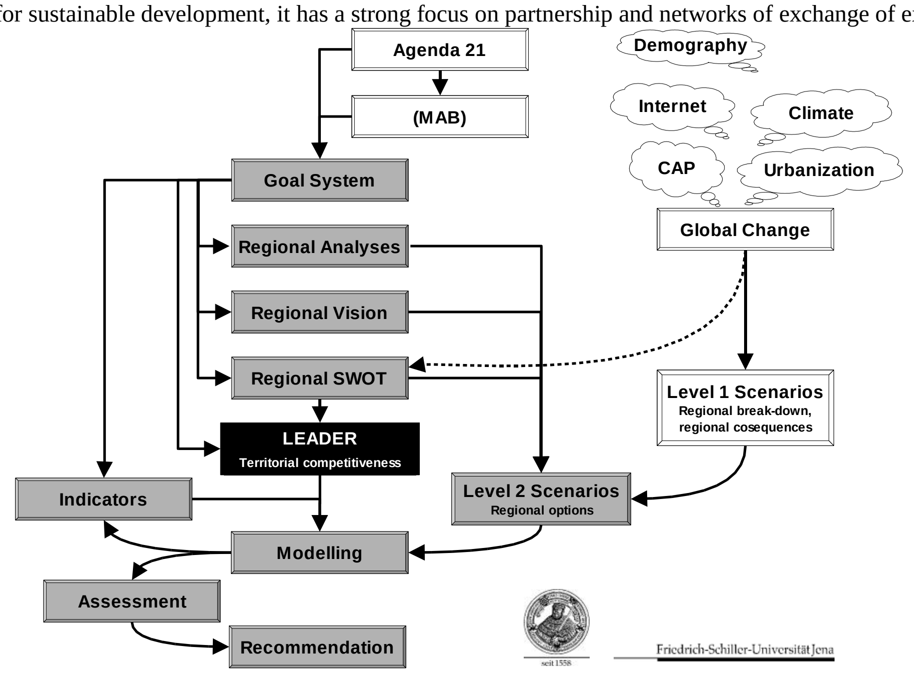

Figure 1: Interaction of tools in the reference area analysis; grey boxes hold the toolset applied in the reference area, white boxes show impacts on the area from outside, LEADER is the basic intervention strategy investigated in the project

2.1 Identification of problems and analysis of problem interrelations

The methodology for problem identification followed the recommendations of the Logical Framework Approach (LFA) [2, 5] and had been implemented successfully during a sequence of cross-border workshops on regional development in each of the six reference areas (RAs). The results of these workshops were problem trees, causal relationships between the problems mentioned, hierarchically ordered in a tree-like manner. Thus the solution of each problem requests the underlying problem(s) to be solved and shows possible starting points for intervention strategies. It must be stressed here that the perception about a problematic issue is subjective for the members of the working group therefore including experts from different fields broadens the working group's knowledge base. Nevertheless the causal relationships need to be examined by experts of the project in order to verify their validity. For example the reason for people leaving the German-German RA proved to be not the lack of job opportunities.
A further step performed were the SWOT analyses identifying the internal (Strengths – Weaknesses) and the external (Opportunities – Threats) positive and negative factors for regional development in the area. In several RAs the elements of the SWOT were positioned in a plane defined by four half-axes (S, W, O, T, see figure 2). The stronger the element was perceived within one category the farther away from the axes' origin it is located. The position inside the quadrants reflects the perception of the factor as e. g. strength and opportunity at the same time. Other RAs used a matrix by putting S and W as rows and O and T as columns. The SWOT analysis can be used for mapping out strategies whereby a good strategy would build on strengths while eliminating weaknesses and take opportunities while avoiding threats.

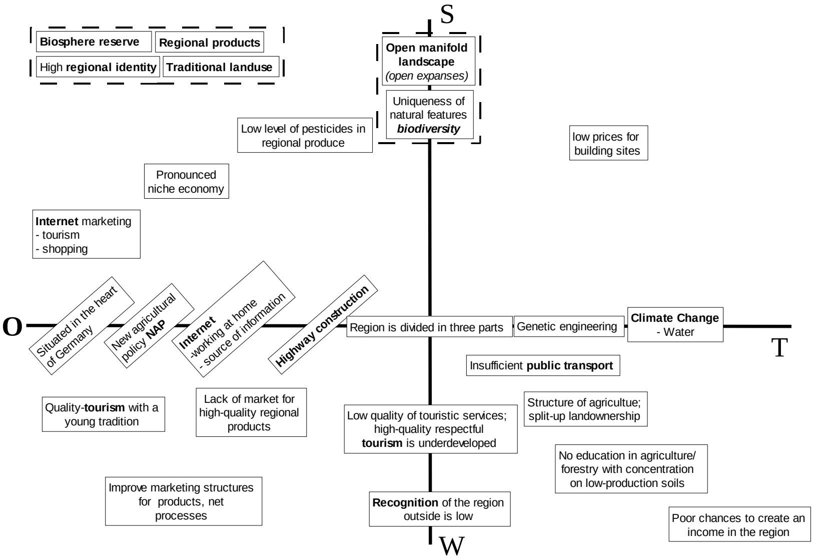

Figure 2: SWOT Analysis of RA2, dotted lines indicate equal position of factors

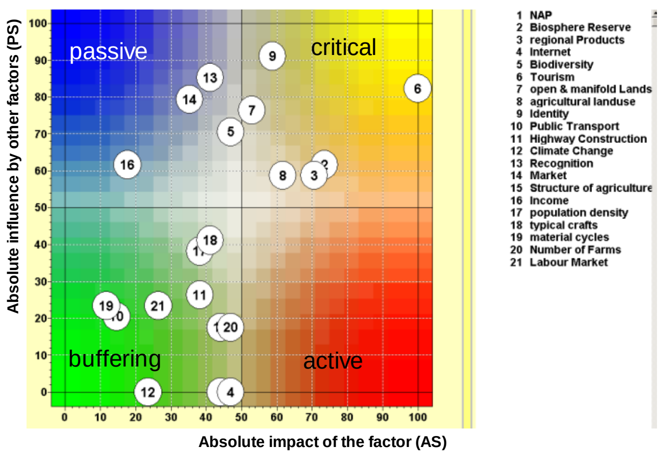

Figure 3: results of analysing the interrelation of the SWOT elements in RA2

Some RAs additionally applied a matrix approach known as paper computer [17] to further analyse the interaction of the SWOT elements. The paper computer was developped by Frederic Vester, who was known as pioneer of *Networked thinking*, a combination of cybernetic and systemic ideas with complexity issues. Central ideas of network thinking included seeing a system as a network of interlinked effects, leading to emergent behavior of the system as a whole. These networks can be described with the help of methods like protocols, mathematical networks, computer software, so that even someone without much understanding of networks will see the relations, including positive and negative feedback loops. Simulations of systemic networks can help to decide the long-term effects of singular measures. According to this all elements can be grouped into active, passive, critical and buffering depending on their specific influence on each other. The values range from no influence (0) to strong influence (3). Total impact (active sum AS) and influence by other factors (passive sum PS) can be calculated and displayed (figure 2). Although the method has some weaknesses [11] it is easy to understand and produces immediate results, which is very valuable in a stakeholder-workshop setting. Additionally the method provides deeper insight in the problem structure of the area and thus helps to identify strategies further in the process.

2.2 Normative future

After the problems had been identified they were reformulated as objectives for the development of the region. By keeping the tree-like structure a new tree evolved showing the means with which to achieve the ends (i.e. top-level objectives). General provisions always guide the formulation of planning objectives. This can be national and international legislation as well as general or sector-specific planning goals that apply for the area. By merging them with the tree the Goal System was formulated for each RA.
In order to formulate strategies, an integrated goal for regional development is needed. This is often referred to as a vision. A vision is a description of the future as it should be and thus is of normative nature. Although a vision is sometimes also called a scenario it was agreed that the term scenario is used differently in IC (see below). There is only one vision for a RA! As a matter of fact the vision is related to the goal system.
The RA's vision (see box for an example) is the result of a creative process and commonly agreed on by the stakeholders. It covers all relevant aspects of the RA. It is very important for a successful visioning process that the members of the working group free themselves from current restrictions. For this a visioning horizon of about 15 years (i.e. until 2020) proved to be very helpful [10]. This has two additional advantages: On the one hand the time span is long enough for real changes to happen on the other hand it is short enough to be still linked with the presence thus not making it a playground for fiction.

Box: Vision for RA 3 (Bavarian Forest / Šumava)

Trans-border conservation area (with similar protection status) surrounded by a buffer zone with tourism and a strong regional market based on innovative technologies and renewable resources.

2.3 Measuring achievements

Having set the frame with objectives it is necessary to measure their achievement. The objectives generated from the analysis steps were linked with indicators to display the situation as it is and to assess steps forward into the direction of a commonly agreed vision. Each RA created its own set of indicators specifically linked with the problems and objectives in the area.
In general indicators are used to relay information on subjects where no direct measurement methods exist. Thus indicators can reduce complex objectives to measurable values. According to [1] they summarize complex information of value to the observer. However, these essential sets of indicators (or system descriptors) are not always obvious for the local decision makers. Trying to handle a complex system like a (transboundary) region means learning to recognize a specific set of indicators, and to assess what their current state means for the viable systems of the region (local economy, the social or ecological circumstances) while always paying attention to the mutual biasing characteristics of each system. In a nutshell: indicator sets are determined by (1) the observed system itself, and (2) the interests, needs, or objectives of connected systems [1].
These first indicator sets were described according to recommendations by the UN Commission for Sustainable Development CSD [16] and had to be broken down to meet the needs of the EU guidelines to evaluate Territorial Competitiveness (TC). The indicators as well as individual knowledge on their usage, parameterisation and data requirements (meta information) were subsequently inserted into the indicator database Navigator for regionalized Indicator Calibration (NEIC). The database search focuses on functionalities along the three primary CSD domains (environment, social issues, and economic aspects) and the use of keywords. The search output is ordered according to the number of users, which gives a first hint regarding popularity and therefore usability of the indicator to measure development processes in a specific regional context. The user is presented with the meta information regarding the usage of each indicator in its specific environment. Moreover, the NEIC system provides the user with the possibility to create an amoeba-like profile, a graphical representation of the individual regional characteristics in view of TC, based on the evaluation of respective indicator performances.

2.4 Setting the frame: scenarios

In order to understand the approach applied in IC, a short introduction to the term scenario is useful. When looking at its usage the term itself is fuzzy but all approaches agree that scenarios draw pictures of the future. Thus a multiple future [7] is accepted. This separates scenarios from prognosis, which assume that the future can be predicted with knowledge from the past [9].
The picture of the future can either be desirable or only possible, separating normative and explorative scenarios. Normative scenarios are created in order to help to decide on a strategy to be applied in imminent decisions and are called vision in the project. Defining a vision does not include a strategy to reach it, which would be necessary if planning is perceived as a future oriented process [3]. Therefore both, a vision and explorative scenarios are needed; the latter enable the decision makers to adapt their strategies by describing what happens if the factors determining regional development behaved in a certain way. For usage in regional development planning, it is further necessary to differentiate between factors that cannot be influenced on a local level and those that can. This differentiation is also referred to as exogenous drivers and management fields [17]. Ignoring this difference leads to confusion and makes it difficult to create a strategy for regional decision-making.
The IC project agreed on referring to a possible development (explorative scenario) of the factors, which cannot be influenced as level-1 scenario. Scenarios can be created along the following scheme [4]: The determining factors for the system under investigation must have been identified and their interrelation understood (see problem analysis above). After that their tendential development can be predicted, assumptions changing this development can be formulated and their results described (process of if-then reasoning). This leads to several images of the future for each factor. The assumptions for the different factors can than be combined in a reasonable and logically consistent way [9] to form scenarios.
The consequences of these level-1 scenarios must be estimated for the RAs in order to show the boundaries for decisions on the local level. In the course of the project the EU's common agricultural policy (CAP) proved to be an important influence in many of the Ras.

2.5 Creating a strategy for problem solution

Having set the frame, a strategy can be mapped out trying to solve the problems raised in the analysis phase in a way that makes the vision come true. For each factor several options can be drafted. Such options describe the possible alternatives that can be taken for each field of decision (see table 1 for an example). Each reasonable and logically consistent combination of options for all relevant factors forms a strategy and is called level-2 scenario in the project. The results of the strategy's implementation can be described either quantitatively using mathematical models (see paper on decision support in this volume) or qualitatively.

Table 1: Options to increase the added value for quality-wine production in RA5

Option	***Do nothing***	***Keep the grape!***	***Market it!***	***Replantation***
Description	No additional effort (i.e. tendential development)	Reduce the share of high-quality grapes that are exported from the region to be processed elsewhere (currently 11 %) to 0 %	Increase the expenditures for marketing high-quality wines	Replant with high quality grapes in a state-of-the-art manner

The tools described so far assume that the future is not a fate but can be shaped. Planning in this sense means taking decisions in order to influence the region in a way that its future state is closer to the vision.

3 CRITICAL KEY INDICATOR SET

Today various international/national assessment paradigms and programmes (e. g. Sustainability, Competitiveness) and respective schemes (TC, Local agenda 21 etc.) are competing to evaluate the implementation of sustainability and competitiveness on the regional and local level. In this situation, it has been a challenge for the project to establish a methodology to identify (1) several exclusive regional indicator sets, describing the unique characteristic problems and goals found in one area, but also (2) one transferable indicator set, describing common characteristics, problems and goals typically found in regions located along the former Iron Curtain (see below).

Indicators represent semantic concepts, having attributes and thus cover different domains of regions' natural and anthropogenic aspects. As indicators serve as communication tools for the mediation process in politics and planning, a common understanding of the expressiveness of individual indicators is essential. Particularly for the practitioner it is important to identify overlaps regarding the thematic coverage of each indicator's expressiveness in its regional context.

The treatment of concepts and the logical description of linkages between object and attribute have a long tradition in philosophy. With the Formal Concept Analysis (FCA) [6], a methodology was introduced to describe these object-attribute relations in a mathematical way and present them in form of structured graphs (figure 4). The methodology of the conducted approach is based on recent work on FCA elsewhere [13, 14, 15, 19].

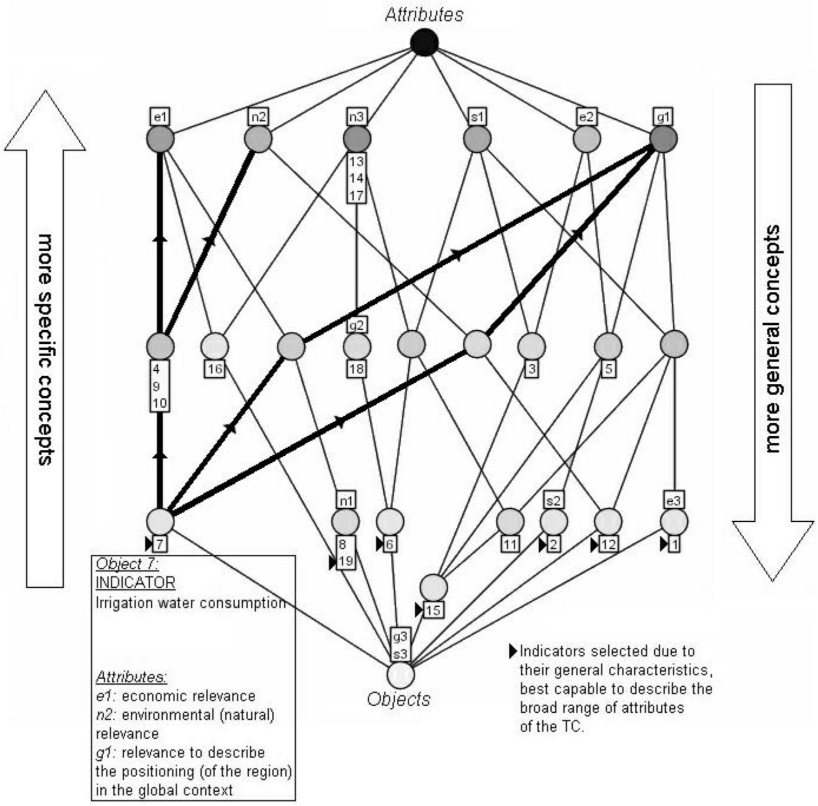

Figure. 4**: Lattice representation of indicators in RA 6 (Greece/Bulgaria)**

***Every node (Point)* represent one concept. The concept is defined by its content (the set of attributes) and its extent (the set of objects). These two aspects define uniquely the given concept for a concrete incidence matrix, above which the set (aggregate) of concepts is constructed (*Begriffsverband)* . If the input for the matrix is changed, the *Begriffsverband* also changes and with it also the conceptual lattice and the calculated concepts.**

***Letters* represent the domains of the assessment scheme (in this case EU's TC concept): e (economical), s (social), n (environmental), g (positioning in the global context). Numbers next to the letters (e1, n3… etc.) represent the weight given to the individual indicators in the respective domain. Numbers without letters are index numbers for indicators.**

Table 2: Regional indicator set for RA 6 Greece/Bulgaria and its explanatory power within the TC framework (results from FCA according to estimation from local experts)

No.	Indicator	Scale unit	Main aspect of TC
1	GDP per capita	€	Economic Structure
2	Unemployment rate	%	Economic Structure
3	Sustainable development strategy available	Yes / No	Institutional Capacity
4	Irrigation water consumption	l	Markets and external relations
5	% of population with adequate sewage/waste-water treatment facilities	%	Physical resources and their management
6	Annual withdrawal of ground and surface water as a %of total renewable water	%	Physical resources and their management
7	Annual catch by major fish species (mullet, daurade,	kg	Environmental conservation
8	Concentration of DO, N, P in water bodies	mg/l	Physical resources and their management

3.1 Minimal Indicator Set

In order to provide a certain level of comparability and evaluation for the international perspective, the project attempted to create a common set of indicators that address the typical problems in IC regions (Minimal Indicator Set MIS). For this subsequent step the presumption was that the MIS is already contained in the combination of the preliminary indicator sets that describe the broad scope of surveyed regional characteristics. The sets were compared and duplicates identified in order to arrive at a set being sound for all six RAs. By crosschecking all original indicator sets from all RAs, indicators were grouped and the group was represented by one member or by a well-established national indicator (aggregation). Additionally some of the indicators needed to be redefined in order to make them comparable. The sustainable availability of regional data to monitor selected indicators turned out to be the most crucial point, eliminating most potential candidates from the MIS. Such a top-down approach to derive the MIS out of bottom up developed indicator sets was done to level the inequalities in regional characteristics and lacks in individual surveys (problem analysis and definition of objectives). The result is an indicator set for decision support on a national or European level.

Table 3: examples for indicators in MIS

Indicator	change in population 1990 – 2001	net migration rate, average 1996 – 2001	share of pensioners	share of arable land	share of grassland
unit	%	‰	%	%	%
data source	regional statistics			satellite imagery	

4 CONCLUSION

The diversity of the reference areas has been a major challenge for the development and application of a unified method. An analysis approach had to be used which offered the required precision for assessing details and, at the same time, was flexible enough for a modern management tool dealing with uncertainties in problem and goal definition. After three years the project demonstrates the advantages and disadvantages of different approaches realized in several cross-border areas.

The diverse state of the economic, social and political development, the volume of already existing cooperation and the degree of mutual trust are all factors enabling or hampering joint planning processes. With the objective to support regional development efforts and to assess progress the IC project was conceived to built on existing trans-boundary platforms. In reality however these platforms partly had to be formed, facilitated or sometimes even replaced by separate communication with individual actors. Accordingly the resulting regional analyses had different focus points. Often the stakeholders, as general practitioners, were rather interested in methods to solve their most urgent problems than on cooperating in the development of rather abstract planning models and tools. In front of this background the project was neither a regional development action nor a pure research study.

As planning is understood as a process, the problem analysis and goal system of a region are neither complete nor final. The project developed a general method based on management tools to approach these issues, tested it in six case studies and thus demonstrated its applicability. The results are transboundary analyses, visions, scenarios and data sets – in some cases for the first time – which laid the ground for further projects.

More individual results and their incooperation into local and regional decision-making processes in the RAs, demonstrating the applicability of the developped toolset in detail are planned to be compiled in the upcoming time. Indicators need a strong explanatory power if they are to influence regional politics. Innovative methods to identify these indicators were introduced (FCA) but the resulting sets are only a recommendation and need to be continuously questioned and revised especially if stakeholder rounds need to be expanded. We expect that there is a need for such small but meaningful indicator sets for regional planning, monitoring and evaluation of all parties involved in such an effort. Furthermore an initial common indicator set (MIS) was created that, when finished, allows the assessment of rural regions under the paradigm of Territorial Competitiveness. This MIS calls for further refinement, test applications and enlargement in follow-up projects, especially concerning the inclusion of qualitative indicators.

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Using Indigenous Knowledge to strenghten Local Governance and to counter Urban Inequality in Nigeria

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Indigenous knowledge is now celebrated by many of its advocates as "the single largest knowledge resource not yet mobilized in the development enterprise" (Paul Richard, in Warren et al, 1996, 476). Recent titles like "Tradition as a Modern Strategy", "Modern Dilemmas and Traditional Insights", "The Indigenization of Modernity", and so on reflect the growing prominence accorded culture and tradition in current development thinking and research. For a long time, African customs and traditions were misperceived as irrational and incompatible with the conventional strategies for economic development, or at any rate as ineffective in coping with present day needs and challenges. But with the economic crisis of the 1980s and 90s, and the policy failures associated with the formal government system, there has been increasing loss of faith in the Wester 'external agency' model of development imposed from the top by national governments and international development agencies. The undue emphasis which this pattern of development places on purely economic and quantitative growth is now blamed for the worsening problems of environmental degradation, widespread poverty, inequality, and the undermining of those values and institutions which hold these negative forces in check.

The renewed interest in indigenous knowledge and institutions is in line with the current advocacy of the minimalist state and the 'enabling approach' as condition for good governance in a period of structural adjustment and public sector reform. Governments are urged by donor agencies, and are in fact obliged to reduce their role to what their dwindling resources and capacities permit; to decentralize the structure of governance, promote genuine partnership, and enlist the broad participation of non state actors and stakeholders, including traditional institutions and other community and civil society organizations. This trend has been reinforced by the UNESCO sponsored "World Decade for Cultural Development" (1988-1997), and other global initiatives which emphasize the cultural dimension of development, and the need to take local knowledge and practice fully into account in the development process (UNESCO 1995; Seragaldin and Teboroff; 1994).

- This paper considers how indigenous knowledge and practice can be put to good use in support of local government and public administration in Nigeria, especially in the current efforts to alleviate poverty and counter social inequality and exclusion. The problems of poverty, neglect and exclusion are most pronounced at the local community level, in the villages and urban slums, where these communities ought to be encouraged to participate in, and bring their own agendas to bear on governance and development. It is at the local community level that indigenous knowledge appears to have the greatest potential to contribute to development if development policies and programmes are made to reflect local priorities, and build upon, and strengthen local knowledge, organisation and capacity.
- One of the primary concerns of the Millennium Development Goals is to improve the health and living conditions of at least 100 million slum dwellers around the world by the year 2020 (UN-Habitat 2003). These slums and irregular settlement have become so pervasive in Africa that they now outnumber legally planned developments, and their social legitimacy appears to be no longer in question; but the appalling environmental conditions associated with them constitute a major threat to the health and well-being of the urban community. Part of the policy challenge addressed by the paper is how to support and regulate the urban informal sector and irregular settlements in order to promote shelter and livelihood for the poor, and at the same time ensure a safe, healthy and socially acceptable environment; how to ensure that the struggle against urban poverty and slum dwelling does not result in a campaign against the urban poor and slum dwellers themselves. The paper examines how urban poverty and the informal city have developed in Nigeria over the last 50 years; the extent to which government policies and programmes have helped or constrained the poor, and how these slums and irregular settlements can be upgraded and progressively integrated into the urban mainstream. It considers how housing and planning codes, standards and regulations inherited from the discriminatory policies and segregation of the colonial period have continued to inhibit the access of the poor to affordable housing and tenure security; how the inadequate provision of water, sanitation and waste management has led to the growth of a wide variety of water-borne and filth-related disease. The aim is to identify the lessons that could help to promote a more positive view and policy regarding the urban poor and the informal city.
- The concluding section considers the essential elements of a strategy to improve the informal city and the conditions of the poor, paying particular attention to the roles which state and local authorities, the international development community and the urban poor themselves could play in a collaborative effort to build safer, healthier, more inclusive and more equitable cities. It also considers how to enlist indigenous knowledge and traditionally based institutions in urban neighbourhoods and the informal sector in the effort to ameliorate the adverse effects of rapid urbanisation, especially in the critical areas of housing, environmental health, infrastructure improvement and service delivery. Finally, paper comments briefly on the indigenous knowledge movement as an appropriate local response to the growing tempo of globalization and to Western knowledge dominance in African development.

1 RESEARCH ISSUES AND POLICY DEBATES:

To mark five years of its indigenous knowledge programme the World Bank recently issued an impressive collection of papers and essays aptly titled *Indigenous Knowledge: Local Pathways to Global Development* (World Bank 2004b). It is in the sense of "local pathways to global development" that this paper perceives glocalization, although the concept is also used to refer to mutually beneficial cooperation among cities and municipalities, and to the role which cities can play in international politics and diplomacy to reform globalization and redress some of the adverse social and economic effects of mindless globalization(Savir,2003). Indigenous knowledge (also sometimes referred to as local knowledge, traditional wisdom, or ethnoscience) is used in different ways by different researchers and advocates, and there are many unresolved debates about how it relates to modern science and other knowledge systems.

- The wider scientific questions of concepts and method in the study of indigenous knowledge, and the practical problems of applying this knowledge and its lessons to development policy and practice cannot be addressed in details here (see Agarawal, 1995; Sillitoe 1998); Blunt and Wanen (1996) The concepts is used here to refer to the vast and largely undocumented body of knowledge, wisdom, skills and expertise which a given community has developed over time, and continues to develop as it grapples with the challenges of its environment, with outside ideas and with constantly changing conditions. It represents the heritage of creative thought and practical everyday life which is passed on orally or through experience from one generation to the next. It is usually tacit knowledge, stored in the peoples individual or collective memories, hence the saying that "each time an elder dies, it is as if a library had burned down". (Easton in World Bank 2004b, p. 208; cf. SCESSAL/LIUASA, 2002). Scholars from a wide variety of disciplines study and seek to apply indigenous knowledge in their own way; but in this paper, it is used simply as a way to introduce a locally informed and endogenous perspective in development policy and practice. Indigenous knowledge is conceived as a means of rethinking and redirecting development in agriculture, health care, natural resource management, etc, and also as a way to involve and enable local actors to participate in their own development.
- It must be emphasized that both indigenous knowledge and modern science are not really in competition or in conflict with each other. Each has some elements of the other. Very few if any serious scholars actually consider indigenous knowledge to be an exclusive alternative to modern science and technology; nor is the exclusive use of modern science enough for the complex tasks of achieving sustainable development in diverse cultural and ecological contexts (World Bank 2004; Haverkot etal, 2002). The real challenge is how not to romanticize indigenous knowledge or idealize modern science as both have their strengths and limitations, and should complement and not confront or undermine each other. The UNESCO World Commission for Cultural Development recommends the active recognition and exploitation of cultural pluralism and "Our Creative Diversity"; and even the International Council of Science has recently urged "governments to support cooperation between holders of traditional knowledge and scientists, to explore the relationships between different knowledge systems and to foster inter-linkages of mutual benefit". (ICSU/UNESCO, 2003; UNESCO 1995).
- There are also many unresolved debates regarding the informal city in Africa; especially about how the informal sector reflects local knowledge and conditions, and what the appropriate government policies towards the sector ought to be. Some of the more optimistic advocates of the sector tend to present it in romantic terms as a form of popular development, a vital source of employment and income for the poor, the seedbed of local entrepreneurship, and a potent instrument in the campaign to combat poverty and social exclusion (Danida 1997; De Soto 1989, 2000. They also condemn the large number of regulations and bureaucratic procedures from the different institutions and levels of government which tend to stifle entrepreneurship, and to inhibit the realization of the full potential of the informal sector (Durand-Lasserve et al, 2002; McAuslan, 1987, 1992; UN-Habitat 1998, 2003).
- On the other hand critics, including many planners and government authorities dismiss the informal sector as an anomaly, a source of disorder, and an obstacle to the development of a modern economy (Abumere et al, 1998; Sachs, 1997). They condemn the slums, health risks, insecurity and exploitation associated with the sector, and hope that like other transitory phases in the course of development, the sector will wither away with time and economic progress. Even those who idealize the sector recognize that it is at best a mixed blessing: "In-so-far as informal sector activities do not respect legal, social, health and quality standards, and furthermore do not pay tax, they violate the rules of fair competition" (Sachs, 1997). Indeed they argue that the urban informal sector has run its course; is now saturated, and may just be replicating the disguised unemployment that prevails in the rural areas.
- These conflicting positions pose a difficult dilemma for planners and policy makers, and tend to reinforce the ambivalence and hostility of official attitudes towards the sector. If the informal sector thrives because of its informality, and because rules and regulations are minimal, does it make sense to try to formalize and integrate it into the formal economy with laws, codes and standards that could disrupt its activities and growth? On the other hand, what about the health hazards, as well as the rights and safety of the vulnerable groups that work in the sector (Rogerson, 1996, 1997; ILO 1991?
- Current research suggests however that the path to urban sustainability lies in greater realism in building and managing a more inclusive and socially equitable city. This would involve reviewing continuously the legislative and administrative environment in order to improve the security of land and housing tenure for the poor, to upgrade slums, and to strengthen urban local governance through broad-based partnerships that take the needs and participation of the poor in the informal sector fully into account (Fernandes et al, 1998; N-AERUS, 2001).

2 THE NIGERIA URBAN SCENE:

Nigeria is the largest and potentially the richest country in Africa, being the sixth largest oil producing country in the world. It has a land area of close to one million square kilometers, and a population of well over 125 million. Estimates at the turn of the century suggest that 43.5 per cent of the population live in urban areas, and this percentage is projected to reach 50 per cent by the year 2010, and 65 per cent by 2020. The rate of urban growth is about 5.5 percent, roughly twice the national population growth rate of 2.9 percent. More than seven cities have populations that exceed one million, and over 5,000 towns and cities of various sizes have populations of between twenty and five hundred thousand. Greater Lagos, the former national capital, has grown from 1.4 million in 1963 to 3.5 million in 1975; is currently about six million, and projected to be 24 million by 2020. Information on the size and employment structure in the informal sector is hard to obtain, but estimates suggest that the sector accounts for between 45 and 60 per cent of the urban labour force, up from about 25 percent in the mid '60s. Sadly, life expectancy at birth is still about 52 years; infant mortality rate is as high as 19.1 per 1000; and the per capita income is only USD 274 (Okunlola, 2001; Nwaka, 1992).

- The development of the informal sector follows closely the general pattern of urban development in the country. A large number of the cities pre-date British colonial rule and still have large indigenous populations. With the establishment of British colonial rule, European Reservations and migrant quarters were grafted onto these native towns. British colonial rule neither anticipated nor approved of the growth of large African urban populations. Although many port cities, rail-side towns and administrative centres owed their growth to the activities generated by European presence, colonial officials remained unreconciled to the idea of rapid urban growth, and tended to see the cities as an unfortunate by-product of colonial activities which had to be firmly contained in order to avoid political subversion and social disorganisation. The towns were not conceived or promoted as centres for industrial production for job creation and self-sustaining growth, but rather as small enclaves for administration, colonial trade and transportation. The policies and institutions for urban development, where such policies existed at all, were very restrictive and myopic, especially in the critical areas of land use control, planning and the provision of infrastructure and services. Planning and housing were used as instruments of segregation and social policy - to ensure that the small community of Europeans was protected in segregated high quality residential reservations. Zoning and sanitary segregation became an obsession (Stock, 1988; Nwaka, 1996). Sadly, the laws, codes, regulations and institutions designed at the time for the small populations envisaged in colonial cities have been inherited with little rethinking by post-colonial administrations, and have naturally been quickly overtaken and overwhelmed by the process of rapid urban growth and post-colonial transformation. Many analysts have observed in post-colonial Nigeria and other African countries a

"new process of urbanization unleashed by the masses of relatively low income migrants, who have flocked into the cities since independence, and are seeking to solve their problems of accommodation and employment informally, and on their own terms...; the urban poor are now dominant, and in most cases are transforming the city to meet their needs, often in conflict with official laws and plans" (Mabogunje, 1992, 1995; Stren 1989).

Although government did not take much official notice of the informal sector in the 1960s and '70s except to seek to eradicate the slums and disorder associated with them, the economic crisis and adjustment programmes of the 1980s and '90s have led to the massive expansion of the informal city. Cutbacks in public spending, drop in real wages, and public sector retrenchment and other austerity measures have swelled the ranks of the informal sector, and weakened the employment and law enforcement capacity of the state. (Meagher and Yunusa, 1991). Official response to the situation has been mixed and often contradictory, including incentives and 'safety nets' to the sector in the form of training credit and other facilities for self-employment, but also repression by overzealous officials in the prosecution of the so-called "War Against Environmental Indiscipline", during military rule in the 1980s, as well as the forced eviction of large numbers of "squatters" in Lagos and other cities.

3 THE CONVENTIONAL OFFICIAL RESPONSE

The informal sector encompasses a wide range of areas of informality -- environmental, spatial, economic and social, covering business activities, employment, markets, settlements and neighbourhoods. Each of these areas has implications for public policy. The informal sector has since the early days of national independence been the major provider of land and housing in the cities, as only about 20 to 40 per cent of the physical developments in the cities is carried out with formal government approval, and are provided with reasonably adequate urban infrastructure and services. (Abumere 1982; Population Report, 2002). Government officials often argue that the practical difficulties of upgrading irregular settlements and connecting them to urban infrastructure and services tend to reinforce their social and physical exclusion, while others argue that official restrictions on the availability of land, and their bureaucratic procedures encourage the growth of more and more irregular settlements on the fringes of the cities and on empty public land.

- In respect of the policies for planning and housing, only a small percentage of Nigerians, mainly top government functionaries, professionals and other rich and privileged people benefit from the formal housing and planning schemes of government. The vast majority of the urban population rely on the informal sector for shelter, and many of the houses in this sector are over-crowded, structurally defective, and sometimes located in areas that do not provide adequate defenses against disease vectors and other health hazards. The legacies of colonial planning and housing have tended to reinforce physical and social divide between the 'formal' and the 'informal' city. The Nigerian Town and Country Planning Ordinance introduced by the colonial regime in 1946 remained virtually unchanged until 1992, not because it was working satisfactorily but because it was largely ignored and by-passed by rapid growth and spontaneous development. Most of the legislation and by-laws for environmental health and sanitation appear to the local people as reminders of colonial segregation and oppression, and have very little current relevance or legitimacy. For instance, residential areas are now widely used for small businesses, in complete disregard of the official zoning arrangements to separate areas of presumed incompatible activities. Although a revised Nigerian Urban and Regional Planning Law was introduced in 1992 to address some of the anormalies of the 1946 law, the administrative and technical institutions needed to implement the provisions of the new legislation are yet to be put in place (Egunjobi, 2002) Also, the Nigerian Land Use Decree or Act, introduced in 1978 to streamline the wide variety of pre-existing land practices, to curb land speculation, and facilitate equitable access to land for bona fide public and private uses has been moved by official arbitrariness and bureaucratic delays, and now constitutes a major blockage on land supply except for the rich and well connected individuals (Nwaka 1992).
- In respect of housing, Nigerian has experimented with virtually all the approaches that were fashionable in the 1960s, 1970s and '80s - viz, slum clearance (which caused much distress and social dislocation); sites and services schemes which tried to open up new land, and have it sub-divided into residential plots for distribution; slum or squatter upgrading which tried to fit new infrastructure and services into already disorderly and crowded

settlements, etc. Following Habitat I in 1976, and the oil boom of the 1970s and early 80s, Nigeria embarked on elaborate programmes of public housing, but, typically, only about twelve percent of the additional 300,000 housing units projected for 1970-74, and twenty five per cent for 1975-80 was actually achieved. The enormous resources earmarked for the purpose were misappropriated or otherwise diverted to the construction of military barracks and other projects of doubtful priority. None of the housing programmes advanced the housing conditions of the poor in irregular settlements but instead tended to provide subsidized housing for high and middle income groups and other well connected persons.

- The environmental conditions in most towns and informal settlements remains appalling and life-threatening. Water supply and sanitation are grossly inadequate for domestic and personal hygiene, leading to a high incidence of water-borne and fifth-related disease. Commercial and domestic wastes are not properly disposed of, with the result that large volumes of rubbish are left to litter the streets and to accumulate in open dumps where flies and other disease carrying insects and rodents proliferate. The open drains are often clogged and exude unpleasant odor. Pot-holes in the streets, pools of stagnant water, and waste water gushing from bathrooms and kitchens provide breeding sites for malarial mosquitoes, and other disease vectors. Food contamination and poisoning, especially in the rapidly growing street foods and catering industry, pose a serious threat to public health; and air pollution, especially from exposure to toxic fumes from open cooking fires and stoves in poorly ventilated homes, is responsible for a wide variety of respiratory infections among women and children. (IIED/DANIDA 2001; Hardoy and Satterthwaite, 1989; McGranahan et al, 1999).
- Government authorities and planners have tended to blame these problems on the informal sector, and have sought to deal with the problem of informality through increased powers of control and regulation, by insisting on legal titles to land, public housing, mortgage finance, etc.; but these conventional approaches have usually by-passed the poor, still leaving the informal sector as the dominant provider of land and housing in large parts of the urban and peri-urban areas.
- Informal sector policies in the 1980s were very repressive, while the response to the sector in the 1990s was much more pragmatic and promotional. The military administration of General Buhari which overthrew the Second Republic was so dissatisfied with the state of the environment that it discontinued with the idea of central planning altogether. Instead, it initiated an aggressive campaign for environmental awareness and sanitation as the focus of the fifth phase of the so-called ‘War Against Environmental Indiscipline’ WAI. A large number of environmental task forces were set up by State Edicts to organize public enlightenment campaigns, and to enforce environmental discipline through mobile sanitation courts. Special days of the month were set aside for general clean up by everybody -- to unblock drains, clean residential and work places, and remove heap of rubbish. The cleanest cities were promised one million naira prize, and a definite improvement in the environment appeared to have been achieved, at least temporarily. Unfortunately, the potential merit of the programme was marred by overzealous officials and the military drive for quick results. The campaign soon became associated with the misguided drive to contain urban growth, and to restrain the informal sector, as the sector was blamed for all sorts of evil social influence -- littering the streets, obstructing traffic, creating various forms of pollution and nuisance, crime, piracy, prostitution, foreign exchange malpractices, etc. Informal sector enterprises such as hawking and other forms of street business were incessantly harassed and compelled to relocate in remote and inaccessible outskirts of the towns. Kiosks, illegal structures and shanty towns in Lagos, Kano, Port Harcourt and other state capitals were raided and ruthlessly demolished (Braimah, 1989; Nwaka, 1996).
- The military approach was certainly not a permanent solution to the problem, as it caused so much discontent and distress, and provoked many human rights activists. The government of General Babangida which overthrew Buhari showed little enthusiasm for environmental sanitation, and has credit for initiating a number of rural and urban social programmes to address the hardship and austerity that came in the wake of Structural Adjustment, notably the well funded Directorate for Food, Roads and Rural Infrastructure, DFFRI, and the Directorates for Employment, NDE, and so on. For the urban informal sector the most relevant initiatives were the establishment of the People’s Bank, the Community Banks and the National Directorate for Employment. Access to credit is important to small business aspiring to grow and become more profitable. Between 1990 and 1992 the government established as many as 401 Community and People’s Banks, modelled on the Asian experience, and on the principles of traditional rotational credit system. These banks were to provide small loans and other forms of financial and business services for the poor and informal sector enterprises, with the whole community acting as guarantor for loan repayment. Within two years these banks together had built up assets of over 981 million naira, mobilized over 640 million in savings and deposits, and disbursed 150 million naira as loans and advances (Mabogunje, 1995). Unfortunately, recent studies suggest that only about 10 per cent of informal sector workers interviewed were aware of how to take advantage of the new facilities offered by the Banks, and the Employment Directorate. Civil Servants, military officers’ wives, and other well connected persons appear to have hijacked the scheme, often getting loans far in excess of the approved official maximum (Dike, 1997; Halfani, 1996).
- The National Directorate for Employment, established earlier in 1987/88, was meant to promote self-employment through training and credit to unemployed youths, but the main orientation of the programme has been to reverse rural-urban migration by encouraging investment in rural agriculture. The informal sector was thought to be already saturated, although the government also launched the National Open Apprenticeship Scheme, as part of the NDE, to support the placement of apprentices in informal sector workshops, and supplement their practical training with other forms of formal training for skills they would need in future for their enterprises. Again, only

a small percentage of unemployed youths and apprentices have benefited from the scheme, which appears to be undermined by underfunding and other forms of malpractice (Dike, 1997).

4 INDIGENOUS KNOWLEDGE AND IMPROVED URBAN GOVERNANCE

The Secretary General of the United Nations has recently identified good governance as "perhaps the single most important factor in eradicating poverty and promoting development". How does indigenous knowledge promote good governance? Much of the current thinking on good governance derives from the recommendations and plans of action of the United Nations-sponsored conferences of the 1990s -- on environment and development, on combating poverty and inequality, on human settlement improvement, gender, health and so on. All these congresses endorse the principles of *enablement, democratic decentralization, participation* and *partnership*, in addition, of course, to the other main elements of good governance such as accountability, transparency, pluralism, and so on.

- The major gap in the good governance agenda appears to be at the local level where the major issues of poverty reduction, popular participation, and support for an active civil society remain largely underresearched and unaddressed. It is also at the local level that indigenous knowledge appears to have the greatest potential to contribute to sustainable development. For most of his distinguished scholarly career, late Professor Claude Ake stressed the need for a home grown model of self-reliant development which can only come about if we learn to "build on the indigenous"

"We build on the indigenous by making it determine the form and content of development strategy; by ensuring that developmental change accommodate itself to these things, be the values, interests, aspirations and/or social institutions which are important to the life of the people. It is only when developmental change comes to terms with them that it can become sustainable." (Ake, 1988, p. 19).

- In his influential World Bank studies, Mamodou Dia with his group, has argued that the most promising way to overcome the shortcomings of the state system and its alien formal institutions in Africa is to recognise "the structural and functional disconnect between the informal, indigenous institutions rooted in the region's history and culture, and formal institutions mostly transplanted from outside" (Dia, 1996; cf Francis with others, 1996). The remedy he argues is to ensure "a reconnect between state and civil society", by identifying the opportunities within indigenous institutions for building a more pluralistic and participatory form of governance and development. Like the earlier UN conferences, the Habitat Agenda of 1996 also highlights the need for "partnership among countries and among all actors within countries. Good urban governance entails finding ways of engaging with the urban poor so that their needs can be reflected in the policies and programmes of city governments". (UNCHS-Habitat, 1998, para. 33)
- Many critics of the Nigerian urban scheme have likened the chaotic pattern of urban development in the country to building a house from the roof down:

... all the institutions of modern urbanization are in place - the banks, the factories, the legal system, the unions, etc.; but all these appear to be suspended over societies that have no firm connection to them, and whose indigenous institutions, even when oriented in the right direction lack the necessary scaffolding to connect them to their modern surrogates. (Mabogunje, 1995)

- The laws, codes and standards that operate in the cities were inherited from the colonial period, and are now applied with little rethinking by the local elite are bureaucrats. This anomalous state of affairs has led to the poor functioning of the cities, and the call for endogenizing or 'radicalizing' the institutional response to rapid urban growth, especially because there are still strong ties between urban and rural areas, and a large urban informal sector.
- To explain the poor performance of public sector management in the cities and elsewhere in Africa, Professor Ekeh has drawn a distinction between the morality of the 'civic public' associated with colonial rule and alien institutions on the one hand, and on the other the 'premodial public', associated with traditional sentiments, values and restraints in various indigenous societies and institutions. The political and administrative structures of the civic realm (the civil service, the police, the judiciary, etc.) were created by the alien colonizers, and therefore tend to elicit a negative and predatory response from the people who see government work as white man's work, and public resources as fair game. There is general apathy and cynicism towards government, and some ambivalence about accountability in governance. By contrast, the general attitude to the premodial realm (ethnic, clan or village) is much more selfless and transparent because of the cultural norms, obligations and sanctions that come into play. (Ekeh, 1975; cf Honey, and Okafor eds., 1998) This partly explains the pervasiveness of ethnic and clan unions in the cities, with strong links to home towns. The argument then is that these traditional values, attitudes and institutions should be consciously harnessed and brought to bear on governance and public affairs in the cities and other spheres of public life.
- In the same way, Dia's influential World Bank studies referred to earlier in the paper have urged for synergy or "institutional reconciliation" between state and community, through measures which increase the technical and organizational capacity of community institutions, and also create a more responsive and accountable public sector. Both formal and informal institutions are here to stay, and need to be made more flexible in their relationship to each other. The formal sector and its institutions need to adapt to local conditions for greater legitimacy and enforceability; informal sector institutions in some cases also need to be renovated and adjusted in order to remain relevant. Local institutions which are sometimes handicapped by limited skills and resources need support links to the budgetary and technical resources available in government and its numerous agencies. (Dia, 1996)
- This concept of institutional reconciliation can be given practical support in urban governance by consciously trying to integrate the vast informal sector to the economic and administrative mainstream; and by encouraging and utilizing

informal urban neighbourhood associations, not only for the well known functions of local security and solidarity but also as active agents for governance and development. For instance, the South African Municipal Structures Act requires all Municipal Councils to develop mechanisms to consult and involve the community and community organizations through Ward Committees and other structures for consultation and collaboration. We have referred earlier in the paper to how the traditional system of rotational credit has influenced the establishment of Community Banks, and Peoples Banks in Nigeria. The challenges is, therefore, how best to build active institutional channels to mobilize and link up individuals and groups in the informal sector to the mainstream of urban government and development.

5 INDIGENOUS KNOWLEDGE AND THE PROMOTION OF THE INFORMAL CITY

The full potential of indigenous knowledge to promote sustainable urbanisation and to counter urban segregation and inequality can only be realized through the collaborative efforts of state and local authorities, the international development community and the predominantly poor inhabitants of the informal city. In this partnership, local governments are in the front line, and need to be strengthened in their technical, financial and administrative capacity through genuine decentralization and increased support from national governments and international development agencies. The concept of Local Agenda 21 of the Rio Earth Summit is based on the premise that local governments are better placed than distant central and state bureaucracies to promote local government and poverty reduction, especially if the citizens, rich and poor, are given a sense of involvement in making decisions about policies and programmes that affect them. The nearer government is brought to the people the more likely it is that the positive traditional norms, values and institutions referred to earlier in the paper will be brought to bear on the development effort. Unfortunately, the record of decentralization and local governance in Nigeria since the 1976 Local Government Reforms has been rather disappointing, in spite of the political rhetoric about power sharing and popular empowerment. (Fed. Rep. Nig., 1976; Olowo 1996, 2001) With the economic crisis of the 1980s and '90s, and the poor functioning of the state system, the tendency has been to off-load more and more functions onto the lower levels of government without the resources and institutional support needed to ensure effective performance; and no distinction is made in the Nigerian Constitution between rural and urban local governments to provide for the special needs of the rapidly growing cities.

- In addition to genuine decentralization, government at the national level must create the enabling environment to support local governments and the informal sector to operate effectively. There is a need to continuously review and update existing legislation in respect of urban planning, building standards, infrastructure and environmental regulations etc., in order to make them more realistic, attainable and compatible with local conditions. While government and planners should retain long term control to guarantee public safety and environmental health, local conditions dictate that planning should become more flexible, more advisory and promotional, and seek to mediate conflicting interests and values, rather than adhere to the traditional preoccupation with zoning, regulation and control to perverse the sanctity of public and private property, and to forceably stop slums from forming. Some adjustments and compromises have to be made to ensure enhanced security of land and housing tenure for the poor in order to give them a sufficient stake in and incentive to improve the quality of where they live and work. Informal sector settlements and activities must be decriminalized to ensure social harmony and sustainability (ILO, 1991; Tripp, 2003; Geoffrey Payne Associates). Indeed, current research suggests that slums and irregular settlements grow not only because the people who live in them are poor, but because of overregulation, the sluggishness of government to provide adequate and affordable land, and failure to harness the energies and resources of the poor in the right direction. The creation of a dual and parallel urban systems - the 'formal' and 'informal', the 'legal' and 'illegal' should give way to an appropriate mix and range of tenure systems and standards within the same city, providing scope for incremental improvement over time as resources improve.
- The indigenous knowledge movement has implications for international development assistance as well. As indicated in the opening paragraphs, the conventional model of development, which has sought to transform African societies into the Western image of what these societies ought to be has not only failed, but has tended to alienate the people from their roots and to undermine local capacity building and self confidence. (Ake, 1988) When technical assistance underrates and overlooks local knowledge and expertise, it reinforces the problems of dependency and underdevelopment instead of reinforcing and building on already existing local capacity. Aid agencies that seek to alleviate poverty must focus more clearly on decentralised cooperation that seeks to reach and assist people more directly and not always on states and governments. They should also adjust the ways they operate so that they can more effectively support and strengthen local institution that relate more closely to the needs and priorities of the intended beneficiaries. (Satterthwaite 2000; IAF 2001) The Habitat Agenda urges the international development community not only to provide new and additional financial support for the goal of "adequate shelter for all", but even more importantly, to address the structural roots of poverty in the developing world through "positive action on the issues of finance, external debt, international trade and transfer of technology". (UN-Habitat 1989)
- But the preservation of indigenous knowledge, and its application to the challenges of development depend largely on the local people in the towns and slums of developing countries themselves as the custodians and practitioners of indigenous knowledge. They must be encouraged to appreciate the strong and weak points of their knowledge and practices, and seek through experimentation to improve and modify them appropriately in the light of change and new ideas. In Nigerian cities, the informal sector operators need to organize and self-regulate themselves better in order to engage more constructively with government and other development partners; increase their power to lobby, negotiate and influence public policy in favour of their sector. They should pool resources through 'clustering' and other forms of cooperation that foster mutual support in a way to help their enterprises to grow and their settlements to improve. (Rogerson, 1996; Rakodi, 1997) Collectively they must curb some of the socially unacceptable 'coping strategies' that tend to discredit them, such as adulteration, crime, unhygienic living habits and practices, etc., and confine themselves to genuine activities

for livelihood which are 'illegal' only in the technical sense of not conforming fully with official regulations and bureaucratic norms that are often arbitrary and inequitable. (Danida, 1997; Mankhoff and Seibal, 1996)

- Marshal Sahlins has rightly emphasized the need for peoples in the developing world "to indigenize the forces of global modernity, and turn them to their own ends", since the real impact of globalization depends on the response developed at the local level. (Sahlins, in Hopper 2000; Davis and Ebbe, 1995) With the increasing tempo of globalization, Africa cannot opt for an insular and entirely home-grown approach to its development, but must follow a path of development which recognizes the merits and limitations of both local knowledge and global science, and explores the interface between the two. Like the Japanese and the rapidly developing countries of Asia, Africa must aspire to achieve an endogenous model of development which has a distinct African cultural fingerprint.

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General Information System for Religious Italian's cultural resources

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ABSTRACT

General Information System for Religious Italian's cultural resources *is a nation-wide geographical information system of Italy implemented from 1996 for the* Ecclesiastic cultural heritage *(CEI) and still under implementation. It contains spatial and descriptive data on areas of cultural, environmental, scenic or public value protected by law. The information system realised two different tools to retrieve information, produce maps and reports and implement the database at three different levels: getting easy information on religious cultural resources, administrative use of central and local offices to control and manage protected areas, study and definition of new areas to protect and implementation of database with new or more detailed information.*

The GIS is designed to link Italian's cultural resources inventories through a user-friendly map interface. The primary system data consist of the inventories of historic properties and architectonic sites, the statewide record of architectural survey coverage, the National Register of Historic Building by the ICCD (Istituto Centrale del Catalogo e della Documentazione). Digital topographic quadrangle maps, county topographic maps, and infrared aerial orthophotos serve as base reference layers. The GIS is defined and discussed in terms of its potential costs and benefits for Cultural Heritage preservation, valorisation and risk analysis. The system is being designed to facilitate the staff responsibilities in the areas of research, review, and compliance.

1 INTRODUCTION

The Division of Historical and Cultural Programs launched a major initiative in late 1996 with its development of a General Information System (GIS) for Religious Italian's cultural resources. The Ecclesiastic Authorities under the "Conferenza Episcopale Italiana" (CEI), the Italian Ministry of Culture (MiBAC) and ICCD (Istituto Centrale del Catalogo e della Documentazione) amended the guidelines for a Community Initiative concerning the listing of cultural heritage intended to encourage the General Information System for the Ecclesiastical cultural heritage (Ministrerial Communication of 14 Jenuary 1998 Prot. N. 286/A 14). The project is jointly financed by the "Qtto per Mille" Programme and by private and public grants. The GIS is designed to link Italian's cultural resources inventories through a user-friendly map interface. The primary system data consist of the inventories of historic properties and architectonic sites, the statewide record of architectural survey coverage, the National Register of Historic Building by the CEI. Digital topographic quadrangle maps, county topographic maps, and infrared aerial orthophotos serve as base reference layers. The system is being designed to facilitate the staff responsibilities in the areas of research, review, and compliance. A publicly accessible workstation in the GIS has been established, and the data will be distributed on disk so that outside planners and researchers will have ready access to current information.

On the other hand the GIS is one important component of a comprehensive computerization project for the practical holdings. The General Information System in Italy serves as the repository of records on more than 70,000 cultural heritage (historic buildings, monuments, medieval architectonic sites, etc) recorded throughout the region. As a whole it gathers data, documentation, information sequences, that highlight, even if only in general terms, situations of danger for monuments. These stand for a support the Ecclesiastic Authorities (CEI - Conferenza Episcopale Italina) to help them to plan, together with the Italian Ministry of Culture (MiBAC), program and address the financial fluxes for restoration and maintenance interventions on single assets. Under the Italian Presidency a scientific research on "Territorial Information systems for the Preservation, Conservation and Management of Cultural Heritage" was developed also for the Ecclesiastic Cultural Heritage under the MINERVA Programme (http://www.minervaeurope.org). In particular the section 3.3.3 of the Minerva Good Practice Handbook describes the important role of geographic information in the context of cultural heritage, e.g. archaeological sites, historical patterns etc., and proposes strategies to bring together Europe-wide actions in the field.

2 THE CASE STUDY: ARCHITECTONIC CULTURAL HERITAGE

The Department of Cultural Resources is the CEI department responsible for preservation of cultural heritage collections and their documentation. To ensure availability for researchers and the public, cultural heritage collections and records should be retrieved, processed, stored and handled in ways that will contribute to their long-term preservation and mainteinence. Requests for using the Generic Information System's collections storage and research facilities should be submitted to the Ecclesiastic Authorities (Conferenza Episcopale Italiana -CEI). The determination of what will be accepted rests with a Ecclesiastic committee appointed by the CEI, on behalf of the National Office for Ecclesiastical Cultural Heritage.

The survey project provides a local base of information about community history and architecture. Ideally the surveyor and the survey serve as a prism--gathering information from many different religious places.

Survey files, organized by county, are maintained at the local "Curie Arcivescovili" at the Cultural Heritage Office, and at the regional offices of the Regional Councillorships of Cultural Heritage, along with survey project reports and detailed maps showing the locations of every recorded property. The extensive collection of survey files, maps, photographs, and reports constitutes a research and reference source, as well as providing private citizens, preservation organizations, and government agencies with a guide to the historic places that merit recognition and protection.

The survey data base includes as primary research modalities the following sources: Inventories, Pre-catalogue and Catalogue of architectonic properties. The inventories of architectonic properties give the general information of the architectural survey and is organized by the following data categories:

1.2 Accession Numbers

All artefacts must be marked with accession numbers supplied by the CEI, except in cases where lot accessions or an alternative accession system have been authorized in advance.

1.3 Provenience Information and provenience designations.

1.4 cronology- diachronic and synchronic analysis

1.5 conservation and maintenance issues - A statement indicating whether conservation treatment was performed, and a list of objects with a description of their treatments should accompany conservation strategies. If conservation has not been completed and is still a work in progress, it provides an itemized list of those objects needing treatment.

All architectonic properties are also organised in files (records), which provides the project name, county, site number(s), accession numbers and number of containers for each project, bibliographic and archive sources, etc; other provenience data, special sample identifiers, handling instructions and related information are required also for the identification of each single record.

A complete accession catalog or artifact inventory are also included. All architectonic properties are placed in appropriate sealed file and labelled with ICCD Standard plus sample-specific CEI identifiers. Accurate, informative labels are required for individual specimens, containers, inventory forms, etc. In general the Standards for mobile cultural heritage includes: Archeological artifacts (record RA-CEI); artistic artifacts (record 0A-D-CEI); artefacts of contemporary art (record 0AC-CEI). The CEI standard for immobile cultural heritage includes: architecture (A-CEI), parks (PG), urban and sub-urban areas (SU/TP), monuments and archaeological materials (MA-CA). The standards for cultural heritage of the territory includes: archaeological sites (record SI); historic centres (CS-CEI).

In particular the architectural survey (records A-CEI) analyses three research modalities: single architectural buildings (church, tower, etc); aggregation of architectural buildings (convents, monasteries, etc) and urban patterns (city centres or historical patterns).

The data systems are being designed to provide access to records through different methods: keyword search, structured database queries, and computerized map query and display. As components of the system are finished, they are being made available at the “CEI central workstations”. In order to provide better access to records, the computerization effort involves scanning forms and photographs and editing of scanned text, and database development.

The system will have a modular architecture of the client-server type and will be organized in two levels: a central one (the CEI Central Unit) and a local one (the Peripheral Units – “Curia Arcivescovile” Units). The CEI Central Unit has the function of analysing and developing models in order to handle both cartographic and alphanumeric information and data on a national level, regarding all degradation factors characterizing the territory as well as assets’ consistence and distribution. The peripheral units have the task to control and collect exact information about the state of conservation of cultural assets, so - about the "vulnerability" at territorial level of respectively regional, provincial, municipal competence. A numeric base cartography has been worked out at the Central Unit which permits a selection of the information levels received (roads, rivers, lakes, communication networks, level curves) according to the chosen scale of representation, and it represents the reference grid for all processing, facilitating the comprehension and reading of the phenomena on the territory. At present the ecclesiastical municipality (such as the Parish) has been established as the minimum reference unit of the system.

3 THE DAMAGE "EVENT" AND THE CONSERVATION STRATEGIES

The adopted model has been decisive for the design of the architecture and for the project realization. To be well acquainted with the risk of damage to which the elements of a particular "statistic population" are subject, means to relate the damage quantity that an event causes over a certain object or individual of the population under consideration, with the probability that that event could occur.

In order to apply this kind of approach to the Ecclesiastical Cultural Heritage, historic-artistic assets have been considered as "units" of the population subject to risk, whose risk level must be calculated. Assets typologies like paintings on wood, canvases, archaeological finds, etc. (some authors prop a subdivision in different classes) being pieces of art that cannot be geographically referred to, have been considered associated to an asset-container, that corresponds better to the above-mentioned scale.

If the variety of historic-artistic assets forming the Ecclesiastical Italian Culture Heritage is taken actually into consideration, as well as the fact that the damage event is the effect of a process of deterioration which cannot be subdivided in "elementary" events to be expressed only in probabilistic terms, that the mechanism according to which the damage event occurs, involves an elevated number of variables connected among each other in an articulated and complex way, it is easy to notice that the application of a rigorously statistic model is impossible, as far as it’s necessary to define preliminarily both the damage "event" and the "probabilistic mechanism" generating the event.

Therefore, since the historic-artistic framework does not permit a probabilistic measure of the risk, it is possible to identify the physics and social variables that influence the deterioration process with the aim of using these "measures" or "factors" in the process of quantifying the risk establishing a functional relation between "the Risk" and "the Risk Factors ". By the term “Risk” I indicate the susceptibility of a given monumental structure to the exposure to the occurrence or lasting of degradation processes.

In a nutshell, the difficulty of a pure probabilistic measure of risk has actually brought to the construction of "Risk Indicators" to express the risk level measure through indexes of that level, independently from of a possible correlation with a real evaluation of probability. The measure of different "Risk Factors" has been in the same way expressed in terms of " Risk Factors Indicators".

In particular, linking the terms “risk”, “vulnerability”, “hazard” and “value”, corresponds to that adopted by UNESCO, that is:

$Risk_i = f\,(Value,\ Vulnerability,\ Hazard)$’.

In other words, risk is directly proportional to the monument’s value, to its characteristics of vulnerability and to the hazard of its context. For the relation I refer to this particular case-study, risk factors can be subdivided into two areas or components, being characterized respectively by:

- the asset Vulnerability (V), in the sense of a condition which is contrary to safety, was assessed considering the individual ecclesiastical monument’s architectural and constructive characteristics; the dimensional data about rooms and structures; building history, the nature of materials it is made of and their possible condition of mechanical, physical-chemical and biological degradation; the presence of painted or sculpted decorative systems and their specific characteristics.

- the asset Danger (D), i.e. by a function indicating the level of potential aggression typical of a given territory, independently from the presence or absence of assets. In this cathegory It is possible to include Value (V) and Hazard (H). In particular, the hazard depends on the possibility that potentially damaging dynamics could develop in the monument’s environment. The hazard scenarios can belong to two main typologies: the physical-environmental and the anthropic one.

In this way it has been possible to express Risk, as a function of these two components and, to measure its intensity through the measure of physical sizes contributing to the determination of above-mentioned parameters. Other variables such as time (t) and the spatial location (x, y, z) can also be introduced with the aim of knowing the space/time distribution of the phenomena to be analyzed and allowing their geographic representation throughout the territory. This model allows to express the Risk as a general function of the vulnerability components relating to each population unit and of the danger components - relating to any geographical area where the asset is:

$$R = R(V_1,V_2,....V_m; D_1,D_2,...D_n)$$

On this purpose three spheres of vulnerability V have been defined according to the characteristic size of the asset’s conservation state and in respect to:

the surface outlook V_1;

the constructive and static-structural characteristics V_2;

utilization and safety V_3.

Analogously three Danger dimensions have been identified according to the sizes by defining the degradation mechanisms. In particular we may say that:

climatic, micro-climatic factors and air-pollutants have been used to describe the environmental/air sphere;

the geomorphologic characteristics of the soil and sub-soil level have been considered in order to define the static/structural sphere;

The demographic and social-economic dynamics have been finally regarded to define the anthropic sphere.

In conclusion we may say that the implementation of the Generic Information system for ecclesiastical cultural heritage make it possible to relate the structure’s vulnerability to the risk degree of the area in order to create a risk scenario.

The GIS is the most suitable information model for supporting analysis of area management aiming at the established objectives, the first of which is the minimization of the environmental degradation impoverishing the site. In this work-in –progress phase, thus, the objective of the research is to analyse the factors causing the structures’ degradation and vulnerability degree in detail, as well as the risk degree for the entire area if the current environmental situation persists.

4 BENEFITS AND COSTS

A cost-benefit analysis must consider all kinds of benefits and costs wether they are accrued by the implementing organisation itself or by potential additional users of the GIS products provided. The cost-benefit analysis must reflect the social benefits and costs and the impacts on other governmental programmes and policy goals.

From a general overview to the literature review, several authors described classification schemes for GIS benefits. Born (1992) differentiates primary and secondary benefits, Knepper (1990) tangible and intangible benefits, Prisley (1987) and Clarke (1991) efficiency, effectiveness and intangible benefits, Antenucci (1991:67) Type 1 to Type 5 benefits. A main emphasis on external benefit can be found by Smith (1992).

In the study of Ecclesiastical cultural heritage the following, a classification based on four benefit categories, is used (Behr 1994):

- benefits due to increased efficiency (achieved by enhancement of productivity);
- operational benefits (capacity enhancements by higher human or technical resources);
- strategic benefits (correlated with the strategic goals of the Ecclesiastic organization such the decentralization of electronic data processing, optimization of business processes, compliance with laws, regulations, and standards - protection of the environment, support of ecological applications).
- external benefits (by easier access to information and faster data distribution).

The difficulty in the case of GIS applications for Ecclesiastical cultural heritage is that there are no market prices for a lot of services provided. Hence, the benefit of GIS based services must be estimated during the survey. However, it is essential for external benefits that “they exist if people who benefit in this way pay for these benefits or not” (Smith 1992).

The first two benefits - efficienty and operational benefits - deal with the management of information, the CEI Documentation Center's primary responsibility. The last two benefits look at the bigger picture of Heritage site monitoring, maintenance and planning, for which MINERVA, States Parties of the Convention and even the public share a joint responsibility.

On the other hand the cost estimation was a vital link in the success or failure of the General Information System project.

The costs of implementing the GIS were primarily in the areas of hardware and software, database development, and training and support. However, the price of a GIS (hardware and software) was not the most important cost factor. Issues such as usability, learning and training cost, support, as well as data compatibility all affect the decision for the General Information System.

In general the principal components were: hardware; software (base software, base GIS and GIS modules); maintenance; services (resources to fulfil the GIS project objectives, e.g. customisation); training, data.

In particular the user interface of the GIS application affected many of these key elements of the study especially when we take the time to measure how long (or using how much effort) to get the job done. This section can only give an overview and expert advice while the subject "cost-benefit of GIS projects" could be described in further researches.

5 SOME FINAL CONCLUSIONS

Explosion of new applications of GIS in Ecclesiastical cultural heritage shows that GIS can be a powerful tool for heritage conservation and valorisation. As the vision of heritage preservation is evolving to consider sites and their context holistically, preservation will inevitably involve a greater use of electronic tools such as GIS. Adoption of this tool among researchers and conservationists will increase in the coming years, particularly for the documentation of larger sites. By adopting this technology as quickly as possible, MINERVA and its partners in Cultural Heritage preservation and valorisation can play a leading role in the development of data standards and spatial databases related to the GIS, and advance the adoption of the Generic Information System as a tool in Ecclesiastical heritage preservation and valorisation.

It is important to anderline that the Generic Informtion System's aim isn't to replace the ICCD institutional site, neither to take his functions, it may assume some of its general contents and make it easier to accede to them, while the ICCD's National Register still keeps its public services and functions and those internal to the Ministry itself. In its actual configuration the GIS (General Information System) assembles a first, nevertheless incomplete determination of the consistence, typology and geographical distribution of the Architectural Cultural Heritage at least in its emergencies. In the near future it will be capable of exploring, overlapping and processing information about the potential risk factors that invest the material configuration of the Ecclesiastical Heritage itself.

The development of the gerarchical DBMS into a new platform by integrating GIS and RDBMS would serve two crucial purposes. Firstly it would allow the user to operate the system without having to grapple with the underlying "intricacies" the GDBMS technology. Secondly, it would allow sharing of information and technical expertise among a wide range of users.

The assessment of costs and benefits also plays an important role during decision making concerning the implementation of geographical information systems (GIS). It is important to underline that only some of the benefits were introduced into the cost-benefit ratio, and not all likely benefits were recognized by potential GIS users and Ecclesiastic authorities. A methodology of assessing benefits has the aim to apply to all categories of benefits in order to assign monetary values to different information products.

The General Information System can be considered a work-in-progress: the contents of the database could be able to be implemented on line in real time from everywhere by the allowed users as the GIS has been designed to be dynamic and interactive. The access is allowed to the ecclesiastic authorities and staff through different search modalities, predefined and free itineraries and through a topographic approach with the geo-referenced repository of information to be matched to the implemented Generic Information System. The objective of the risk analysis is a *sustainable management* of the religious site, allowing an increase of visitors and the achievement of optimal conditions for the preservation of ecclesiastical cultural heritage at the same time. The model I have chosen could serve as a platform for all future expectations for the layout of the area of Italy.

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Der Umgang mit räumlichen Informationen in der politischen Diskussion - Erfahrungen aus dem Hessischen Landtag

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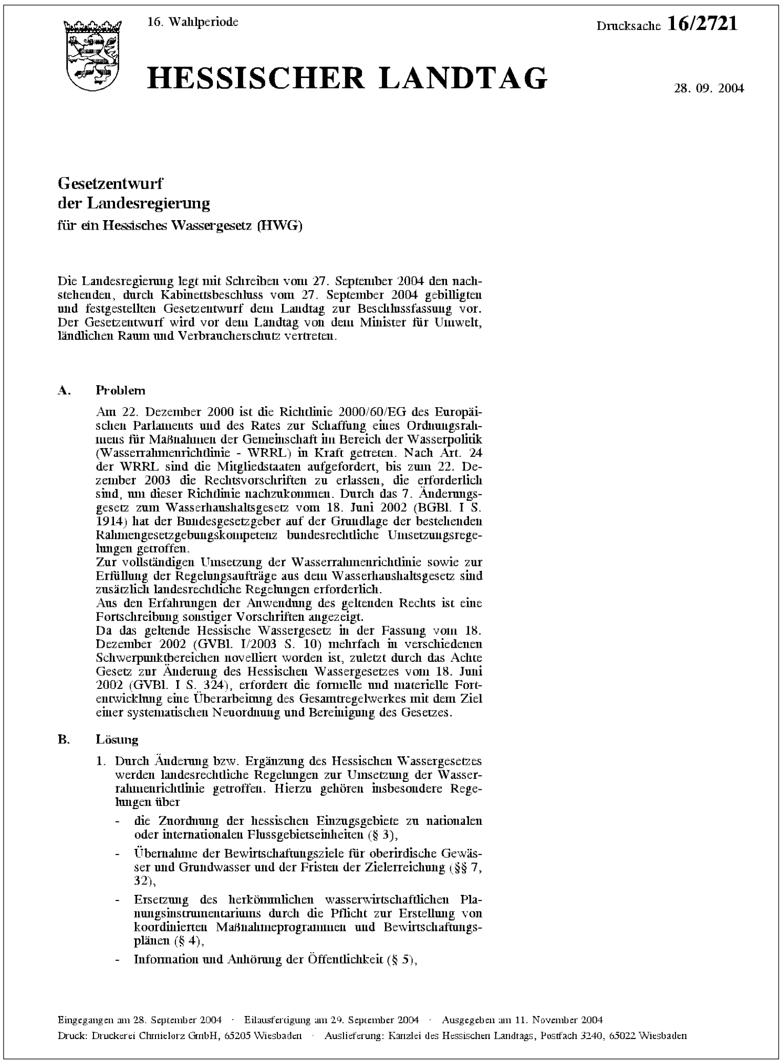
1 EINLEITUNG

Ein Großteil politischer Entscheidungen hat einen engen Raumbezug. Beispiele hierfür sind insbesondere Standort- bzw. Trassenentscheidungen oder die räumliche Gesamtplanung (in Deutschland Raumordnung und Bauleitplanung). Darüber hinaus haben viele Entscheidungen eine direkte Auswirkung auf den Raum. So förderten beispielsweise die fiskalischen Instrumente Eigenheimzulage und Pendlerpauschale in Deutschland den Wegzug der Wohnbevölkerung aus den Städten (siehe u.a. BBR, 2002). Ein weiteres Beispiel für politische Entscheidungen mit Raumwirkungen sind Nutzungsbeschränkungen im Rahmen des Naturschutzes oder des Hochwasserschutzes. Während die konkreten Gebietsabgrenzungen in diesen Beispielen durch die jeweiligen Fachverwaltungen vorgenommen werden, werden die Ausgestaltungsmöglichkeiten der Nutzungsbeschränkungen durch den Gesetzgeber und damit durch die Parlamente im Rahmen politischer Entscheidungen festgelegt.

Im vorliegenden Beitrag wird die Frage untersucht, wie mit den räumlichen Informationen in der politischen Diskussion umgegangen wird, welche Anforderungen an die Informationen existierten und welche Chancen zur verstärkten Integration räumlicher Informationen in die politische Diskussion bestehen. Als Fallbeispiel dient die Diskussion um den vorsorgenden Hochwasserschutz im Hessischen Landtag in den Jahren 2002 bis 2004.

2 DAS PARLAMENT ALS WICHTIGER ORT DER POLITISCHEN DISKUSSION

Die formelle parlamentarische Arbeit ist ein wesentlicher Teil der politischen Diskussion und wird im Rahmen des Beitrags deshalb im Mittelpunkt stehen. Weitergehende Bestandteile politischer Diskussions- und Entscheidungsprozesse insbesondere informelle Aspekte wie der Einfluss der Massenmedien oder von Lobbygruppen werden im Rahmen dieses Beitrages nicht berücksichtigt.



16. Wahlperiode

Drucksache **16/2721**

HESSISCHER LANDTAG

28. 09. 2004

Gesetzentwurf
der Landesregierung
für ein Hessisches Wassergesetz (HWG)

Die Landesregierung legt mit Schreiben vom 27. September 2004 den nachstehenden, durch Kabinettsbeschluss vom 27. September 2004 gebilligten und festgestellten Gesetzentwurf dem Landtag zur Beschlussfassung vor. Der Gesetzentwurf wird vor dem Landtag von dem Minister für Umwelt, ländlichen Raum und Verbraucherschutz vertreten.

A. Problem

Am 22. Dezember 2000 ist die Richtlinie 2000/60/EG des Europäischen Parlaments und des Rates zur Schaffung eines Ordnungsrahmens für Maßnahmen der Gemeinschaft im Bereich der Wasserpolitik (Wasserrahmenrichtlinie - WRRL) in Kraft getreten. Nach Art. 24 der WRRL sind die Mitgliedstaaten aufgefordert, bis zum 22. Dezember 2003 die Rechtsvorschriften zu erlassen, die erforderlich sind, um dieser Richtlinie nachzukommen. Durch das 7. Änderungsgesetz zum Wasserhaushaltsgesetz vom 18. Juni 2002 (BGBl. I S. 1914) hat der Bundesgesetzgeber auf der Grundlage der bestehenden Rahmengesetzgebungskompetenz bundesrechtliche Umsetzungsregelungen getroffen.
Zur vollständigen Umsetzung der Wasserrahmenrichtlinie sowie zur Erfüllung der Regelungsaufträge aus dem Wasserhaushaltsgesetz sind zusätzlich landesrechtliche Regelungen erforderlich.
Aus den Erfahrungen der Anwendung des geltenden Rechts ist eine Fortschreibung sonstiger Vorschriften angezeigt.
Da das geltende Hessische Wassergesetz in der Fassung vom 18. Dezember 2002 (GVBl. I/2003 S. 10) mehrfach in verschiedenen Schwerpunktbereichen novelliert worden ist, zuletzt durch das Achte Gesetz zur Änderung des Hessischen Wassergesetzes vom 18. Juni 2002 (GVBl. I S. 324), erfordert die formelle und materielle Fortentwicklung eine Überarbeitung des Gesamtregelwerkes mit dem Ziel einer systematischen Neuordnung und Bereinigung des Gesetzes.

B. Lösung

1. Durch Änderung bzw. Ergänzung des Hessischen Wassergesetzes werden landesrechtliche Regelungen zur Umsetzung der Wasserrahmenrichtlinie getroffen. Hierzu gehören insbesondere Regelungen über
   - die Zuordnung der hessischen Einzugsgebiete zu nationalen oder internationalen Flussgebietseinheiten (§ 3),
   - Übernahme der Bewirtschaftungsziele für oberirdische Gewässer und Grundwasser und der Fristen der Zielerreichung (§§ 7, 32),
   - Ersetzung des herkömmlichen wasserwirtschaftlichen Planungsinstrumentariums durch die Pflicht zur Erstellung von koordinierten Maßnahmeprogrammen und Bewirtschaftungsplänen (§ 4),
   - Information und Anhörung der Öffentlichkeit (§ 5),

Eingegangen am 28. September 2004 · Eilausfertigung am 29. September 2004 · Ausgegeben am 11. November 2004
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Abb.1: Vorblatt des Gesetzentwurfs der Landesregierung zur Novellierung des Hessischen Wassergesetzes (Drucksache 16/2721)

Die formelle parlamentarische Arbeit des Hessischen Landtages ist in der Geschäftsordnung des Hessischen Landtages (GO) detailliert geregelt. Schwerpunkte der Geschäftsordnung sind die Regelung der Einberufung und Ordnung der Sitzungen des Landtages (Plenum), Wahlvorgänge, die Bildung und Besetzung von Ausschüssen und die einzelnen Schritte bei der Beratung und dem Beschluss von Gesetzen und Anträgen.

Die Abgeordneten des Landtages haben die Möglichkeit, sich in Fraktionen zusammenzuschließen. Die Mindeststärke einer Fraktion beträgt fünf Abgeordnete (§§ 40ff GO). Fraktionen sind mit eigenen Rechten und Pflichten ausgestattet und dienen der politischen Willensbildung im Landtag. Sie helfen den Mitgliedern, ihre parlamentarische Tätigkeit auszuüben und zur Verfolgung gemeinsamer Ziele aufeinander abzustimmen (§ 1 Hessisches Fraktionsgesetz). Zur Wahrnehmung Ihrer Aufgaben erhalten die Fraktionen Räume und finanzielle Mittel bzw. Bedienstete durch den Hessischen Landtag. Die Höhe der Mittel orientiert sich an einem Grundbetrag für jede Fraktion, an einem Betrag für jedes Mitglied und einem weiteren Zuschlag für jede Oppositionsfraktion (Oppositionszuschlag). Die Ausstattung mit Räumen orientiert sich an der Zahl der Mitglieder der Fraktion und der Zahl der Bediensteten (§§ 2 und 3 Hessisches Fraktionsgesetz). Darüber hinaus erhalten die Bediensteten und die Abgeordneten eine Grundausstattung am Arbeitsplatz, die einen für Office-Anwendungen geeigneten netzwerkfähigen PC einschließt.

Wesentliche Arbeitsformen des Hessischen Landtages sind dabei das Plenum (§ 43 und §§ 56ff GO) und die Fachausschüsse (§§ 50ff GO). Während das Plenum generell öffentlich tagt (§ 56 GO) ist die Arbeit in den Ausschüssen in der Regel nicht öffentlich (§ 89 GO). Alle wesentlichen Vorgänge des

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Landtages werden verschriftlicht. Über jede Plenarsitzung wird ein Stenografischer Bericht angefertigt, der den Sitzungsablauf möglichst wortgetreu wiedergibt (§ 109 GO). Grundlage der parlamentarischen Arbeit sind die Landtagsdrucksachen (siehe Abbildung 1). In ihnen werden alle Vorlagen der Landesregierung und der Abgeordneten schriftlich dokumentiert. Die Ausführung und die Verteilung sind in der Geschäftsordnung des Landtages geregelt (§ 108 GO). Inzwischen sind sowohl die Protokolle der Landtagssitzungen als auch die Landtagsdrucksachen für die Öffentlichkeit auch über das Internet zugänglich (http://www.hessischer-landtag.de/index.cfm?rubrik=6). Dies ist jedoch ein zusätzliches Angebot, das bis jetzt noch keinen Eingang in die einschlägigen Regelungen gefunden hat. Die Drucksachen liegen in Textform vor. Visualisierte Informationen werden in Einzelfällen als Anlage beigefügt.

Den Abgeordneten und der Landesregierung steht ein breites Spektrum von Instrumenten zur Verfügung, um die politische Diskussion zu initiieren. Herausragende Aufgabe des Landtages ist die Verabschiedung von Gesetzen. Die Landesregierung, die Fraktionen oder mindestens fünf Abgeordnete können Gesetzentwürfe einbringen. Dies muss in schriftlicher Form erfolgen. Der Landtag setzt sich dann in einem streng festgelegten Verfahren im Plenum und in dem bzw. den zuständigen Fachausschüssen mit dem Gesetzentwurf auseinander (§§ 11ff GO).

Mit Anträgen können die Fraktionen oder mindestens fünf Abgeordnete die Landesregierung zu einem bestimmten Handeln oder zu Berichten auffordern. Auch Anträge müssen schriftlich eingereicht werden. Sie werden im Plenum und in der überwiegenden Zahl der Fälle in dem bzw. den zuständigen Fachausschüssen beraten (§§ 27ff GO).

Zur Diskussion aktueller Themenstellungen dient die Aktuelle Stunde, die allen Fraktionen die Möglichkeit gibt, während einer Plenarsitzungswoche ein Thema zur Aussprache zu benennen (§ 31 GO). Die Anträge dafür sind schriftlich vorzulegen.

Wichtige Mittel zur Informationsbeschaffung aber auch zur Initiierung von politischen Diskussionsprozessen sind Anfragen. Fraktionen oder mindestens fünf Abgeordnete können in Großen Anfragen schriftlich die Landesregierung um Auskunft zu bestimmten Sachverhalten auffordern. Die Große Anfrage wird durch die Landesregierung schriftlich in Form einer Landtagsdrucksache beantwortet und in der Regel im Plenum diskutiert (§ 34 GO). Die Abgeordneten haben darüber hinaus die Möglichkeit, in Kleinen Anfragen von der Landesregierung Antworten zu Fragestellungen zu bekommen. Diese werden schriftlich in Form einer Landtagsdrucksache beantwortet. Eine Aussprache dazu findet nicht statt. Darüber hinaus können Abgeordnete der Landesregierung in Auskunftsersuchen Fragen stellen, die diese schriftlich beantwortet (§ 35 GO). Auch Mündliche Fragen als Form der Anfragen müssen schriftlich eingereicht werden. Sie werden von der Landesregierung im Plenum mündlich beantwortet und im Protokoll der Landtagssitzung dokumentiert. Durch die vorgegebene Form werden Fragen zu räumlichen Informationen in der Regel in Textform beantwortet.

Damit wird deutlich, dass den Abgeordneten zahlreiche Instrumente zur Verfügung stehen, um von der Landesregierung Informationen zu erhalten. Die Landesregierung ist zur Beantwortung der Fragen verpflichtet. Ihr werden dafür Fristen eingeräumt, die sich an der Art der Anfrage orientieren (siehe §§ 27, 32 und 34ff GO). Berichtsanträge sind explizit auch für vertrauliche Gegenstände vorgesehen (§ 32 GO). Die Ergebnisse der Berichterstattung unterliegen dann ggf. der Vertraulichkeit. Darüber hinaus steht dem Landtag das Recht zu, mit einem Fünftel der Mitglieder einen Untersuchungsausschuss einzusetzen. Dieser hat neben dem Recht auf Akteneinsicht das Recht, Beweiserhebungen im Rahmen der Strafprozessordnung durchführen zu lassen (Artikel 92 der Hessischen Verfassung). Zusammenfassend lässt sich feststellen, dass die Abgeordneten damit sehr weitreichende rechtliche Befugnisse über den Zugang zu Informationen haben. Diese umfassen unter anderem alle relevanten Umweltdaten der öffentlichen Verwaltung.

3 DIE BEDEUTUNG RÄUMLICHER INFORMATIONEN IN DER POLITISCHEN DISKUSSION

In den Interviews (2004) wurde deutlich, dass die befragten politischen Akteure je nach Themenbereich einen bis zu einhundert prozentigen Raumbezug feststellten. Als Beispiele wurden insbesondere Infrastrukturvorhaben und Standortfragen benannt. Für diese Themen wurden von den Akteuren in der Regel auch räumliche Informationen eingeholt. Das Spektrum der Informationsbeschaffung reichte dabei von Ortsbesichtigungen bis zu textlichen Auswertungen. Für alle diskutierten Themenstellungen im Umweltbereich gaben die Akteure an, räumliche Informationen für die Meinungsbildung zu nutzen.

Diese Einschätzung der befragten politischen Akteure deckt sich mit dem großen Angebot raumbezogener Informationen im Umweltbereich und in den Anforderungen der Umweltverwaltung an Informationen für das Verwaltungshandeln (für den Hochwasserschutz siehe ausführlich Dapp, 2002, S. 34ff; für Raumordnung und Bauleitplanung siehe Dapp, 2001, S. 31ff). Besonders deutlich zeigt sich dies bei Planfeststellungsverfahren für große Infrastrukturprojekte. Bill (1999, S. 248) ist sogar der Ansicht, dass bei Überwachung und Schutz der Umwelt ein Arbeiten mit Informationen ohne räumlichen Bezug in der Regel scheitert, „da es darauf ankommt, eine Vielzahl fachspezifischer Daten über die Lage miteinander zu verknüpfen.“ Eben diese Möglichkeit der Verknüpfung wurde von der Mehrheit der befragten Akteure als Wunsch für eine Verbesserung der Informationslage geäußert (Interviews, 2004).

Die individuelle Kompetenz und Erfahrung der Akteure im Umgang mit räumlichen Informationen ist sehr heterogen. Dies lässt sich vor allem auf den beruflichen Werdegang zurückführen (siehe hierzu ausführlich, Hessischer Landtag, 2003). Lediglich ein Interviewpartner verfügt über eine Vorqualifikation. Ein Abgeordneter musste sich auf Grund einer Nebentätigkeit mit der Erfassung räumlicher Informationen befassen und hat dadurch auch praktische Erfahrungen mit einem Geographischen Informationssystem gesammelt. Die anderen Interviewten haben sich ihre jeweiligen Kompetenzen zum Umgang mit räumlichen Informationen autodidaktisch angeeignet. Eine Strategie für den gezielten Kompetenzerwerb besteht derzeit weder für die Abgeordneten noch für die Mitarbeiterinnen und Mitarbeiter der Fraktionen (Interviews, 2004).

Neben den fachspezifischen Aspekten ist die Bedeutung räumlicher Informationen in der politischen Diskussion auch durch das Wahlsystem gegeben. Durch die Bildung von Wahlkreisen soll sichergestellt werden, dass die unterschiedlichen Regionen in den Parlamenten vertreten sind. Im Hessischen Landtag werden 55 Abgeordnete aus den Wahlkreisen direkt gewählt, gewählt ist dabei der bzw. die Abgeordnete mit den meisten Stimmen im Wahlkreis, und weitere 55 Abgeordnete über die Landesliste entsprechend der Stimmenanteile ihrer Parteien in Hessen zu den direkt gewählten Abgeordneten ergänzt. Für die Abgeordneten sind deshalb

Themen in „ihrem“ Wahlkreis oft von besonderem Interesse. Dies äußert sich beispielsweise in Anfragen mit besonderem Raumbezug.

Frage 282 der Abg. Eckhardt, SPD-Fraktion

Ich frage die Landesregierung: Da der Ministerpräsident laut „Fuldaer Zeitung“ vom 16. September 2004 am Ziel, gleiche Lebensverhältnisse in Hessen zu schaffen, nicht mehr festhält, wie hoch ist seiner Meinung nach der angemessene Lebensstandard für den **Landkreis Waldeck-Frankenberg** in Prozent gegenüber dem für Frankfurt am Main?

Frage 283 des Abg. Spies, SPD-Fraktion

Ich frage die Landesregierung: Da der Ministerpräsident laut „Fuldaer Zeitung“ vom 16. September 2004 am Ziel, gleiche Lebensverhältnisse in Hessen zu schaffen, nicht mehr festhält, wie hoch ist seiner Meinung nach der angemessene Lebensstandard für den **Landkreis Marburg-Biedenkopf** in Prozent gegenüber dem für Frankfurt am Main?

Frage 284 des Abg. Quanz, SPD-Fraktion

Ich frage die Landesregierung: Da der Ministerpräsident laut „Fuldaer Zeitung“ vom 16. September 2004 am Ziel, gleiche Lebensverhältnisse in Hessen zu schaffen, nicht mehr festhält, wie hoch ist seiner Meinung nach der angemessene Lebensstandard für den **Werra-Meißner-Kreis** in Prozent gegenüber dem für Frankfurt am Main?

Abb.2: Auszug aus der Auflistung der Mündlichen Fragen von Abgeordneten der SPD Fraktion in der Plenarsitzung am 23. November 2004, die wortgleiche Fragen für „ihre“ Wahlkreise stellten (nach Plenarprotokoll 16/50 vom 23.11.2004, Hervorhebung durch den Autor)

4 INFORMATIONSTECHNISCHE ANWENDUNGSMÖGLICHKEITEN DES HESSISCHEN LANDTAGES

Die rasante Entwicklung der Informations- und Kommunikationstechnologien der letzten Jahrzehnte eröffnet der auf einer Jahrtausende alten Tradition[43] beruhenden Verwaltung zahlreiche neue Möglichkeiten zum Umgang mit Informationen (siehe ausführlich Dapp, 2002, S. 39ff). Um den Einsatz dieser Technologien auch in den Parlamenten zu ermöglichen, müssen sowohl die rechtlichen Rahmenbedingungen als auch eine geeignete räumliche und informationstechnische Ausstattung vorhanden sein.

4.1 Rechtliche Möglichkeiten zur Nutzung von Informationstechnologien

Die Abläufe der Parlamente sind stark formalisiert. Ziel der Regelungen ist es, alle Entscheidungen und die parlamentarische Debatte zu dokumentieren und dadurch für die Öffentlichkeit nachvollziehbar zu machen. Dies setzt für alle Einzelschritte der parlamentarischen Abläufe eine lückenlose und möglichst fälschungssichere Dokumentation voraus, unabhängig von der Art der Informationen, die genutzt werden. Um die Echtheit jederzeit nachvollziehen zu können, müssen die Dokumente eindeutig authentifizierbar sein. Diese Anforderung kann durch elektronische Signaturen prinzipiell gewährleistet werden. Durch sie ist es möglich, die Person bzw. Institution zu identifizieren, die ein Dokument erstellt hat, und den Originalzustand des Dokumentes zu belegen.

Inzwischen sind elektronische Signaturen auf EU-Ebene durch die EU-Richtlinie 1999/93/EG geregelt, die durch das Signaturengesetz (SigG) seit dem Jahr 2001 in das deutsche Recht integriert ist. In Hessen wurde Ende November 2004 mit der Einbringung des Zweiten Gesetzes zur Änderung verwaltungsverfahrensrechtlicher Regelungen (Drucksache 16/2865) in den Landtag das Gesetzgebungsverfahren eingeleitet, um die Möglichkeit zu eröffnen, die Schriftform durch die elektronische Form in Verbindung mit einer qualifizierten elektronischen Signatur zu ersetzen. Durch diese rechtlichen Regelungen wird die elektronische Form mit der Schriftform gleichgestellt. Damit ist es prinzipiell möglich, alle Abläufe in digitaler Form abzuwickeln.

Die rechtlichen Regelungen müssen jedoch in vielen Bereichen entsprechend geändert werden, da sie explizit die Schrift-/Papierform verlangen. So werden im Rahmen der derzeitigen (September 2004 bis voraussichtlich Frühjahr 2005 dauernden) Novellierung des Hessischen Wassergesetzes Möglichkeiten für die Anwendung der elektronischen Form eröffnet. Wesentliche Teile des Verwaltungshandelns werden jedoch ausgeschlossen, da die elektronische Form eine Überprüfbarkeit lediglich für 30 Jahre sicherstellt, was beispielsweise für unbefristete Erlaubnisse, Genehmigungen und Befreiungen des Wasserrechts nicht ausreichend ist (siehe u.a. Drucksache 16/2721, S. 65).

4.2 Ausstattung des Hessischen Landtages zur Informationsbeschaffung und -vermittlung

Der Hessische Landtag ist in der Altstadt von Wiesbaden in einem in den letzten 160 Jahre gewachsenen heterogenen Gebäudekomplex untergebracht. Ein Schwerpunkt der Gebäude bildet das klassizistische Wiesbadener Schloss, das Mitte des 18. Jahrhunderts errichtet wurde und seit 1946 für den Landtag genutzt wird. Der Plenarsaal als regelmäßiger Tagungsort des Landtags wurde im Jahr 1962 fertiggestellt und seitdem nur unwesentlich verändert. Die Innenräume des Gebäudes mit dem fensterlosen Plenarsaal und die technische Ausstattung erfüllen die Anforderungen nicht mehr (waechter+waechter, 2004, S. 1ff). Charakteristisch für den Plenarsaal ist insbesondere die frontale Sitzordnung (siehe Abbildung 3). Das bedeutet, dass die Abgeordneten gegenüber der Landesregierung sitzen. Ein direkter Sichtkontakt zwischen den Abgeordneten und innerhalb der Regierung ist nur bedingt möglich. Hervorgehoben ist das Rednerpult, das von den meisten Plätzen gut eingesehen werden kann. Körperlich kleine Abgeordnete und Abgeordnete im Rollstuhl sind jedoch nur von etwa der Hälfte der Plätze einsehbar. Die informationstechnische Ausstattung des Plenarsaals sieht die Möglichkeit der Visualisierung von Informationen nicht vor. Auch der Einsatz von PCs an den Abgeordnetenplätzen oder für die Be-

[43] Bereits die Hochkulturen in Mesopotamien seit dem späten 4. Jahrtausend vor unserer Zeitrechnung verfügten über eine ausgeprägte Bürokratie. Sie zeichnete sich durch eine ausgeprägte Neigung zum Auflisten, Erfassen und Zählen aus. Eine große Verwaltung beschäftigte sich damit, den Eingang, die Bearbeitung und den Ausgang von Menschen, Tieren und Sachgütern zu erfassten (Sasson, 1995, S. 2202).

sucherinnen und Besucher ist nicht vorgesehen. Zur Unterstützung der Kommunikation und der Reden ist eine Mikrofonanlage installiert, die allen Abgeordneten zur Verfügung steht.

Abb.3: Plenarsaal des Hessischen Landtags im Dezember 2004

Die Räume in denen die Ausschüsse tagen sind unterschiedlich ausgestattet. Sie sind ebenerdig und in der Regel so groß, dass die Tische für die Abgeordneten in „Hufeisenform" angeordnet werden können. In den meisten Räumen wird die Kommunikation durch eine Mikrofonanlage für die Abgeordneten unterstützt. Zur Visualisierung von Informationen stehen mobile Projektionswände von ca. vier Quadratmeter Größe zur Verfügung (siehe Abbildung 4). Als Präsentationstechnik stehen Beamer und Overhead-Projektoren zur Verfügung. Eine Ausstattung der Räume mit PCs und Netzwerkanschlüsse ist nicht vorhanden.

Den Fraktionen stehen unterschiedlich ausgestattete Arbeitsräume für die Abgeordneten und die Mitarbeiterinnen und Mitarbeiter zur Verfügung. Das Spektrum reicht von ca. 10 Quadratmeter großen Dachzimmern bis zu ca. 40 Quadratmeter großen Büroräumen. Darüber hinaus verfügen alle Fraktionen über Besprechungsräume, in denen die mobilen Präsentationstechniken des Landtages genutzt werden können. Alle Arbeitsräume sind an das Netzwerk des Hessischen Landtags angeschlossen. Damit steht allen Abgeordneten und den Mitarbeiterinnen und Mitarbeitern sowohl ein Anschluss an das Behördenintranet des Landes Hessens einschließlich der Email-Kommunikation als auch an das Internet zur Verfügung. Der Zugriff auf die raumbezogenen Datenbestände der Landesverwaltung ist auf einzelne Themenbereiche (z.B. Karten zur Gewässergüte) beschränkt. Eine eigenständige Analyse ist nicht möglich. Die Ausstattung der PCs an den Arbeitsplätzen ist auf übliche Office-Anwendungen ausgelegt. Eine weitergehende Hard- und Softwareausstattung ist in der Regel lediglich in den Pressestellen vorhanden, die zusätzlich über Möglichkeiten zur Bildbearbeitung und anderer für die Öffentlichkeitsarbeit notwendige Ausstattungen verfügen. Darüber hinaus hält der Hessische Landtag eine Bibliothek zur Informationsbeschaffung vor, die an das öffentliche Fernleihesystem angeschlossen ist und mit den Bibliotheken der hessischen Ministerien eng zusammenarbeitet.

Abb.4: Vorbereitung für den Einsatz audiovisueller Medien in der Rotunde des historischen Teils des Hessischen Landtages mit Hilfe mobiler Projektionswände und -projektoren im Dezember 2004

Alle formalisierten Abläufe und der Informationsaustausch erfolgen generell schrift- und papierbasiert. So müssen beispielsweise Anträge im Original unterschrieben und von der zuständigen Stelle mit einem Zeitstempel versehen werden, um die Einhaltung von Fristen zu dokumentierten. Alle Unterlagen werden in der Hausdruckerei vervielfältigt und von Boten in Papierform verteilt. Zur Vereinfachung der Arbeit der Kanzlei werden die Unterlagen von den Fraktionen zusätzlich elektronisch zur Verfügung gestellt, um eine händische Erfassung zur Erzeugung eines einheitlichen Druckbildes zu vermeiden und das Internetangebot einfacher bereitstellen zu können. Mit Hilfe des Internetangebotes können alle Drucksachen über Stichworte gesucht werden. Neben dem veränderungssicheren TIFF-Format, das den Nachteil großer Dateien und damit langer Ladezeiten mit sich bringt, wird seit Ende 2002 auch das PDF-Format eingesetzt. Damit ist auch eine einfachere Weiterverwendung der Dateien möglich. Derzeit verfügen weder die Abgeordneten noch die Beschäftigten im Landtag über die Möglichkeit, elektronische Daten rechtssicher zu signieren und Signaturen zu überprüfen. Dadurch ist der Einsatz digitaler Informationen bzw. Dokumente auf Bereiche beschränkt, die nicht rechtssicher abgewickelt werden müssen.

In den Interviews (2004) wurde deutlich, dass die technische Ausstattung der Abgeordneten und der Mitarbeiter und Mitarbeiterinnen nicht auf die Verwendung und insbesondere eine eigenständige vertiefte Analyse räumlicher Informationen ausgerichtet ist. So stehen auch keine Geographischen Informationssysteme zur Verfügung. Damit ist es für die Akteure unmöglich, zeitnah eigene Fragestellungen unabhängig zu beantworten. Sie sind damit auf die Auskünfte der Landesregierung oder von Dritten angewiesen. Damit unterliegen sie der Gefahr, Diskussionsgrundlagen zu erhalten, die nicht neutral bzw. unter bestimmten politischen Setzungen zu Stande gekommen sind. Die digitalen Geobasis- und Umweltdaten der Landesverwaltung stehen der politischen Diskussion deshalb in den meisten Fällen nur indirekt über Anfragen zur Verfügung, soweit sie nicht über das Internet oder andere Medien veröffentlicht sind. Die Beantwortung von Anfragen durch die Landesregierung erfolgt generell in Textform. In wenigen Einzelfällen werden Anlagen mit Karten angehängt. Die Fristen für die Beantwortung betragen mindestens eine Woche (Dringlicher Berichtsantrag) und reichen bis zu mehreren Monaten (Große Anfragen).

Das Internet wird in den Interviews (2004) als Quelle für die schnelle Informationsbeschaffung mehrfach genannt. Wobei den Interviewten bewusst ist, dass diese Informationen jeweils die Sicht der jeweiligen Herausgeber darstellen und deshalb nur teilweise direkt verwendet werden können. Besonders wichtig ist den Interviewten deshalb auch das Informationsangebot von „seriösen“ Anbietern - wobei die Seriosität unterschiedlich eingeschätzt wird.

4.3 Perspektiven

Seit Ende der 1990er Jahre wird über eine Modernisierung des Landtages diskutiert. Im Mittelpunkt der Diskussion steht dabei vor allem die Repräsentationsfunktion des Plenargebäudes, die Informationsmöglichkeiten für die Öffentlichkeit und die Büros der Abgeordneten insbesondere in den Dachräumen. Nach einem Architekturwettbewerb im Jahr 2001 und einem Scheitern der Entscheidung über einen Neubau vor der Landtagswahl im Jahr Februar 2003 beschloss der Landtag im Mai 2004 mit großer Mehrheit die Umsetzung eines deutlich reduzierten Projektes, das bis Ende 2006 umgesetzt sein soll. Wesentlicher Baustein des Konzeptes ist dabei der Abriss und Neubau des Plenarsaals und die Ertüchtigung von Büroräumen.

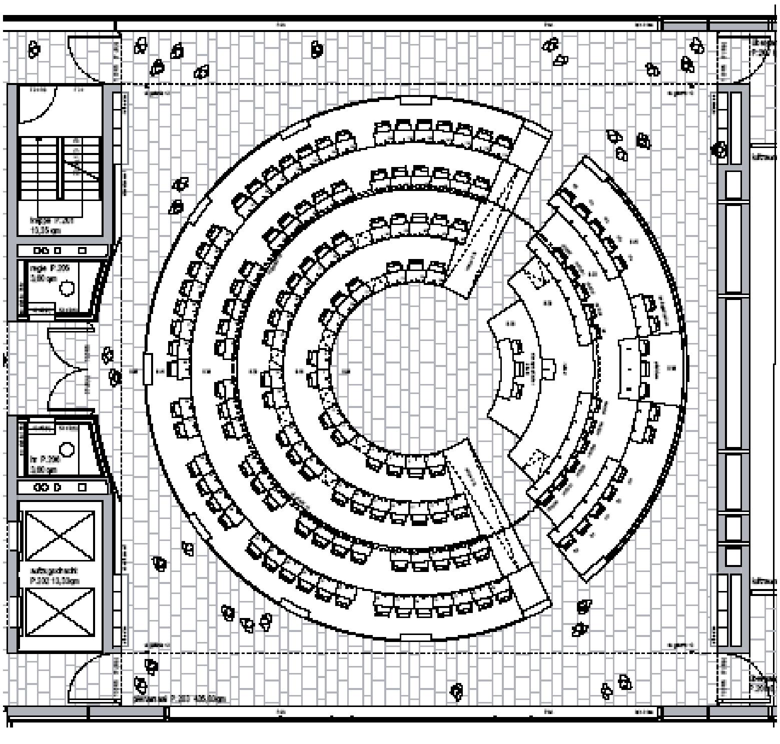

Abb.4: Zukünftiger Plenarsaal des Hessischen Landtages (Hessischer Landtag, 2004, S. 3)

Im Plenarsaal und den neuen Besprechungsräumen sollen aktuelle Informationstechnologien installiert werden. Insbesondere sollen die Abgeordnetenplätze im Plenarsaal für den Einsatz mobiler Rechner ausgestattet werden. In den Besprechungsräumen sind darüber hinaus fest installierte aktuelle Präsentationstechniken vorgesehen. Der neu geplante Plenarsaal zeichnet sich durch eine kreisförmige Anordnung der Sitzreihen aus (siehe Abbildung 5).

Insgesamt ist zu erwarten, dass mit der Erweiterung der technischen Möglichkeiten durch den Landtagsumbau der Einsatz von aktuellen Präsentationstechniken in den Ausschusssitzungen zunehmen wird. Für die Plenarsitzungen ist dagegen keine deutliche Änderung zu erwarten. Durch die verbesserte informationstechnische Ausstattung der Abgeordnetenplätze verbessern sich lediglich die Zugriffsmöglichkeiten auf das Landtagsnetzwerk. Eine informationstechnische Neuausstattung speziell für die Nutzung räumlicher Informationen ist nicht geplant. Auch eine zielgerichtete Strategie zur Steigerung der Kompetenzen zum Umgang mit räumlichen Informationen der Akteure ist nicht vorgesehen. Die geringe Änderung der Arbeitsweise der Abgeordneten durch den Landtagsumbau wurde in den Interviews von den Abgeordneten bestätigt

(Interviews, 2004).

Wesentliche Impulse für die internen Abläufe und die Informationsbeschaffung sind durch die eGovernment-Initiaitven des Bundes (siehe ausführlich BMI, 2004) und des Landes Hessen zu erwarten. Im E-Government-Masterplan Hessen 2003 – 2008 (Lemke, 2003, S. 8) ist als Grundlage aller eGovernment-Verfahren der Aufbau einer harmonisierten eGovernment-Infrastruktur mit folgenden Schwerpunkten vorgesehen:

Die Schaffung eines einheitlichen Netzwerkes für alle Dienststellen der Hessischen Landesverwaltung,

die **Einrichtung eines harmonisierten Verzeichnisdienstes**, der alle Mitarbeiterinnen und Mitarbeiter in den unterschiedlichen Dienststellen der Hessischen Landesverwaltung umfasst und Grundlage einer **Public-Key-Infrastructure** (PKI) ist, um die elektronische Signatur und Verschlüsselung im Rahmen einer harmonisierten **E-Mail-Infrastruktur** sicherzustellen,

die Installation des **zentralen Portals** *„hessen.de"* als Grundlage einer Harmonisierung des Internetauftritts aller Ressorts der hessischen Landesverwaltung und nachgeordneter Dienststellen, einschließlich eines Portals für die Mitarbeiterinnen und Mitarbeiter und

die Etablierung eines z**entralen Dokumentenmanagements** als Grundlage ressortübergreifender Sachbearbeitung in allen Dienststellen der Hessischen Landesverwaltung.

Für den Bereich der räumlichen Informationen ist das Ziel, ein ressortübergreifendes Geoinformationssystem zu etablieren (Lemke, 2003, S. 15), von besonderer Bedeutung.

Bei aller Skepsis gegenüber der Umsetzung von IT-Großprojekten (siehe auch Krempl, 2004, S. 218ff) ist davon auszugehen, dass sich in den nächsten fünf Jahren die Nutzungsmöglichkeiten für elektronische Informationssysteme in der Arbeit des Hessischen Landtages deutlich erweitern werden. Damit ist auch die verstärkte Nutzung räumlicher Informationen für die politische Entscheidungsfindung verbunden.

5 FALLBEISPIEL VORSORGENDER HOCHWASSERSCHUTZ

Durch die Hochwasserereignisse am Rhein Mitte der 1990er Jahre wurde der Umgang mit Hochwasser zumindest in Fachkreisen bis hin zur europäischen Ebene intensiv diskutiert. Durch Finanzmittel der EU konnten u.a. mit dem Programm IRMA (INTERREG Rhine-Meuse Activities) zahlreiche transnationale Projekte angestoßen werden (siehe IRMA, 2004). Mit den Hochwasserereignissen an der Oder und insbesondere an der Elbe wurde der Hochwasserschutz auch zu einem Thema einer breiten politischen Diskussion (siehe ausführlich Dapp, 2002, S. 20ff). Im Hessischen Landtag (seit 2003 absolute Mehrheit der CDU, 1999-2003 CDU und FDP) sind dabei als Schwerpunkte die Novellen des hessischen Wassergesetzes in den Jahren 2002 und 2004 (laufend) und die Diskussion zum Verhalten Hessens zum Hochwasserschutzgesetz des Bundes (Mehrheit SPD und BÜNDNIS 90/DIE GRÜNEN) im Bundesrat (Mehrheit CDU-geführter Landesregierungen) im Jahr 2004 zu sehen. Dabei hatten und haben zwei Fragen besondere Bedeutung:

- Ist ein Bauverbot in Überschwemmungsgebieten notwendig?
- Ist ein Ackerbauverbot in Überschwemmungsgebieten bzw. in den erosionsgefährdeten Abflussbereichen erforderlich?

Beide Fragestellungen haben offensichtlich einen großen Raumbezug und bieten sich deshalb als Fallbeispiel für die Fragestellung an.

Mit der Novelle des Hessischen Wassergesetzes im Sommer 2002 wurde durch die damalige CDU/FDP-Landesregierung die Regelung für die Bebauung von Überschwemmungsgebieten verändert. Bis zu diesem Zeitpunkt war eine Bebauung der Überschwemmungsgebiete in Hessen generell untersagt und Ausnahmen mussten in jedem Einzelfall durch die Obere Wasserbehörde genehmigt werden. Mit der neuen Regelung wurde die Entscheidung über die Bebauung einschließlich der Neuausweisung von Baugebieten innerhalb der im Zusammenhang bebauten Ortsteile in die Verantwortung der Gemeinden übergeben. Die Gemeinden können seitdem in eigener Verantwortung über die für die Bebauung besonders relevanten Bereiche der Überschwemmungsgebiete entscheiden.

Von Seiten der Regierungsfraktionen wurde die Steigerung der Souveränität der Gemeinden positiv hervorgehoben. Von der Opposition wurde auf die höhere Fachkompetenz und die größere Unabhängigkeit der Oberen Wasserbehörde gegenüber Investoren hingewiesen. Trotz der Oder-Flut im August 2002 wurde der von der Landtagsfraktion von BÜNDNIS 90/DIE GRÜNEN vorgelegte Antrag zur Änderung des Hessischen Wassergesetzes für einen verbesserten Hochwasserschutz u.a. durch die Wiederherstellung des Bauverbotes in Überschwemmungsgebieten mit der Mehrheit von CDU und FDP am 25. September 2002 abgelehnt. In der Diskussion wurde nicht auf die konkreten räumlichen Auswirkungen der vorgeschlagenen Änderungen in Hessen eingegangen. Weder konnte von Seiten der Befürworter der Aufgabenverlagerung auf die Gemeinden der konkrete Bedarf nachgewiesen werden noch wurde von Seiten der Gegner eine Abschätzung des zusätzlichen Schadenspotenzials oder vergleichbare räumliche Informationen eingefordert. Die parlamentarische Debatte konzentrierte sich neben der Begründung der geforderten Änderung mit dem abstrakten Gefährdungspotenzial vor allem auf die Bereitstellung finanzieller Mittel für den Deichbau durch die CDU/FDP-Landesregierung und ihrer Vorgängerregierung (SPD und BÜNDNIS 90/DIE GRÜNEN), das Problembewusstsein und die Kompetenz der Gemeinden und den Vorwurf der Instrumentalisierung der Betroffenen der Elbe-Flut. Zusammenfassend lässt sich feststellen, dass die Diskussion für eine Veränderung der Zuständigkeit für die Bebauung von Überschwemmungsgebieten ohne konkrete räumliche Informationen geführt wurde. So wurde in den Diskussion weder darauf Bezug genommen, welche Regionen oder Gemeinden einen besonders großen Bedarf für eine Veränderung haben, noch wurde herausgearbeitet für welche Regionen oder Gemeinden besondere Risiken durch die Neuregelung befürchtet werden. Es wurde lediglich ein Fallbeispiel für einen Hallenbau in einem Überschwemmungsgebiet angeführt (Plenarprotokolle 15/113 und 15/116, 2002).

Zur Vorbereitung der Diskussion der Novelle des Hessischen Wassergesetzes 2004 wurde von der Opposition die Landesregierung in einer Kleinen Anfrage (Drucksache 16/2537) vom 13. Juli 2004 dazu aufgefordert, über die Erfahrungen mit der Neuregelung der Bebauung von Überschwemmungsgebieten zu berichten. Bei der Beantwortung Mitte November verwies die Hessische Landesregierung darauf, dass sie keine Auswertung über die Bauleitplanung in Überschwemmungsgebieten durchführt und deshalb im Rahmen einer Kleinen Anfrage nicht detailliert auf die Fragen eingehen kann. Als Beantwortung verweist die Landesregierung lediglich auf die bundesrechtlich geregelte Beteiligung der Wasserbehörden als Träger öffentlicher Belange.

Die Frage nach Überschwemmungsgebieten innerhalb geschlossener Ortschaften beantwortet die Landesregierung durch eine Flächenberechnung auf Basis einer Verschneidung der ATKIS Kategorie Ortslage mit den vorliegenden Überschwemmungsgebietsgrenzen. Dabei wird weder die Definition der ATKIS-Ortslagen erläutert noch auf entstehende Probleme durch unterschiedliche Maßstabsebenen und Erfassungszeiträume hingewiesen. Die Verwendbarkeit der Aussagen wird zusätzlich durch die derzeit begrenzte digitale Verfügbarkeit der Abgrenzungen der Überschwemmungsgebiete eingeschränkt.

Kontrovers diskutiert wurde seit Juni 2004 das Abstimmungsverhalten des Landes Hessen im Bundesrat zum Hochwasserschutzgesetz des Bundes. Die CDU-Landesregierung in Hessen lehnt den von der Bundesregierung (SPD und BÜNDNIS 90/DIE GRÜNEN) vorgelegten Entwurf eines Hochwasserschutzgesetzes insbesondere wegen des vorgesehenen langfristigen Verbotes des Ackerbaus und des Bebauungsverbotes in Überschwemmungsgebieten ab (MULV, 2004). Die in der Diskussion von der Landesregierung im Juni vorgetragenen Zahlen über die betroffenen Ackerbauflächen (30.000ha) wurden von BÜNDNIS 90/DIE GRÜNEN massiv in Zweifel gezogen. Die Landesregierung wurde mit Hilfe eines Dringlichen Berichtsantrags (Drucksache 16/2413) aufgefordert, die Zahlen zu belegen und räumlich zu konkretisieren. Dabei musste sie eingestehen, dass ihr keine konkreten Zahlen vorliegen, die genannten Zahlen jedoch zu hoch sind (ULA-Protokoll, 2004). Trotzdem wurden diese Zahlen von der Landesregierung weiter als Argument für die Ablehnung im Bundesrat angeführt. Die Landesregierung wurde daraufhin in einer Kleinen Anfrage (Drucksache 16/2538) zu den tatsächlich betroffenen Flächen befragt. In der Beantwortung benennt die Landesregierung die genutzten digitalen Datenbestände (z.B. das Retentionskataster Hessen bzw. das Amtliche topographische Karteninformationssystem ATKIS). Eine Erläuterung zur Qualität der Daten (z.B. Aktualität, Auflösung, Definition der Flächenzuordnungen) erfolgt dagegen nicht. Als Ergebnis stellt die Landesregierung fest, dass sie für 969km von ca. 4300km im Retentionskataster Hessen erfassten Gewässerkilometern konkrete Aussagen treffen kann. Diese Gewässerabschnitte verfügen über eine Überschwemmungsgebietsfläche von 124km^2. Davon entsprechen 58km^2 der Landnutzungskategorie „Acker“ nach ATKIS. Von diesen „Acker“-Flächen liegen 10,3km^2 innerhalb der abflusswirksamen Bereiche (siehe Drucksache 16/2538).

Für die betrachteten Bereiche bedeutet dies, dass lediglich 18 Prozent der Ackerbaufläche in den Überschwemmungsgebieten tatsächlich von einem Ackerbauverbot betroffenen wären. Auch wenn eine direkte Übertragung auf alle Überschwemmungsgebiete in Hessen nicht möglich ist, so zeigt sich doch, dass die von der Landesregierung genannten Zahlen deutlich nach unten korrigiert werden müssen. Neben der inhaltlichen Klarstellung zeigt der zeitliche Ablauf der Beantwortung des Dringlichen Berichtsantrags und der Kleinen Anfrage die Wichtigkeit für die politischen Akteure, selbst über räumliche Informationen verfügen zu können. Alle Berechnungen für die Kleine Anfrage wurden auf Basis bei der Landesregierung vorhandener digitaler Datenbestände angefertigt. Trotzdem sah sich die Landesregierung am 1. Juli nicht in der Lage, die Fragestellung im Rahmen eines Dringlichen Berichtsantrags vom 24. Juni 2004 zu beantworten. Die Kleine Anfrage vom 13. Juli wurde Ende Dezember 2004 beantwortet. Selbst bei einer Vernachlässigung der Sommerpause erhielt die Fragestellerin erst nach über drei Monaten eine Antwort auf Ihre Fragen. Für die aktuelle politische Diskussion ließen sich die Ergebnisse deshalb nicht nutzen.

In der Debatte im Rahmen der Einbringung des Gesetzentwurfs zur Novelle des Hessischen Wassergesetzes im Oktober 2004 durch die hessische Landesregierung wurden die Regelungen der unterschiedlichen Themenbereiche intensiv diskutiert. Obwohl von allen Abgeordneten in ihren Beiträgen die Regelungen zum Hochwasserschutz und insbesondere der Überschwemmungsgebiete angesprochen - und je nach politischer Ausrichtung kommentiert - wurden, verzichteten alle Akteure auf eine Darstellung der betroffenen Flächen. Lediglich für die Uferrandstreifen wurde grob auf die Raumwirksamkeit eingegangen, indem über die Breite diskutiert wurde. Dabei wurden jedoch keine Gewässer mit besonderer Relevanz oder räumliche Auswirkungen benannt. Dies ist auch auf die in diesem Fall auf fünf Minuten begrenzte Redezeit zurückzuführen, die eine ausführliche Darstellung von Details erschwert.

Das Fallbeispiel macht deutlich, dass den politischen Akteuren die Wirkung ihrer Diskussionsgegenstände auf den Raum prinzipiell bewusst ist. Gleichzeitig zeigt sich jedoch auch die Bereitschaft, Entscheidungen auch ohne konkrete und detaillierte Auswertungen der räumlichen Wirkungen zu fällen. Obwohl eine vollständige Sicherheit über die Auswirkungen von Entscheidungen bei komplexen Fragestellungen in der Regel nicht möglich und oft auch nicht notwendig ist (siehe ausführlich Dörner, 2000), wird im Fallbeispiel doch deutlich, dass hier in weiten Teilen darauf verzichtet wird, auch vorhandene räumliche Informationen in die politische Diskussion zu integrieren.

Die Analyse der politischen Diskussionen des Fallbeispiels steht teilweise im Widerspruch zu den Ergebnissen der Interviews (2004). Dabei waren alle Befragten der Ansicht, dass die im Fallbeispiel behandelten Fragestellungen eine hohe Raumrelevanz haben. Alle Interviewpartner gaben an, räumliche Informationen im Zusammenhang mit den Fragestellungen genutzt zu haben und betonten die Notwendigkeit von weiteren räumlichen Informationen insbesondere zu den maximalen Auswirkungen von Hochwasserereignissen. Im Gegensatz zu den weitgehend homogenen Antworten zur Raumrelevanz und zur Nutzung von räumlichen Informationen unterschied sich die Einschätzung des Einflusses der räumlichen Informationen auf die Meinungsbildung erheblich. Das Spektrum reichte dabei von „groß“ bis „eher gering“. Dabei besteht kein Zusammenhang mit der Befürwortung oder Ablehnung der Regelungen.

Diese Ergebnisse machen deutlich, dass mit einer „informationstechnische“ Verbesserung alleine keine Steigerung der Bedeutung und Anwendung räumlicher Informationen erreicht werden kann. Zusätzlich ist eine Steigerung der Motivation und Kompetenz für den Umgang mit räumlichen Informationen notwendig. Dabei können und sollen informationstechnische Hilfestellungen wie interaktive Tutorials usw. einen Beitrag leisten.

Das Fallbeispiel verdeutlicht auch die derzeit eingeschränkte Verwendbarkeit räumlicher Informationen durch die politischen Akteure. Da sie in vielen Fällen im Bereich der räumlichen Informationen darauf angewiesen sind, Fragestellungen auf dem zeitaufwändigen Weg einer Anfrage zu bearbeiten, besteht ein bedeutendes Nutzungshemmnis für den Einsatz in der oft auf aktuelle Informationen angewiesenen politischen Diskussion. Darüber hinaus zeigt sich, dass aus der Beantwortung der Fragen oft neue Fragestellungen entstehen. Eine eigenständige Bearbeitung durch die politischen Akteure könnte diesem Problem begegnen. Dafür müssten jedoch sowohl die dafür erforderlichen Kompetenzen vermittelt und notwendige Tools bereitgestellt als auch die Daten geeignet aufbereitet werden, so dass eine einfache und gleichzeitig sachgerechte Nutzung sichergestellt wird. Mit der derzeitigen technischen Ausstattung und dem Aufbereitungs- und Bereitstellungsstand der Daten, der fast ausschließlich auf die verwaltungsinterne Nutzung zugeschnitten ist, lässt sich eine solche Nutzung durch die politischen Akteure in den Themenbereichen des Fallbeispiels nicht umsetzen. Dafür müssten insbesondere die Datenbestände erheblich aufbereitet werden. Projekte dazu wurden durch die Hessische Landesregierung begonnen (siehe Drucksache 16/2538, Fragen 10 und 11).

6 FAZIT

6.1 Geringe Verwendung räumlicher Informationen

Die Beschreibung der politischen Diskussion im Hessischen Landtag macht deutlich, dass diese Diskussionen im Plenum und in den Ausschüssen auf Texten unterschiedlicher Länge in Form von Landtagsdrucksachen basieren. Ein weitergehender Einsatz von Medien erfolgt durch die Abgeordneten selbst bzw. auf Anregung der Abgeordneten. Während sich dies im Plenum auf Grund der Ausstattung vor allem auf die Präsentation von Materialien als rhetorische Geste beschränkt (siehe Abbildung 6), werden in den Fachausschüssen teilweise Informationen visualisiert.

Abb.6: Der Vorsitzende der Fraktion von BÜNDNIS 90/DIE GRÜNEN Tarek Al-Wazir erläutert in der Plenarsitzung am 24. November 2004 die räumliche Verteilung der Inanspruchnahme der Eigenheimzulage (Heibel, 2004)

Während die politische Diskussion zum weit überwiegenden Teil textbasiert ist, orientiert sich die Fachdiskussion insbesondere im Umweltbereich zu einem großen Teil an räumlichen Informationen in Kartenform und nutzt die Möglichkeiten zeitgemäßer Informationstechnologien insbesondere im Bereich Geographischer Informationssysteme. Auf fachlicher Ebene herrscht Einigkeit, dass die Bedeutung räumlicher Informationen im Umweltbereich sehr hoch ist und in vielen Fällen regionalisierte bzw. räumlich differenzierte Betrachtungsweisen sinnvoll bzw. notwendig sind.

Insgesamt lässt sich feststellen, dass im Rahmen der parlamentarischen Arbeit eine den aktuellen technischen Möglichkeiten entsprechende Analyse und Präsentation räumlicher Informationen nicht erfolgt.

Für die Vorbereitung der parlamentarischen Arbeit werden die vorhandenen räumlichen Informationen nur in geringem Umfang genutzt. Eigenständige Analysen der parlamentarischen Akteure sind nur über den zeitaufwändigen Weg von Anfragen möglich, was die Nutzungsmöglichkeit für die aktuelle politische Debatte erheblich einschränkt. In der Regel stehen lediglich der Verwaltung für die Vorbereitung parlamentarischer Entscheidungen Geographische Informationssysteme zur Verfügung. In Einzelfällen wird in der politischen Debatte mit zusammenfassenden Rauminformationen wie Gesamtflächen argumentiert, die räumliche Verteilung spielt dabei in der Regel keine Rolle.

Eine Ausnahme bildet lediglich die „Betroffenheit“ von Wahlkreisen. Hier wird von verschiedenen Abgeordneten Wert darauf gelegt, dass „ihr“ Wahlkreis explizit benannt bzw. hervorgehoben wird.

6.2 Anforderungen an räumliche Informationen für die politische Diskussion

Die Anforderungen an räumliche Informationen - insbesondere die Genauigkeitsanforderungen und die Anforderungen an die Aktualität - für die politische Diskussion hängen wie für andere Anwendungsfelder auch von der jeweiligen thematischen Fragestellung und von der Betrachtungsebene (z.B. lokal, regional, national, international) ab. Im Unterschied zu Fachdiskussionen, in denen diese Anforderungen in der Regel zu Beginn festgelegt werden, bilden solche Definitionsfragen in der politischen Diskussion die Ausnahme. Oft wird in politischen Diskussion der Eindruck erweckt, Entscheidungen ließen sich nur mit tagesaktuellen und möglichst detaillierten Informationen treffen. Dabei wird teilweise versucht, dem politischen Gegner zu unterstellen, er verfüge über veraltete oder nicht hinreichend genaue Informationen. Dabei wird selten darüber reflektiert, welche Aktualität und Genauigkeit notwendig ist. Mit Hilfe von geeigneten Metadaten muss sichergestellt werden, dass die Daten sachgerecht ausgewählt werden können. Darüber hinaus sind für die politische Debatte die Herkunft der Daten und damit die mögliche Interessen der Erhebenden von erheblicher Bedeutung. Diese Informationen müssen mit Hilfe der Metadaten leicht zu ermitteln sein, was bei den derzeitigen Datenbeständen nur teilweise möglich ist.

Ein wesentlicher Faktor für die Nutzbarkeit von Informationen - insbesondere auch räumlichen Informationen - ist eine geeignete Aufbereitung der Informationen. Die Informationen sollten dazu geeignet sein, die Betroffenheit der Bevölkerung von Entscheidungen zu verdeutlichen, zukünftige Trends erläutern und auch parallele Planungen berücksichtigen (z.B. Zusammenführung der Ausweisung von Gewerbebieten, der Ansiedlungsstrategie der Wirtschaftsförderung und möglicher Flächen für die Rückgewinnung von Retentionsraum). Hier bestehen noch erhebliche Defizite. Neben der verbesserten Aufbereitung der Informationen und weiteren Anstrengungen für eine leichtere Benutzbarkeit von Geographischen Informationssystemen ist jedoch auch eine Erweiterung der Kompetenzen der Akteure für die Nutzung räumlicher Informationen notwendig. Insbesondere müssen sie in die Lage versetzt werden, ihre Anforderungen an die räumlichen Informationen so zu formulieren, dass eine gezielte Bereitstellung einfach möglich wird. Eine ausschließlich „technische" Weiterentwicklung im Bereich der Informationstechnologie bzw. der Informationsbestände wird dafür nicht ausreichen.

Besonders relevant für den Einsatz räumlicher Informationen in der politischen Diskussion ist der schnelle und unkomplizierte Zugriff auf die Informationen. Die politische Auseinandersetzung ist in der Regel von sehr kurzfristigen Reaktionen geprägt, so dass die Informationsbeschaffung entsprechend schnell verlaufen muss. Besonders wertvoll sind in diesem Zusammenhang gute Suchmaschinen und übersichtlich aufgebaute Informationsportale. Um einen effektiven Einsatz räumlicher Informationen zu ermöglichen, sind in diesem Bereich erhebliche Verbesserungen notwendig. Für die politischen Akteure muss ein gleichberechtigter Zugriff auf die räumlichen Informationen der Verwaltung ermöglicht werden. Dabei müssen selbstverständlich der Datenschutz der Bürgerinnen und Bürger sowie die berechtigten Geheimhaltungsinteressen der Wirtschaft sichergestellt werden.

6.3 Ausblick

Die zunehmenden regionalen Unterschiede - als Beispiele seien hier nur die sich verstärkenden Unterschiede der Bundesländer, die Stadt-Umland Problematik und die strukturellen Veränderungen im Zuge des Demographsichen Wandels innerhalb der Bundesländer benannt - erfordern auch räumlich differenzierte Problemlösungen. Dies macht es zukünftig noch stärker erforderlich, räumliche Informationen in die politische Diskussion einfließen zu lassen. Dafür muss eine geeignete Informationsinfrastruktur aufgebaut werden, die sicherstellt, dass

die entscheidungsrelevanten Grundlageninformationen flächendeckend vorliegen,

die vorhandenen Informationen den Entscheidungsgremien einfach und kostenfrei zugänglich sind,

die unterschiedlichen Informationen entsprechend der Fragestellung mit geringem Aufwand kombinierbar sind,

durch umfassende Metadaten und eine geeignete Aufbereitung die Informationen für die Beantwortung politischer Fragestellungen nutzbar sind.

Darüber hinaus müssen die politischen Akteure zum Einsatz räumlicher Informationen motiviert und in die Lage versetzt werden, mit diesen sachgerecht umzugehen.

Insgesamt sind die Chancen für eine verstärkte Nutzung räumlicher Informationen in der politischen Diskussion und daraus resultierend auch eine räumlich differenzierterer Umgang mit politischen Fragestellungen gut. Die weiter fortschreitende technische Entwicklung und die umfangreichen Bemühungen zur Umsetzung des eGovernment auf den unterschiedlichen administrativen Ebenen verbessern die informationstechnische Verfügbarkeit der räumlichen Informationen. Die geplante Einführung eines Informationsfreiheitsgesetzes in Deutschland und die Umsetzung der EU Richtlinie zur Umweltinformation (EU Richtlinie 2003/4/EG) in nationales Recht mit dem Gesetz zur Neugestaltung des Umweltinformationsgesetzes im Dezember 2004 verbessern die rechtlichen Rahmenbedingungen erheblich (siehe für den vorsorgenden Hochwasserschutz auch Dapp, 2004, S. 184) und werden dazu beitragen, dass Informationen insbesondere im Umweltbereich einfacher verfügbar werden und stärker als bisher in elektronischer Form über das Internet einfach zur Verfügung stehen.

Neben diesen Voraussetzungen müssen jedoch weitere Randbedingungen für den Einsatz räumlicher Informationen in der politischen Diskussion verändert werden. So stellt sich die Frage, wie es gelingt, die Kompetenzen für den Einsatz räumlicher Informationen bei den politischen Akteuren zu steigern. Eine wesentliche Motivation für den Einsatz räumlicher Informationen in der politischen Diskussion ist die Wirkung auf die Öffentlichkeit. Hier stellt sich die Frage, inwieweit räumliche Informationen öffentlichkeitswirksam für die Vermittlung politischer Fragestellungen einsetzbar sind. Während der zunehmende Trend zur Visualisierung eine Verwendung räumlicher Informationen befördert, steht dem der Trend nach einer immer stärkeren Reduzierung der politischen Aussagen auf mediengerechte „Kernbotschaften" entgegen, der eine differenzierte Betrachtung politischer Fragestellungen immer schwerer macht. Eine weitere Untersuchung dieser Fragestellungen sollte parallel und im engen Bezug zur Weiterentwicklung der informationstechnischen Voraussetzungen erfolgen, um die Anwendung räumlicher Informationen in der politischen Diskussion weiter zu unterstützen.

7 QUELLEN

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Drucksache 16/2413: Dringlicher Berichtsantrag der Abgeordneten Ursula Hammann (BÜNDNIS 90/DIE GRÜNEN) betreffend Aussagen über den Gesetzentwurf zum vorsorgenden Hochwasserschutz der Bundesregierung durch Minister Dietzel vom 24. Juni 2004.

Drucksache 16/2537: Kleine Anfrage der Abgeordneten Ursula Hammann (BÜNDNIS 90/DIE GRÜNEN) betreffend Bauvorhaben in Überschwemmungsgebieten seit der Aufhebung des Bauverbots im Hessischen Wassergesetz im Juli 2002 vom 13. Juli 2004.

Drucksache 16/2538: Kleine Anfrage der Abgeordneten Ursula Hammann (BÜNDNIS 90/DIE GRÜNEN) betreffend Aufwirkungen des von der Bundesregierung vorgelegten Gesetzes zur Verbesserung des vorbeugenden Hochwasserschutzes in Hessen vom 13. Juli 2004.

Drucksache 16/2865: Gesetzentwurf der Landesregierung für ein Zweites Gesetz zur Änderung verwaltungsverfahrensrechtlicher Vorschriften vom 12. November 2004.

Plenarprotokoll 15/113 über die 113. Plenarsitzung der 15. Wahlperiode vom 28. August 2002.

Plenarprotokoll 15/116 über die 116. Plenarsitzung der 15. Wahlperiode vom 25. September 2002.

Plenarprotokoll 16/49 über die 49. Plenarsitzung der 16. Wahlperiode vom 7. Oktober 2004.

Plenarprotokoll 16/50 über die 50. Plenarsitzung der 16. Wahlperiode vom 23. November 2004.

7.3 Interviews

Zur Ermittlung der Nutzung von räumlichen Informationen in der Arbeitspraxis des Hessischen Landtages, zur Rolle von räumlichen Informationen im Rahmen des Fallbeispiels und der Kenntnisse der politischen Akteure über Geographische Informationssysteme wurden die für den Themenbereich Hochwasserschutz zuständige Sprecherin und die zuständigen Sprecher der Fraktionen im Hessischen Landtag sowie der Parlamentarische Referent des Hessischen Ministeriums für Umwelt, Ländlichen Raum und Verbraucherschutz am 25. und 26. November 2004 durch den Autor mit Hilfe eines einheitlichen Frageleitfadens einzeln interviewt. Damit wurden die vorhandenen Quellen und die Erfahrungen des Autors ergänzt und überprüft. Den Befragten wurde eine anonymisierte Verwendung zugesagt, um eine parteipolitische Verwendung der Ergebnisse auszuschließen und damit eine offene Gesprächsatmosphäre zu ermöglichen. Allen Beteiligten dankt der Autor für Ihre Bereitschaft, sich auf die Fragestellungen einzulassen und unvoreingenommen zu antworten. Interviewt wurden Gernot Grumbach; Umweltpolitischer Sprecher der SPD Landtagsfraktion; Ursula Hammann, Sprecherin für Umwelt-, Natur- und Tierschutz der Landtagsfraktion von BÜNDNIS 90/DIE GRÜNEN und stellvertretende Vorsitzende des Ausschusses für Umwelt, Ländlichen Raum und Verbraucherschutz; Heinrich Heidel, Umweltpoltischer Sprecher der FDP Landtagsfraktion und Vorsitzender des Ausschusses für Umwelt, Ländlichen Raum und Verbraucherschutz; Roger Lenhart, Umweltpolitischer Sprecher mit Schwerpunkt Wasser der CDU Landtagsfraktion und Andreas Monz, Parlamentarischer Referent des Hessischen Ministeriums für Umwelt, Ländlichen Raum und Verbraucherschutz.

7.4 Gesetze und Richtlinien

EU-Richtlinie 2003/4/EG des Europäischen Parlaments und des Rates vom 28. Januar 2003 über den Zugang der Öffentlichkeit zu Umweltinformationen.

Geschäftsordnung des Hessischen Landtages vom 16. Dezember 1993 (GVBl. I S. 628) in Kraft gesetzt und geändert durch Beschluss des Landtages vom 5. April 2003 (GVBl. I S. 110).

Gesetz über die Rechtsstellung und Finanzierung der Fraktionen im Hessischen Landtag (Hessisches Fraktionsgesetz) vom 5. April 1993, GVBl. I S. 106.

Gesetz zur Neugestaltung des Umweltinformationsgesetzes vom 22. Dezember 2004, BGBl I, S. 3704ff.

7.5 Sonstiges

Protokoll des Ausschusses für Umwelt, Ländlichen Raum und Verbraucherschutz (ULA) vom 1. Juli 2004, nicht öffentlich.

Einbindung einer Wissensbasis in GIS

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1 EINLEITUNG

In einem Planning Support System (PSS) wird im Regelfall Expertenwissen aus sehr verschiedenen Fachdisziplinen vorgehalten. Expertenwissen wird benötigt, um Planungsentscheidungen fundiert unterstützen zu können. Hieraus ergibt sich folgende zentrale Fragestellung: Wie funktioniert der Zugriff auf das Wissen? Bei FLUMAGIS - als Beispiel eines solchen PSS im Bereich des Flusseinzugsgebietsmanagements - handelt es sich um ein spezialisiertes GIS, das neben den üblichen Analyse-Funktionen zusätzliche enthält, die fachlich begründete Methoden in sich bergen. Wir setzen in diesem Papier voraus, dass dieses Experten-Wissen in einer Wissensbasis angelegt wird und fokussieren die Fragestellung, wie das GIS auf die Wissenbasis zugreift.

FLUMAGIS ist eine Software, die das Gewässereinzugsgebietsmanagement unterstützt. Es ergeben sich hier besondere Anforderungen an die Planungspraxis, da die Europäische Union anhand der Wasserrahmen-Richtlinie (EU-WRRL) (http://europa.eu.int/scadplus/leg/de/lvb/l28002b.htm) bestimmte Planungsvorgaben gemacht hat. Um diesen Anforderungen gerecht werden können, muss das Experten-Wissen aus einer Vielzahl von Fachdisziplinen eingebracht und nutzbar gemacht werden. Als Ausgangsbasis dient in FLUMAGIS ein klassisches Geoinformationssystem (GIS), das um spezielle Fähigkeiten erweitert wird.

So können Simulationsmodelle und Berechnungen angestoßen werden, die es dem Benutzer (Planungsexperten aber eingeschränkt auch Laien) ermöglicht, bestimmte spezifische Funktionen betreffend der Bewertung des Zustands eines Gewässers auszuführen.

Dabei handelt es sich um
1.) die Darstellung des Ist-Zustands
2.) die Feststellung von Defiziten
3.) die Erstellung einer angepassten Maßnahmenauswahl
4.) eine prognostizierende Bewertung der Maßnahmen, die vom Nutzer ausgewählt wurden.

Der ermittelte Zustand kann für Berichte verwendet werden und für die Planung von Maßnahmen eingesetzt werden. Es ist anzumerken, dass das System nicht die Planung selbst machen soll, sondern den Planer eine möglichst breite und fundierte Auswahl von Alternativen zur Verfügung stellen soll, damit dieser durch Versuch und Irrtum zu einer bestmöglich abgewägten Lösung kommen kann (vgl. Möltgen 2002).

Um Expertenwissen in dieser Form nutzbar zu machen, ist es erforderlich, die verschiedenen Fachgebiete übergreifend und zusammenhängend formal zu beschreiben. Im Umfeld der Informatik hat sich in diesem Zusammenhang die 'analytische Ontologie' herausgebildet, die eine Lehre von grundlegenden Kategorien und Zusammenhängen ist. Sie findet und beschreibt solche und identifiziert Attribute oder Entitäten. Das menschliche Verständnis der Welt steht dabei im Mittelpunkt, also die Semantik.

Der Begriff 'Ontologie' wird in diesem Papier wie folgt verwendet: Eine Ontologie ist im Bereich der Wissensrepräsentation ein formal definiertes System von Dingen und/oder Konzepten und Relationen zwischen diesen Dingen. Zusätzlich enthalten Ontologien Regeln. Über diese allgemeine Definition hinaus ist für das Verständnis dieses Papiers kein weiteres Wissen über diesen Begriff notwendig, da dies nicht Gegenstand des Papiers ist (vgl. Sowa 2000).

In der praktischen Anwendung werden benötigte Regeln für die Anwendungsdomäne identifiziert und in der Wissensbasis als Module verfügbar gemacht, die ihrer Bedeutung entsprechend verknüpfbar sind. Fachexperten können diese noch nicht miteinander in Beziehung stehenden Module anhand einer grafischen Oberfläche dazu nutzen, ihr Wissen zu formalisieren. Dazu sind keine weiteren Programmierungen notwendig. Somit kommen bestimmte Regeln in Zusammenhang mit der jeweiligen Bedeutung, die den Modulen zugeordnet ist, zur Anwendung. Im Beispiel FLUMAGIS werden zusätzliche Datenbestände benötigt, die Informationen über die betrachteten Gegenstände enthalten. Man geht hierbei davon aus, dass bestimmte Objekt-Informationen in Form von Datenbanken verfügbar sind. Dieses Wissen ist jedoch nicht mit dem konzeptionellen Wissen zu verwechseln, das zum Aufbau der Wissensbasis benötigt wird.

2 FLUMAGIS - DATEN-MODELLE IN GIS UND WISSENSBASIS

Das Forschungsprojekt FLUMAGIS war für die Erstellung des Prototypen auf ein räumlich begrenztes Projektgebiet beschränkt, um die Durchführbarkeit des Projektes sicher zu stellen. Somit gab es zunächst einen eingeschränkten Katalog von Fragestellungen und entsprechende Methoden, um diese zu beantworten. Es kommen nur sehr bestimmte Gewässertypen und Lebensgemeinschaften im Projektgebiet vor. Da eine mandatorische Anforderung die Erweiterbarkeit um weiteres Expertenwissen war, wurde von Anfang an darauf gesetzt, eine Wissensbasis zu verwenden, die eine ontologische Beschreibung der fachlichen Zusammenhänge zulässt, ohne diese jedoch 'hart' in Form von Programm-Code zu programmieren. Das heißt, dass grundlegende Kategorien von bestimmten Gegenständen in der realen Welt gebildet und deren Verhalten zueinander in abstrakter Form beschrieben wurden. Die Wissensbasis wurde dabei so gestaltet, dass konkrete Bezüge herstellbar und somit eine Abfragbarkeit gegeben ist (vgl. Borchert 2004). Die Umsetzung der Wissensbasis selbst ist nicht Gegenstand dieses Textes, sondern ihre Anbindung an das GIS. Sie ermöglicht die spätere Ausdehnung auf andere Regionen, die ein breiteres Fachwissen erfordern. Dieses Fachwissen wird dann durch Experten in der Wissensbasis ergänzt werden. Es ist zu erwarten, dass der Aufwand hierfür jedoch erheblich geringer sein wird, als für die Erstellung der ersten Wissensbasis, da das Grundgerüst der Ontologie allgemein und erweiterbar gehalten ist.

Um eine möglichst gute Wiedernutzbarkeit der einzelnen Komponenten von FLUMAGIS zu erreichen, wurde von Anfang an auf komponenten-basierte Entwicklung gesetzt (s. Abb. 1). Da die Wissensbasis für Planungsfälle an Ems und Aa im Münsterland sehr umfangreich ist und die Startzeit dieser Komponente etwa eine Minute benötigt, wurde sie schon während der Projektlaufzeit serverseitig angebunden und für den Mehr-Benutzer-Zugriff vorbereitet. So musste eine genaue Unterscheidung der Funktionalitäten von Wissensbasis und GIS getroffen werden. Die Entwicklung einer recht lose gekoppelten Applikation, die es ermöglicht schwergewichtige Komponenten in entsprechend optimierten Umgebung laufen zu lassen, war von Anfang an Maxime des Projektes.Dies verursachte zunächst einen erheblichen Mehraufwand, stellte jedoch gerade zu Ende des Projektes eine sehr wichtige und vereinfachende Kernfähigkeit des Gesamt-Systems dar.

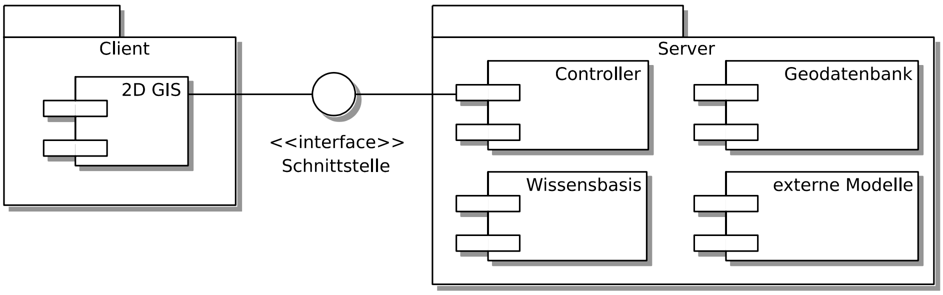

Abb. 1: Komponenten von FLUMAGIS (Quelle: Eigene Darstellung)

Dies soll Anhand eines Anwendungsfalls aus FLUMAGIS beschrieben werden, der die Defizit-Analyse bezüglich der Gewässer-Strukturgüte enthält. Der Nutzer erhält zunächst eine Gesamtübersicht über eine Region, in der er sich dann ein Untersuchungsgebiet auswählen kann. Dies kann er im einfachsten Fall anhand der Festlegung eines Auswahlrahmens tun. Bei dieser Tätigkeit kommt die Umsetzung des Maßstabswechsels, der in der WRRL für Berichte festgelegt ist, zum Einsatz. Dies ermöglicht die Verwendung stark unterschiedlicher Maßstäbe. Ist das Zielgebiet gewählt, kann der Benutzer zunächst Defizitfestellungen für unterschiedliche Fachdomänenen machen, die letztendlich allesamt im Zusammenhang mit dem Gewässer selbst stehen. Zu diesem Zeitpunkt, wird das erste Mal die Wissensbasis aufgerufen. Die zur Beantwortung der Fragestellung jeweils benötigten Informationen werden dann durch das GIS zusammengestellt, an die Wissensbasis-gesendet und dort analysiert. Die Wissensbasis sendet die ermittelten Defizite wieder an das GIS, das im Nachgang eine Visualisierung erzeugt. Der Nutzer kann die Defizite betrachten und eine Wissensbasis-gestützte Prognose durchführen. Die Ergebnisse erscheinen wiederum im GIS und der Benutzer kann sich nun Maßnahmen-vorschläge, die an bestimmte Defizite gekoppelt sind, vorschlagen lassen, die ebenfalls in der Wissensbasis organisiert sind. Nachdem er bestimmte Maßnahmen ausgewählt hat, kann anhand der direkt im GIS geänderten Geodaten eine Maßnahmen-Prognose gemacht werden, die eine Bewertung der erstellten Planungsvariante ermöglicht. Zur Erstellung bestimmter Analysen kann sich die Wissensbasis weiterer Simulationsmodelle bedienen, die entweder extern als weitere Komponente verfügbar gemacht werden (z.B. Simulations-Modelle) oder intern als eigens implementierte Simulation zur Anwendung kommen.

Die anhand von Experten-Interviews und Literaturrecherche erstellte Anforderungs-Analyse zeigte nicht nur auf, welche Funktionalitäten insgesamt benötigt werden. Bei der Gestaltung der Komponenten konnte eine Trennung der benötigten Daten und Funktionen festgestellt werden, die bis auf wenige Ausnahmen die zu Beginn des Projektes formulierte Maxime "keinen Monolithen zu erzeugen" in den Bereich des Machbaren rückte. Beispielsweise kann die Wissensbasis weitgehend ohne räumliche oder geometrische Informationen auskommen - nur in einigen Fällen wird die Topologie des Gewässer-Netzes oder anderer Geo-Objekte benötigt. So kann auf die Übermittelung von großen Geometrie-Datenmengen verzichtet und eine gut erweiterbare spezialisierte Analyse-Fähigkeit des GIS erstellt werden. Wie sich die Modelle unterscheiden, soll im nächsten Kapitel erörtert werden.

3 DIFFERENZIERUNG DER DATENMODELLE IN GIS UND WISSENSBASIS

Die Geodatengrundlage in FLUMAGIS besteht aus Geobasisdaten aus der Planungspraxis, die in einer Geodatenbank vorgehalten werden. Hierbei handelt es sich um Raster- und um Vektordaten. Die Rasterdaten lassen sich unterscheiden in 2D-Kartenwerke, die zur besseren Orientierung des Betrachters dienen und Höhen-Raster, die zur hydrologischen Berechnung und für die 3D-Visualisierung eingesetzt werden. Die Vektordaten sind 0-, 1- und 2-dimensional und repräsentieren beispielsweise punktförmig erhobene Informationen oder linienhaft den Verlauf des Gewässers oder die Nutzung von Flächen. Wie üblich sind Vektordaten in relationalen Datenbanken angelegt und enthalten in jeder Tabellen-Zeile eine Entität mit einer Geometrie, einer thematisch festgelegte Anzahl von möglichen Attributen und ein eindeutiges Schlüsselfeld. Die Themen sind ebenfalls klassisch in Layern organisiert.

Die beschriebenen Inhalte geben somit Geometrie, Topologie und Attribute in Form von Texten oder Zahlen wieder - deren Bedeutung bzw. Semantik jedoch zunächst einmal nicht näher festgelegt ist. Wie im UML-Sequenz-Diagramm (Abb 3) sichtbar wird, ist die erste Funktion, die der Nutzer in einem Planungsprozess durchführt, die Darstellung des Ist-Zustands, die ihm die Betrachtung der Daten (Daten-Exploration) ermöglicht. Für diesen ersten Schritt ist der Zugriff auf die Wissensbasis noch nicht erforderlich, lediglich eine grobe semantische Beschreibung der Daten genügt, um eine entsprechende Organisation der Ansicht im GIS zu ermöglichen. Diese Information gibt wieder, welcher Datensatz bzw. Layer welchem Themen-Gebiet zuzuordnen ist. Da diese Information auch für die spätere Kommunikation mit der Wissensbasis benötigt wird, wurde das oben beschriebene Modell erweitert. Welche Layer welche Bedeutung haben, ist somit komponentenübergreifend für GIS und Wissensbasis in Form einer Kategorisierung festgelegt und der Benutzer muss, wenn er neue Layer einbindet, diese den entsprechenden Kategorien zuordnen. Wir nennen dies im Weiteren 'semantische Grobbeschreibung' des Layers.

Schon bei der darauf folgenden Defizit-Analyse stößt das GIS jedoch an die Grenzen seiner Funktionalität: Hierzu reicht die reine GIS-Analyse nicht aus, da sich vielschichtige Bedeutungszusammenhänge für die jeweilige Entität ergeben, die im GIS nur durch aufwändige zusätzliche Programmierung nutz- bzw. abfragbar gemacht werden könnten. Die funktionale Erweiterung des GIS auf diese Weise verbietet sich jedoch aufgrund der wie oben dargestellt geforderten Erweiterbarkeit für andere Projektgebiete.

In der Wissensbasis werden neben den Modellen für die physischen Objekte aus der realen Welt Modelle für die fachlichen Zusammenhänge derselben (also das Expertenwissen) geschaffen. Vereinfachend kann man sagen, dass die Geoobjekte in einen größeren Bedeutungszusammenhang gestellt werden. Eine Besonderheit hierbei ist, dass diese Zusammenhänge nicht nur deskriptiv als Ontologie abgelegt werden, sondern entsprechend ihren kausalen Zusammenhängen in Beziehung gesetzt werden können. So wird es möglich, Ursachen und Folgen von Zuständen und Veränderungen festzustellen (Borchert 2004). Die Modelle der Wissensbasis für die physikalischen Objekte unterscheiden sich von den Geoobjekt-Modellen dadurch, dass sie keine geometrischen Informationen enthalten, jedoch durchaus die (benötigten) Attribute und bei Bedarf auch die Information über topologische Zusammenhänge der Objekte (s. Abb. 2). Die oben erwähnte semantische Grobbeschreibung von bestimmten Layern stimmt mit der aus dem GIS überein und so können unter Hinzunahme der ebenfalls übernommenen Schlüsselfelder Objekte eindeutig identifiziert bzw. neu erstellte Objekte auf einen eindeutigen Ursprung zurückgeführt werden. Somit sind Redundanz-Probleme in der Datenhaltung ausgeschlossen.

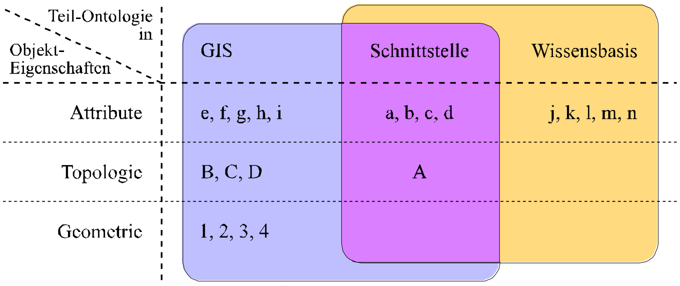

Abb. 2: Unterschiedliche Modell-Eigenschaften in GIS und Wissensbasis (Quelle: Eigene Darstellung)

Beide Komponenten (GIS und Wissensbasis) verfügen über eine Anzahl von gegenseitigen Funktionsaufrufen, die es der jeweiligen Komponente ermöglichen, ihre Aufgaben zu erfüllen (siehe nächstes Kapitel). Die Schnittstelle zwischen den beiden Komponenten bildet diese Funktionsaufrufe ab und verwendet zur Parametrisierung der Abfragen eine Schnittmenge aus den beiden Daten-Modellen bzw. einen Teil der Ontologie, die beiden Komponenten gemein ist. Es handelt sich hierbei um ein reduziertes Geoobjekt-Modell, das eindeutige Schlüssel und bestimmte Attribute enthält.

Als Beispiel für ein von verschiedenen Funktionen verwendetes Datenmodell wird die Defizit-Festellung für die Strukturgüte eines Gewässers dargestellt. Die benötigten Informationen können im Wesentlichen an den Gewässerabschnitten festgemacht werden. Diese werden duch Punkte repräsentiert, die eindeutige Zugriffs-Schlüssel (in zwei Attribut-Tabellen-Spalten enthalten). Diese Schlüssel werden mit weiteren attributiven Daten verknüpft, die teilweise auch aus weiteren relationalen Datenbanken herangezogen werden müssen. Welche Daten wie verknüpft werden und somit auch die Festlegung der Semantik dieser Daten erfolgt also größten Teils zu diesem Zeitpunkt. Schlussendlich ist jedem Gewässerabschnitt eine baumartige Struktur zugeordnet, die eine Teil-Ontologie der Wissensbasis darstellt - was eine direkte Weiterverarbeitung möglich macht. Die Wissensbasis untersucht unter Verwendung einer Regelbasis die gelieferten Daten hinsichtliche der angeforderten Fragestellung und liefert dann neue Daten zurück, die einem neuen Modell, nämlich dem Defizit-Modell, entsprechen. Anhand der ebenfalls mit zurück gelieferten eindeutigen Schlüssel ist ein Rückgriff auf die Geometrien der Gewässerabschnitte möglich. Das Endprodukt wird durch das 2D-GIS erzeugt, das neue Geoobjekte erzeugt (die in diesem Falle aus denselben Geometrien bestehen - allerdings kann ein und derselbe Punkt mehrfach auftreten, wenn mehrere Defizite in einem Abschnitt festgestellt wurden). Die Erstellung eines neuen Themen-Layers mit neuen Objekt-Kennungen wird auch erforderlich, um die möglicherweise aus verschiedenen Fachmodellen synthetisierten Geodaten in einen gemeinsamen neuen Datensatz zu integrieren.

4 FUNKTIONENSAUFRUFE ZWISCHEN GIS UND WISSENSBASIS

Als Schnittstelle zum Benutzer wird die 2D-GIS-Komponente eingesetzt. Hat der Benutzer sein Analyse-Gebiet ausgewählt, kann er sich zunächst den noch nicht analysierten Ist-Zustand auf Basis der Ausgangsdaten betrachten. Möchte er eine der FLUMAGIS-Analyse-Funktionalitäten aufrufen, so muss eine Anfrage an die Wissensbasis gestellt werden. Dazu wird anhand der semantischen Grobbeschreibung der Layer überprüft, ob die erforderlichen Daten für das oben beschriebene gemeinsame Objekt-Modell geladen sind. Ist dies der Fall, wird eine räumliche Abfrage durchgeführt, die die im Untersuchungsgebiet befindlichen Geoobjekte filtert und diese in das beschrieben Objekt-Modell umwandelt (Mapping). Der dann durchgeführte Funktionsaufruf instruiert die Wissensbasis über die durchzuführende Analyse und transferiert die Objekte zur Wissensbasis. Die Wissensbasis kann falls erforderlich weitere Anfragen an das GIS senden - dies wäre beispielsweise der Fall, wenn flussaufwärts weiter Informationen benötigt würden, die nicht Teil des gewählten Untersuchtungsgebietes sind. Dazu würde dann die Wissensbasis einen GIS-Funktions-Aufruf starten, der ebenfalls dem Schema Anfrage-Antwort entspricht. Schließlich wird die Wissensbasis die Antwort erzeugen und das entsprechende Antwort-Datenmodell füllen, das an das GIS zurückgeliefert wird. Dem GIS ist dann wiederum überlassen, anhand der Objekt-Referenzen den Raumbezug herzustellen und so eine Visualisierung der Antwort zu generieren. Der Ablauf wird im UML-Sequenz-Diagramm sichtbar (Abb. 3) (vgl. Seeman 2000).

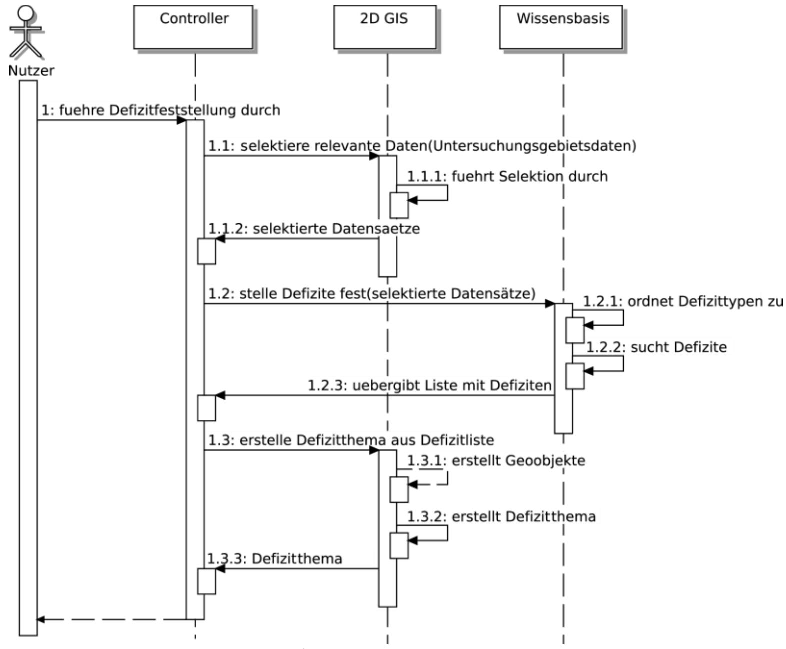

Abb. 3: Sequenzdiagramm der Defizitanalyse in FLUMAGIS (Quelle: Eigene Darstellung)

Aus Sicht des GIS sind die Aufrufe an die Wissensbasis Analyse-Funktionen, die in der Wissensbasis implementiert sind und dort ausgeführt werden. Die Wissensbasis benötigt zur Beantwortung bestimmter Fragestellungen weitere GIS-Funktionen, die sich in eine Auswahl klassischer GIS-Operatoren (wie 'clipping', 'buffering', etc.) zerlegen lassen. Eine Auswahl solcher Funktionen ist der Wissensbasis in abstrahierter Form bekannt und kann vom GIS als Kette von Operationen abgearbeitet werden. Darüber hinaus benötigt die Wissensbasis weitere Funktionen, die nicht vom GIS sondern intern implementierten Modellen oder extern gekoppelten Modellen verfügbar gemacht werden (was nicht Gegenstand dieses Papiers ist). Die funktionale Trennung in FLUMAGIS wird in der folgenden Tabelle aufgeschlüsselt, wobei mit 'thematisch' die oben erwähnte semantische Grobbeschreibung der Layer gemeint ist und mit semantisch die ontologisch gestützte Analyse in der Wissensbasis.

FLUMAGIS-Funktion	beteiligte Komponenten	Suchschlüssel
Untersuchungsgebiet auswählen	GIS	räumlich, thematisch
Defizit-Analyse	GIS	räumlich, thematisch, attributiv
	Wissensbasis	attributiv, semantisch
Maßnahmen-Vorschläge	Wissensbasis	attributiv, semantisch
Prognose	GIS	räumlich, thematisch, attributiv
	Wissensbasis	attributiv, semantisch

Tab. 1: Funktionen und Komponenten (Quelle: Eigene Darstellung)

Die erstellte Tabelle vernächlässigt weitere eingesetzte Komponenten, wie beispielsweise Simulationsmodelle, Geodatenbank oder 3D-Visualisierung. Es sollte dennoch deutlich werden, dass unter In-Kauf-Nahme der recht aufwändigen semantischen Zuordnung von Geobasisdaten ein 2D-GIS in seiner Funktionalität erheblich erweitert werden kann. Dabei macht man sich zu Nutze, dass nur ein kleiner gemeinsamer semantischer Ausschnitt bzw. eine gemeinsame Teil-Ontologie zur Kommunikation verwendet werden muss, was die den Aufwand für Daten-Zuordnung im GIS wiederum reduziert. Der bei Weitem aufwändigere Modellierungs-Anteil steckt in der Wissensbasis, was jedoch für das GIS ohne weitere Konsequenzen bleibt.

5 ARCHITEKTUR

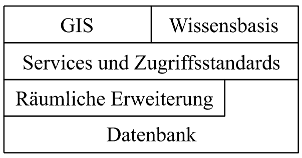

Abb. 4: FLUMAGIS Schichtmodell (Quelle: Eigene Darstellung)

Die Architektur der Gesamtanwendung FLUMAGIS kombiniert im Wesentlichen zwei Architektur-Muster (vgl. Nachschlagewerk Eilebrecht 2004): Das Schicht-Modell und das Model-View-Controller-Muster (MVC). Anhand des Schicht-Modells wird deutlich, wie die funktionale Trennung in der Anwendung vorgenommen wurde (s. Abb. 4). Das MVC-Muster kommt in FLUMAGIS in seiner Standard-Form zum Einsatz – zumindest, was die Sicht des Benutzers angeht (s. Abb. 5). Um den kombinierten Komponenten (die durchaus eigenständig lauffähig sind) gerecht zu werden, ist dieses Muster mehrfach anzuwenden - unter der Verallgemeinerung, dass es nicht immer ein Benutzer sein muss, der das Ergebnis als Sicht wahrnimmt, sondern dass an dessen Stelle auch andere Komponenten auftreten können. Insgesamt wird hierdurch sichtbar, dass FLUMAGIS die Aufgabe hat, dem Benutzer gewisse Arbeiten abzunehmen und bestimmte Komponenten, die auch eigenständig arbeiten könnten so komfortabel wie möglich zur Verfügung zu stellen und die durch andere zu steuern. (s. Abb. 6)

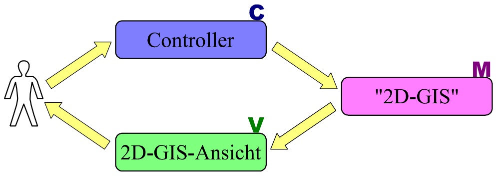

Abb. 5: MVC-Muster 2D-GIS (Quelle: Eigene Darstellung)

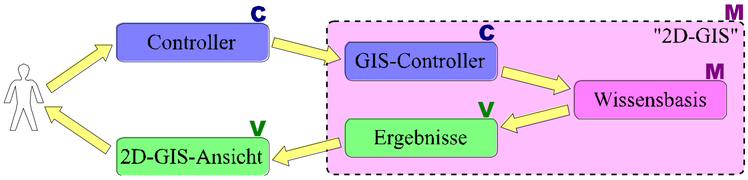

Abb. 6: Mehrfach-Verwendung des MVC-Musters (Quelle: Eigene Darstellung)

Für das Funktionieren des Gesamtsystems und die langfristige Wartbarkeit ist von entscheidender Bedeutung, wie die Schnittstellen spezifiziert werden. So weit wie möglich werden in FLUMAGIS Schnittstellen eingesetzt, die auf Standard-Dokument-Formate oder standardisierte Protokoll-Formate zurückgreifen. Für nicht als Standards spezifizierte (Web-)Dienste oder Schnittstellen haben insbesondere die syntaktischen Standards und die Application-Level-Standards ein großes Gewicht. Dies ist für die Zukunftsfähigkeit dieser hoch-spezialisierten Schnittstelle von entscheidender Bedeutung (vgl. Colan 2004). Für die neu zu definierenden Schnittstellen, die meist auch in Computer-Netzen verwendbar und für Client-Server-Konstrukte vorbereitet sein sollten, wird XML verwendet. Die Dokumentformate bzw. aus den Ontologien erzeugte Klassen-Hierarchien werden mit XML-Schema spezifiziert. Diese Schemata können in Kombination mit der Web Service Description Language (WSDL) für eine implementierungs-unabhängige und gut erweiterbare Beschreibung von Schnittstellen eingesetzt werden (vgl. Ballinger et al. 2004).

Auszugsweise folgt ein Teil des erzeugten XML-Schemas. Die ausgefüllte Form dieses spezifischen Dokumentformats kann neben der Schnittstellen-Kommunikation später auch von der Planungspraxis zur Erstellung von textlichen Planungsinformationen verwendet werden:

```
<complexType name="Gewaesserabschnitte">
    <sequence>
        <element name="Mitglieder" type="strukturGuete:Gewaesserabschnitt"/>
    </sequence>
</complexType>
<complexType name="Gewaesserabschnitt">
    <sequence>
        <element name="Identifikationsblock" type="strukturGuete:Identifikationsblock" maxOccurs="1"/>
        <element name="Laufentwicklung" type="strukturGuete:Laufentwicklung" maxOccurs="1"/>
        <element name="Laengsprofil" type="strukturGuete:Laengsprofil" maxOccurs="1"/>
        <element name="Sohlenstruktur" type="strukturGuete:Sohlenstruktur" maxOccurs="1"/>
        <element name="Querprofil" type="strukturGuete:Querprofil" maxOccurs="1"/>
        <element name="Uferstruktur" type="strukturGuete:Uferstruktur" maxOccurs="1"/>
        <element name="Gewaesserumfeld" type="strukturGuete:Gewaesserumfeld" maxOccurs="1"/>
    </sequence>
    <attribute name="GKZ" type="string" use="required"/>
    <attribute name="Abschnitt" type="int" use="required"/>
    <attribute name="Originallayername" type="string" use="required"/>
</complexType>
```

Die Klasse „Gewaesserabschnitte“ kann direkt in der WSDL-Datei referenziert werden. Ein Auszug:

```
<message name="Gewaesserabschnitte" >
    <part type="strukturguete:Gewaesserabschnitte" name="parameters" />
</message>
<message name="StrukturgueteDefizit" >
    <part type="defizit:Defizitliste" name="parameters" />
</message>
```

6 UMSETZUNG

Hier wird kurz beschrieben, wie die Verbindung zwischen GIS und Wissensbasis erzeugt wurde. Zunächst wurde von den Fachpartnern im Projekt das benötigte Expertenwissen formalisiert. Das Wissen aus den verschiedenen Disziplinen wurde in einer übergeordneten Ontologie in Verbindung gebracht und eine Regelbasis gebildet, die die spätere Verarbeitung von konkreten Daten ermöglicht. Die Wissensbasis wurde so erweitert, dass sie aus bestimmten Teilen der Ontologie Klassen-Modelle in Form von XML-

Schema-Dateien erzeugen kann. Die direkte Erzeugung des Datenmodells aus der Wissensbasis hat den Vorteil, dass die Anbindung der Schnittstelle ohne aufwändige Konvertierungen realisiert werden kann. Die allgemeine Anwendbarkeit der Schnittstelle sollte so ebenfalls sichergestellt sein.

Die so erzeugten Schemata enthalten ein Datenmodell, das bereits einen Teil der Schnittstelle darstellt. Ergänzend kommt noch die technische Beschreibung der Schnittstelle hinzu, d.h. welche Kommunikations-Protokolle verwendet werden und welche Teile des Datenmodells Ein- und Ausgabe-Daten sind. Hierzu wird die Web-Service-Definition-Language genutzt - ein XML-Format, das die Festlegung dieser Parameter ermöglicht.

Diese Schnittstelle ist unabhängig von einer Programmierung oder Programmier-Sprache erstellt worden. Um sie nutzbar zu machen, ist die Umsetzung in ausführbaren Programm-Code erforderlich. Zu diesem Zweck wurden diverse Rahmenwerke erstellt, die Programm-Quell-Codes in vielerlei Sprachen automatisiert erzeugen können. In FLUMAGIS kommt hauptsächlich die Programmiersprache Java zum Einsatz. Im praktischen Einsatz hat sich das Web-Service-Framework 'Axis' (http://ws.apache.org/axis) bewährt. Der erzeugte Quellcode kann mit geringen Anpassungen direkt verwendet werden.

7 FAZIT

Während der Entwicklung der verschiedenen Programmkomponenten war zunächst kein Funktions-Test der Gesamt-Anwendung möglich. Daher war der erste Test für die Projekt-Mitglieder selbst überraschend problemlos. In den ersten Versionen waren die Schnittstellen-Beschreibung noch vollständig manuell erstellt worden, da zunächst das Schwergewicht der Entwicklung auf den Kern-Funktionalitäten der Komponenten lag. Die Weiterentwicklung in mehreren iterativen Schritten zeigte enormes Potenzial zur Vereinfachung des Prozesses der Software-Entwicklung.

Dies mündete in der Erkenntnis, dass die Art der hier vorgenommenen Gestaltung von Geosoftware zwar auf den ersten Blick sehr komplex ist, jedoch nach Überwindung der technischen Hürden eine gut erweiterbare Ausgangsbasis darstellt.

Technologisch gesehen konnte durch die gewählte Architektur eine Optimierung erreicht werden, weil sowohl die (hier nicht diskutierten) Modelle, als auch die Wissensbasis auf angemessener Hardware als Server zum Laufen gebracht werden konnten. Dies eröffnet die Perspektive, auch die Ontologie selbst erweitbar oder gar austauschbar zu machen. Die jeweils aktuelle Version wäre dann allen Nutzern direkt verfügbar.

Hinsichtlich der Interoperabilität müssen wir davon ausgehen, dass eine weitergehende Standardisierung der hier entwickelten Dienste nicht sinnvoll erscheint. Die weiter Verwendung hängt viel mehr davon ab, ob die Ontologie so gut verallgemeinert wurde, dass sie den Anforderungen aus der Praxis gerecht werden kann. Ist dies der Fall, so werden damit einhergehend auch die geschaffenen Schnittstellen eine entsprechende Wiedernutzbarkeit aufweisen, da die nutzbaren Standards in einer Weise eingesetzt wurden, die hoch spezialisierte Schnittstellen in Zusammenarbeit mit der Wissensbasis schneller implementierbar machen.

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Interaktion im virtuellen Raum durch Echtzeitkopplung mit 2D-GIS

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1 EINLEITUNG

In den letzten Jahren gibt es im Umfeld der Geovisualisierung einen starken Trend hin zur 3D-Echtzeitvisualisierung und damit einhergehend auch zur Interaktion im virtuellen Raum. Über aufwändige Modelle muss die Verbindung zwischen Eingabegeräten, Fachdomäne und virtueller Welt erstellt werden. Erschwerend kommt hinzu, dass Eingabegeräte im Normalfall nur über zwei Freiheitsgrade verfügen. Betrachtet man die Anforderungen, die sich speziell im Umfeld der Raumplanung ergeben, so ist eine solche 3D-Interaktion nicht in jedem Falle erforderlich. Der Abstraktionsgrad einer 2D-Visualisierung erleichtert nicht nur die Einbindung von bestimmten Interaktionen sondern auch den Umgang mit solchen Systemen. Dennoch wird ein Echtzeit-Erleben von getätigten Eingaben ermöglicht. Dieser Beitrag fokussiert, wie eine dreidimensionale Umgebung für bestimmte Anwendungsfälle und -schritte durch eine entsprechende 2D-Komponente ergänzt werden kann. Änderungen in der einen Umgebung werden bei fachlich sinnvollen Bearbeitungen in Echtzeit auch in der anderen angezeigt.

Hierbei wird soweit möglich auf Datenstrukturen aus dem 2-Dimensionalen zurückgegriffen, die beispielsweise in Form von Texturen in der 3D-Umgebung zum Einsatz kommen. 3D-Daten kommen nur in Form von Visualisierungsobjekten, jedoch nicht als 3D-Geodaten vor. Dies ist jedoch keine prinzipielle Beschränkung der Applikation. Die benötigten Daten für die 3D-Echtzeitumgebung werden soweit möglich standardisiert lokal oder netzbasiert vorgehalten. Die editierten zweidimensionalen Geodaten können in ihrem Ausgangsformat (beispielsweise Shapefiles) abgespeichert werden und sind somit auch für andere Anwendungen bzw. innerhalb einer Geodateninfrastruktur verfügbar.

Über die reine Visualisierung hinaus bieten beide Komponenten ihrer Dimensionalität entsprechende GIS-Funktionalitäten. In einem Anwendungsfall aus der Landschaftsplanung wird eine derartige Interaktion praktisch umgesetzt und gezeigt, wie diese in eine heterogene System-Architektur eingebunden werden kann.

2 ANWENDUNGSFALL IN FLUMAGIS

FLUMAGIS ist der Prototyp eines Planning Support Systems (PSS) zur Unterstützung von Planungsentscheidungen bei der Umsetzung der Wasserrahmenrichtlinie (WRRL) der Europäischen Union (http://europa.eu.int/scadplus/leg/de/lvb/l28002b.htm, zuletzt abgerufen am 30.11.04). Ziel der EG-WRRL ist das Erreichen eines „guten ökologischen Zustands“ aller Fließgewässer im Gebiet der Europäischen Union. Im System werden für Gewässereinzugsgebiete Methoden und Visualisierungen zur Bearbeitung und Simulation/Prognose von Planungsentscheidungen bereitgestellt. Hierzu werden verschiedene hydrologische, vegetationskundliche, sozioökonomische und limnologische Modelle in das System eingebunden, die aufgrund vorhandener (Geo-)Daten Ergebnisse produzieren, die entsprechend visualisiert werden müssen. Visualisierungen sind sowohl im zwei- als auch im dreidimensionalem Raum möglich. Das System basiert auf einer Client-Server Architektur. (vgl. Möltgen & Streit 2004)

In FLUMAGIS ist neben der in Geoinformationssystemen (GIS) üblichen zweidimensionalen Darstellung für bestimmte Anwendungsfälle auch eine dreidimensionale Visualisierungsumgebung notwendig. Um beispielsweise ein Geländemodell mit Höheninformationen zu visualisieren, ist eine 3D-Umgebung unumgänglich. Darüberhinaus bietet die 3D-Umgebung eine für die Planungsbeteiligten realitätsnähere und „anfassbarere“ Visualisierung. So wird der Akzeptanzgrad von Planungsentscheidungen erheblich verbessert und somit die Kommunikation im Planungsprozess gravierend vereinfacht. Eine gute Kommunikation kann Planungsprozesse verbessern (vgl. Lehmkühler 1999, S. 121).

Für eine Prognose des Zustands eines Fließgewässers bei Änderung der entsprechenden Landnutzungsart in der Flussaue müssen mit Hilfe entsprechender GIS-Funktionalitäten verschiedene Ausgangsszenarien modelliert und vorbereitet werden können. Deshalb ist es erforderlich, dass das System über die reine Visualisierung hinaus diese GIS-Funktionalitäten zur Editierung von Geometrien und Attributen zur Verfügung stellt. In unserem Anwendungsfall geht es um die Änderung der Landnutzung von intensivem Ackerbau zu extensiv genutztem Wald, damit der Eintrag von düngungsbedingtem Nitrit verringert wird. Zur Erzeugung der Szenarien ist es notwendig, dass polygonale Flächen editiert und in der Größe verändert werden können.

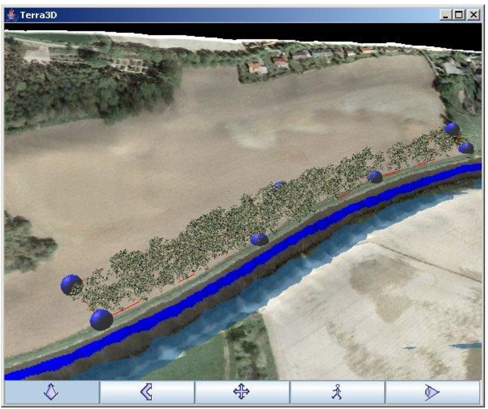

Abb. 1: Erste Implementierung eines 3D-Clients (Quelle: Eigene Darstellung)

Für die Bearbeitung der Fragestellung wird in der ersten Umsetzung aus verschiedenen Gründen eine großmaßstäbige dreidimensionale Umgebung geschaffen. Um fachlich sinnvoll arbeiten zu können, benötigt man dreidimensionale Geländemodelle, die verschiedene besondere Geländestrukturen (beispielsweise Terrassenkanten der Aue) identifizierbar zu machen. Weiterhin ist der Wald neben dem Gewässer das wichtigste Objekt, weil es den Baum als größte Entität des Lebensraums enthält. Zur kooperativen Planung sollte der Wald realitätsgetreu modelliert werden, damit die erzeugte Visualisierung qualitativ überzeugen kann.

Erste Tests mit der 3D-Umgebung (s. Abb. 1) zeigten auf, dass der Schwierigkeitsgrad der Interaktion im dreidimensionalem Raum deutlich höher liegt, als im zweidimensionalen. Mit den Standardeingabegeräten (in diesem Fall die Computermaus) ist es für den Benutzer schwierig zu unterscheiden, in welche Richtung er die Knoten des Polygons bei der Editierung bewegt. Ist es die Ebene, in der das Polygon liegt, oder verändert er die Knoten in der Höhe? Grundsätzlich gibt es in der 3D-Interaktion verschiedene Voraussetzungen zu beachten (siehe Kapitel 4). Die Anforderungen für eine erfolgreiche Interaktion sind für den Benutzer höher.

In einer 2D-Umgebung (s. Abb. 2) sind Polygoneditierungen unproblematischer. Bei der Editierung (beispielsweise Verschiebung) von Knoten ist eine Interaktion ohne Betrachtung von Voraussetzungen und komplizierten technischen Finessen möglich. Sie findet in einer für den Anwender „gewohnten“ Umgebung statt. Zusätzlich ist es für die Bearbeitung des Anwendungsfalls ausreichend, Polygone im zweidimensionalem Raum zu erstellen und zu bearbeiten. Allerdings fallen die o. a. Vorteile der höheren Realitätstreue durch die 3D-Visualisierung weg.

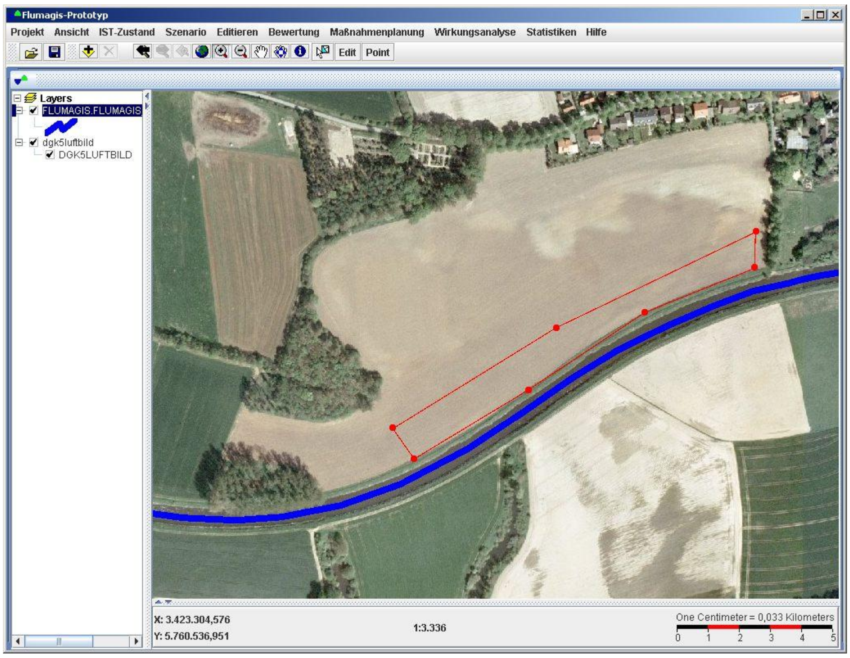

Abb. 2: Gleichzeitige Darstellung im 2D-Client (Quelle: Eigene Darstellung)

Um die hohen Anforderungen an den Benutzer und die zusätzlichen technischen Voraussetzungen einer reinen 3D-Visualisierung abzumildern, wird für die Interaktion zusätzlich eine „normale“ 2D-GIS-Umgebung inklusive Visualisierung hinzu gekoppelt. Somit werden die Vorteile der vereinfachten Interaktion in der 2D- und die Vorteile der besseren Visualisierung im 3D-Bereich kombiniert.. Beide Visualisierungen werden gleichzeitig angezeigt und Veränderungen im einen Raum synchron und ohne Zeitverzug in der jeweils anderen Umgebung aktualisiert.

May et al. 2004 geben eine genauere Übersicht über die Systemspezifikation in FLUMAGIS.

3 THEORETISCHE GRUNDLAGEN DER 3D-GEOVISUALISIERUNG BZW. 3D-VISUALISIERUNG

Aus den Entwicklungen des Forschungsfelds Computergraphik in den letzten Jahrzehnten ist das Arbeitsfeld der interaktiven 3D-Visualisierung entstanden.

Geovisualisierung stellt besondere Anforderungen an die Visualisierung. Charakteristika von Geodaten und darauf operierenden Methoden müssen berücksichtigt werden. Hierfür ist es beispielsweise erforderlich, dass alle visualisierten Objekte einen exakten Raumbezug vorweisen und das Visualisierungssystem zusätzlich einfache GIS- und kartographische Funktionalitäten bereitstellt. „Ziel der Forschungs- und Entwicklungsaktivitäten im Umfeld der Geovisualisierung ist die Bereitstellung theoretischer Grundlagen, Methoden und Werkzeuge für den Aufbau entsprechender Visualisierungsumgebungen zum Zweck der Exploration, Analyse, Synthese oder Präsentation raumbezogener Daten.“ (Schmidt 2002, S. 13)

Für die theoretische Betrachtung von 3D-Geovisualisierung sind zwei Aspekte von besonderer Bedeutung:

Wie werden meine Geoobjekte dargestellt?

Wie kann ich mit den visualisierten Geoobjekten interagieren?

Für die Interaktion in der 3D-Visualisierungsumgebung gibt es verschiedene Möglichkeiten. Sogenannte Metaphern umschreiben die Interaktionsmöglichkeiten. Kapitel 4 beschreibt u. a. einige dieser Metaphern und die vorhandenen Hardware-Lösungen.

In der klassischen 3D-Visualisierung nutzt man das Prinzip der Visualisierungspipeline (Haber & McNabb 1990) zur Generierung der 3D-Darstellung. Eine Visualisierungspipeline besteht aus drei streng auf einander abfolgenden Arbeitsschritten: Selektion/Filterung, Mapping und Rendering. Für 3D-Geovisualisierung müssen spezielle Aspekte beachtet werden.

Für die Darstellung der Geoobjekte im virtuellen Raum muss als erstes überlegt werden, welche Geoobjekte für die fachliche Fragestellung von Bedeutung sind. Die Darstellung von allen vorhandenen aber nicht im Sinne der Problemstellung unbedingt bedeutsamen Geoobjekten ist nicht sinnvoll. Werden zu viele Geoobjekte zeitgleich angezeigt, wird der Anwender schnell überfordert und von den für ihn interessanten Geoobjekten abgelenkt. Zusätzlich gilt es, die Anzahl der Geoobjekte aus reinen Performanzgründen möglichst gering zu halten. Dieser Schritt wird als „filtern“ beschrieben. Im zweiten Schritt muss überlegt werden wie die nun „gefilterten“ Geoobjekte sinngemäß visualisiert, also auf entsprechende Visualisierungsobjekte „gemappt“ werden. Dieser Schritt ist erforderlich, damit unterschiedlich dimensionierte Geoobjekte realitätsgetreu visualisiert werden können. (vgl. Schmidt 2002, S. 64f)

Beim Mapping wird noch keine Sichtbarkeitsanalyse im Sinne der Computergraphik durchgeführt, sondern ausschließlich thematisch entschieden, welche Geoobjekte überhaupt von Bedeutung sind. Durch sogenanntes Rendering sämtlicher vorhandener Visualisierungsobjekte entsteht ein wahrnehmbare Bild für den Anwender. Erst beim Rendering wird eine Sichtbarkeitsanalyse durchgeführt und Bäume, die von der Kameraposition nicht mehr sichtbar oder nur zum Teil sichtbar sind, nicht oder nur im sichtbaren Teil visualisiert. Hier geht es um rein optische Aspekte und die Betrachterposition.

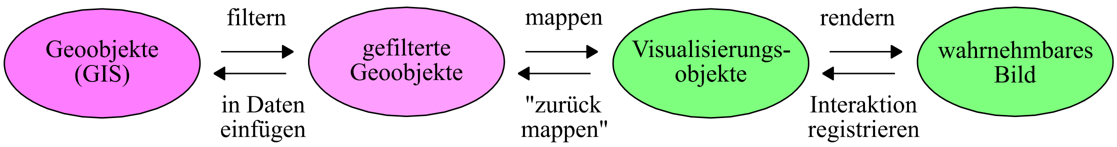

Abb. 3: Schritte der 3D-Visualisierung nach Schmidt 2002 (Quelle: Eigene Darstellung)

Für die Visualisierung beispielsweise der Landnutzung in einer Flussaue liegen die Daten in zweidimensionalen Polygonen vor. Für zweidimensionale Geoobjekte (in diesem Fall die Landnutzung Wald in einer bestimmten Fläche) benötigt man keine dreidimensionale Darstellung. Für die 3D-Darstellung wird vom Polygon „Wald“ auf einzelne dreidimensionale Baummodelle gemappt, die innerhalb des räumlich referenzierten „Waldpolygons wachsen“. Alle Bäume bilden den Wald, den sich der Anwender vorstellen soll. Auch die Rückrichtung vom Visualisierungsobjekt zum Geoobjekt muss im Falle einer Interaktion betrachtet werden. Die visualisierten Objekte müssen wieder auf Geoobjekte zurück gemappt und die Geoobjekte wieder in die vorhandene Datengrundlage eingefügt werden. Wird beispielsweise der Wald in der flächenhaften Ausdehnung geändert (die Verteilung der Visualisierungsobjekte „Bäume“ wird verändert) so müssen diese wieder in ein verändertes Landnutzungspolygon umgewandelt und in die Datengrundlage eingepflegt werden. Abb. 3 verdeutlicht dieses Schema. Die Trennung von Originaldaten und Visualisierungsdaten gibt sich durch die unterschiedliche Farbgebung.

4 GEO- UND INTERAKTIONSMODELLE

Neben den erweiterten Datenmodellen - dreidimensionale Daten haben zusätzlich zu X- und Y- noch eine Z-Koordinate für den Höhenwert - müssen für eine erfolgreiche Interaktion sechs statt zwei Freiheitsgrade der Objekte kontrolliert werden können. Freiheitsgrade beschreiben die Möglichkeiten, wie Objekte im Raum bewegt bzw. gedreht werden können. Je mehr Dimensionen, desto mehr Richtungen in die verschoben werden kann und je mehr Achsen, um die man drehen kann. Für eine volle Kontrolle über alle sechs Freiheitsgrade im Dreidimensionalem muss teure Hardware vorhanden sein. Es gibt verschiedene Lösungen (genannt Metaphern) im immersiven (beispielsweise Cave) und semi-immersiven Bereich (z. B. 3D-Workbench). Zusätzlich braucht man Zeigegeräte, die alle sechs Freiheitsgrade unterstützen (beispielsweise 3D-Maus o. ä.). Für den Einsatz in der Planungspraxis sind derartige Systeme momentan aus verschiedenen Gründen nicht effektiv einsetzbar. Kosten (bis in den sechsstelligen Eurobereich) und hoher Administrations- und Programmieraufwand sprechen dagegen.

Um auf 3D-Visualisierung aber nicht verzichten zu müssen, gibt es andere Lösungen für Standard-Desktop-Arbeitsplätze. Mit der „normalen“ Computermaus können zwei Freiheitsgrade kontrolliert werden (im Sinne der X- bzw. Y-Achse jeweils in beide Richtungen). Folglich müssen vier fehlende Freiheitsgrade ausgeglichen werden. In der Geovisualisierung kann man sich zu Nutze machen, dass Geoobjekte nicht nur durch Geometrie (absolute Lage im Raum) und Topologie (die Lage der Geoobjekte zueinander), sondern auch durch Attribute und Semantik thematisch definiert sind. Durch diese thematischen Eigenschaften lassen sich sogenannte Constraints definieren, die beschreiben, was man mit den Geoobjekten „machen darf“ und wie sich sich im Raum verhalten. Constraints können geometrischer, topologischer oder struktureller Natur sein. Folgendes Beispiel zur Verdeutlichung: Ein Baum hat immer einen festen Punkt in einer Ebene (dort wo er wächst). Man kann also für die Interaktion die Höhe außer Betracht lassen („ein Baum kann nicht in der Luft schweben“), denn es interessiert nur der Punkt, wo er in der Ebene verankert ist. Für die Visualisierung ist die Z-Koordinate hingegen wichtig, da die Höhe des Baums sonst nicht modelliert werden kann. „Der Benutzer kann also nur so mit einem Geoobjekt interagieren, wie es dem Verhalten seines 'realen Gegenstücks' entspricht.“ (Merten 2002, S. 4)

Um im beschriebenen Anwendungsfall die Interaktion in der 3D-Umgebung zu ermöglichen, müssen die zugrunde liegenden Daten genauer analysiert werden. Für die interaktive geometrische Änderung von Landnutzung reicht es aus, sich auf zweidimensionale Landnutzungspolygone zu beschränken. Der einzelne Baum ist für die Interaktion nicht von Interesse, ebenso wenig der Höhenwert. Ein Polygon besteht aus Knoten (Eckpunkten), die Knoten verbindenden Kanten (Begrenzungslinien) und einer durch die Knoten und Kanten definierten Innenteil. Das Polygon liegt achsenparallel zur X- und Y-Achse und ist in einem Punkt mit dem darunterliegenden Geländemodell verankert. Dies ist der Constraint der auf dem der betrachtete Anwendungsfall beruht. Wenn nun das Landnutzungspolygon in der Größe verändert wird (beispielsweise durch Verschieben der Knoten innerhalb der aufgespannten Ebene) wird für die neue Fläche ein Wald generiert, der aus einzelnen Visualisierungsobjekten „Baum“ besteht und durch das

Polygon an sich begrenzt wird. Diese Eigenschaft erlaubt eine gleichzeitige Darstellung und Interaktionsmöglichkeit in der 2D-Umgebung, da dort ebenfalls auf reinen zweidimensionalen Polygonen operiert wird.

Im Fall von FLUMAGIS wird die Interaktion zusätzlich in der 3D-Umgebung gewährleistet. Das Polygon wird in der oben beschriebenen Ebene aufgespannt und die Knoten durch Sphären dargestellt, die innerhalb der Ebene verschoben werden können. Die Visualisierung von 3D-Interaktion im 2D-Darstellungsraum ist ebenso synchronisiert.

5 ARCHITEKTUR

Die Implementierung des Anwendungsfalls basiert auf zwei Architekturmustern (auch „Pattern“) und dem objektorientierten Programmier-Paradigma (einen guten Überblick bietet Oestreich 2001). Pattern sind Architekturmuster zur optimierten Lösung von abgrenzbaren oft auch sich wiederholenden Teilproblemen innerhalb eines Softwaresystems (vgl. Gamma et al. 1995). Sie erleichtern die Implementierung und Wartbarkeit von Programmcode. Das System ist getreu dem Model-View-Controller Pattern (Eilebrecht & Starke 2004 S. 55 ff., Krutscher 1997), kurz MVC aufgebaut. Die Kommunikation zwischen der 2D- und 3D-Umgebung folgt dem Observer-Pattern (Cooper 1998 S. 177 ff., auch Beobachter-Muster bei Seemann & v. Gudenberg 2000 S. 190 ff.). Mit dem Observer-Pattern lässt sich das Problem lösen, dass mehrere Objekte vom Zustand eines anderen Objekts abhängig sind. Wenn sich der Zustand dieses dritten Objekts ändert, werden die abhängigen Objekte entsprechend benachrichtigt.

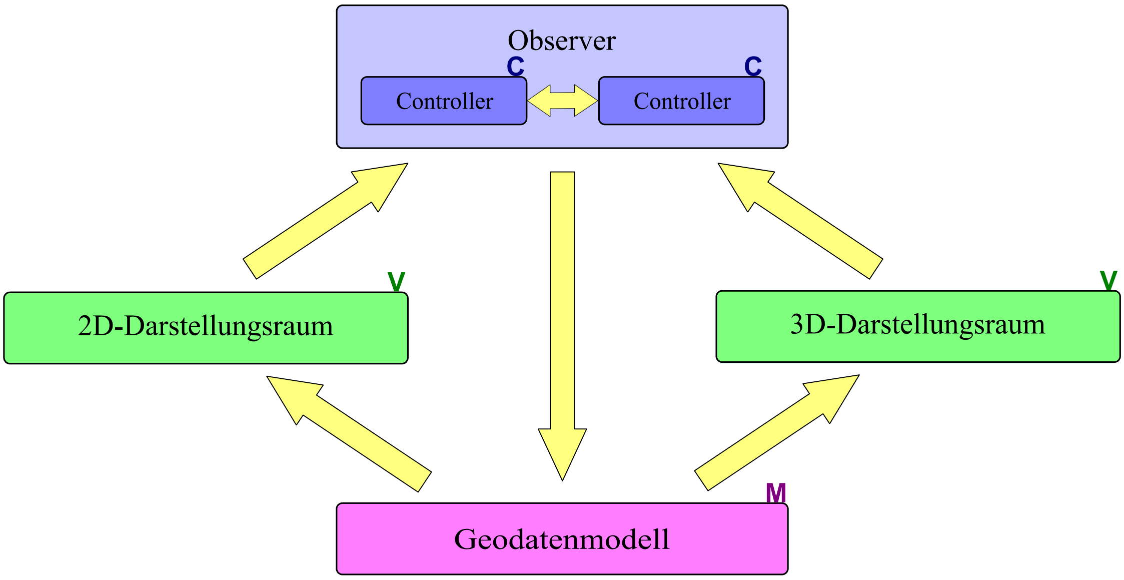

Abb. 4: Architekturmodell (Quelle: Eigene Darstellung)

Anhand von Abb. 4 wird die verwendete Architektur ersichtlich. Die unterschiedliche Farbgebung und die Einzelbuchstaben repräsentieren die verschiedenen Systemeinheiten Model (Rosa), View (Grün) und Controller (blau). Sowohl die 2D- als auch die 3D-Applikation sind in sich eigenständige Komponenten, die getrennt voneinander jeweils nach dem MVC-Pattern entwickelt worden sind. Durch objektorientierte Programmierung, die auf bestmögliche Erweiterbarkeit ausgelegt ist, war es einfach beide Komponenten zu koppeln. Beide operieren allerdings im Falle der Kopplung auf dem selben Modell, welches das Geodatenmodell (im Anwendungsfall das Landnutzungspolygon) und entsprechende Funktionalitäten zur Bearbeitung der Daten bereitstellt. Der Anwender interagiert direkt mit einem der beiden Darstellungsräume. Jeder Darstellungsraum wird auf Benutzereingaben durch einen eigenen Controller überwacht, der Veränderungen registriert. Ist eine Interaktion aus einer der beiden Darstellungsräumen gemeldet worden (Eingabe), wird vom Observer das Geodatenmodell entsprechend geändert und auf Basis des Datenmodells eine neue Ausgabe für den jeweils anderen Darstellungsraum angefordert. Durch den Observer wird also gewährleistet, dass die Ausgabe in beiden Darstellungsräumen synchronisiert wird und die gemeinsam verwendeten Geodaten entsprechend aktualisiert werden. Jeder Darstellungsraum ist für sich dafür verantwortlich, entsprechend der Änderungen im Datenmodell eine geeignete Visualisierung zu erstellen. Für die 3D-Darstellung ist dies in Kapitel 3 und 4 beschrieben, die Visualisierung im 2D erfolgt nach „bewährten“ Prinzipien, die nicht Gegenstand dieses Papiers sind.

6 UMSETZUNG

Abb. 5 zeigt die Eingliederung und Umsetzung des Anwendungsfalls in den FLUMAGIS-Prototyp. Für die Visualisierung sind die voneinander unabhängigen Clients für den 2D- und 3D-Darstellungsraum zuständig. Diese sind über eine Controller-Komponente mit der Serverseite verbunden. Der Controller überwacht die Interaktionen des Benutzers aus beiden Clients und löst entsprechende Befehle auf der Serverseite aus. Die Serverseite ist nicht als „ein“ Server zu verstehen, sondern aus verteilten Servern mit jeweils gekapselten Funktionalitäten. Die Geodatenbank hält die Geodaten vor. Über die Wissensbasis sind die verschiedenen Modelle zur Simulation, Analyse und Prognose angebunden (s. Kapitel 2). Das komplette System mit Ausnahme der Geodatenbank ist in Java implementiert worden. (vgl. May et al. 2004)

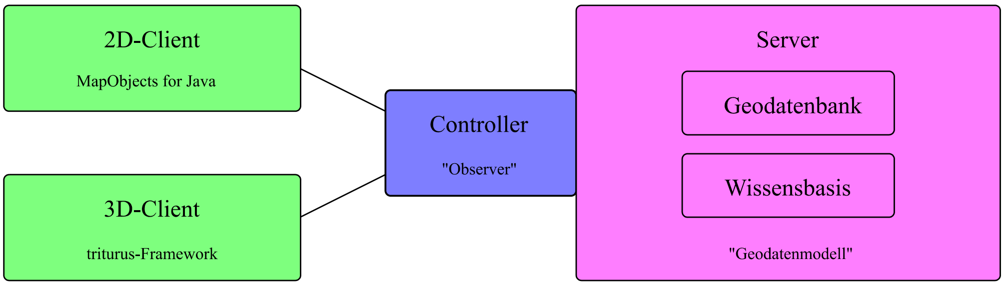

Abb. 5: Umsetzung des Anwendungsfalls in FLUMAGIS (Quelle: Eigene Darstellung)

Der 2D-Client wurde mit "Map Objects for Java 2" der Firma ESRI entwickelt. Map Objects stellt Bibliotheken, vorgefertigte Visualisierungskomponenten und Datenstrukturen vorprogrammiert zur Verfügung. Nach dem Baukasten-Prinzip kann einfach eine Applikation zusammengestellt werden. Map Objects ist unter einer proprietären Lizenz veröffentlicht. Die offene Systemarchitektur ermöglicht, dass künftig auch Alternativen zu Map Objects aus dem Bereich der Freien Software angebunden werden. Erste diesbezügliche Versuche werden zur Zeit durchgeführt.

Die 3D-Visualisierungsumgebung basiert auf dem triturus Framework (Schmidt et al. 2004) des Instituts für Geoinformatik (Universität Münster) und der conterra GmbH (Münster). triturus stellt 3D-Datenmodelle zur Verfügung und kapselt die Daten von der jeweiligen Visualisierungsengine. Für die Visualisierung können beliebige auf Szenengraph-APIs basierende Renderengines, beispielsweise Java3D oder Xith3D, angebunden werden. In triturus wird Java3D der Firma Sun Microsystems verwendet. Für die Visualisierungsobjekte „Baum“ werden Modelle der Firma Xfrog verwendet, die insbesondere in Größe und Wuchsform mittels eines Simulationsmodells realitätsnah erzeugt wurden. Die Baumart wird durch Attribute im Geodatenbestand festgelegt.

Das zu bearbeitende Landnutzungspolygon wird dynamisch auf die Geländeoberfläche aufgelegt, so dass es in jedem Fall oberhalb der Selbigen liegt. Hierzu sind entsprechende geometrische Operationen notwendig, die bei jeder Veränderung durchgeführt werden müssen.

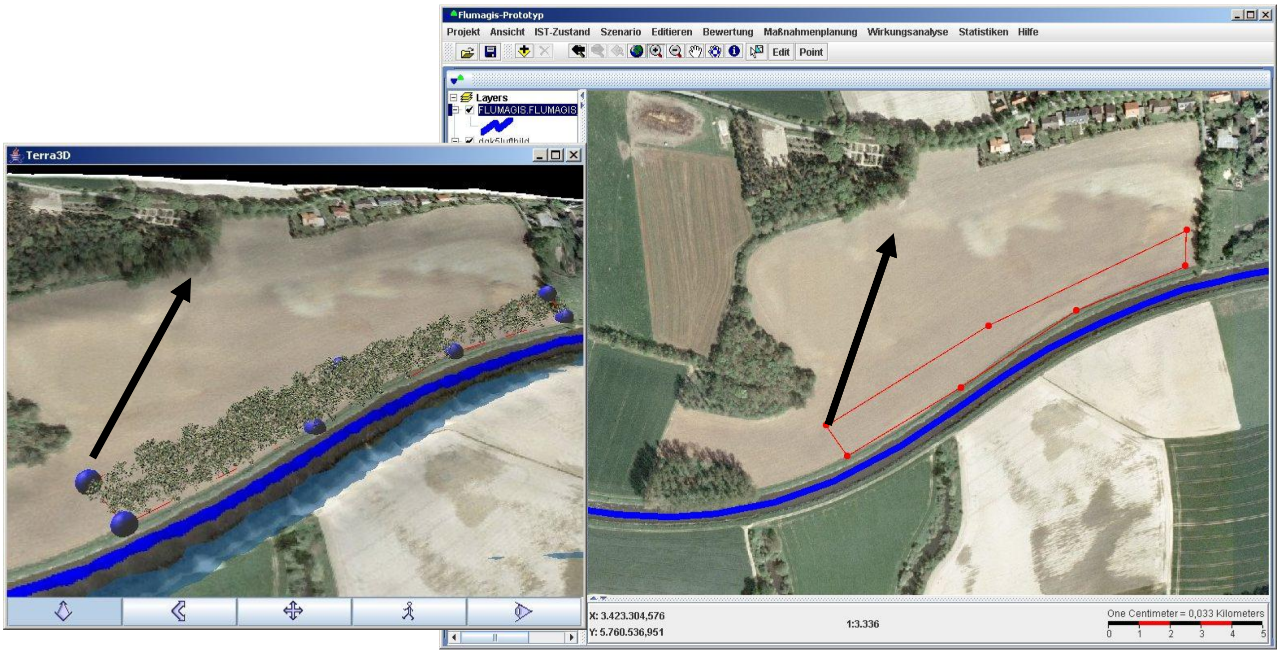

Abb. 6: Synchrone Visualisierung in beiden Darstellungsräumen (Quelle: Eigene Darstellung)

Während einer durch eine Interaktion (sei es zur Veränderung der Betrachterposition oder Editierung) verursachten Neuberechnung des Bildes werden sämtliche Visualisierungsobjekte durchlaufen (entsprechend dem Iterator-Pattern in Eilebrecht & Starke 2004, S. 36 ff.) und entsprechend der neuen Situation gerendert. Im Falle einer Polygoneditierung wird zusätzlich das Geodatenmodell entsprechend aktualisiert und für das Visualisierungspolygon die Anzahl der Bäume angepasst.

Da die Clients für die beiden Darstellungsräume und der Observer auf dem selbem Clientrechner ausgeführt werden, ist die Verwendung eines speziellen Kommunikationsprotokolls nicht notwendig. Die Clients und er Observer tauschen ihre Informationen java-intern aus.

In Abb. 6 wurde beispielhaft ein Uferrandstreifen mit Wald angelegt, der landschaftsökologisch gesehen einen Puffer zwischen der argrarökonomisch genutzten Ackerfläche und dem Gewässer (in diesem Fall die Ems bei Einen) bilden soll. Die beiden Pfeile deuten eine Änderung des am Weitesten links liegenden Knoten und seine synchrone Visualisierung in beiden Darstellungsräumen an.

7 FAZIT

Durch Verringerung der Dimensionalität des Darstellungsraums wird die Interaktion vereinfacht. Die 2D-Darstellung ist hierbei als weiter abstrahiert zu betrachten. Die 3D-Interaktion stellt höhere Anforderungen an den Benutzer. Das Ziel der Visualisierungs-/Interaktionskopplung beider Darstellungsräume: Dem Nutzer in seiner gewohnten Domäne entgegen kommen und somit die Usability von computergestützten Planungswerkzeugen erhöhen.

	Abstraktion	***Interaktion***
2D-Darstellung	Hoch	Einfach
3D-Darstellung	Gering	Komplex

Tab. 1: Eigenschaften der einzelnen Darstellungsräume bzgl. Abstraktion und Interaktionskomplexität (Quelle: Eigene Darstellung)

Durch die synchrone Koppelung von 2D- und 3D-Darstellung bei gleichzeitiger Operation auf den selben Daten werden die jeweiligen Vorteile (dargestellt in Tab. 1) der einzelnen Darstellungen kombiniert. „Die dreidimensionale Visualisierung eines Planungsentwurfs ist ein geeignetes Mittel, um die visuelle Kommunikation im Planungsprozess zu erleichtern, da diese Form der Darstellung eher der alltäglichen Wahrnehmung des Menschen entspricht.“ (Merten 2002, S.1) Aufgrund dessen ist in der 3D-Darstellung eine geringere Abstraktionsanforderung an den Benutzer gestellt. Die hohe Interaktionskomplexität ist als gravierender Nachteil zu werten. Dieser Nachteil wird in unserem Beispiel durch die verringerte Komplexität der Interaktion in der 2D-Darstellung ausgeglichen. Der Nachteil der hohen Abstraktion vom reellen Raum in die 2D-Darstellung wird durch die reellere Visualisierung im Dreidimensionalen ausgeglichen.

Es wurde ein System entwickelt, dass ohne teure Hardware (3D-Metaphern) und komplizierte Constraints-Implementierung an jedem Desktop-Arbeitsplatz verfügbar ist.

Dabei ist zu beachten, dass dies nicht für alle fachlichen Fragestellungen und Szenarien geeignet ist. Sobald für Geodaten der Höhenwert als zusätzliche Variable betrachtet werden muss, ist der beschriebene Ansatz nicht anwendbar.

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Die Eignung dreidimensionaler Displaytechnologien zur Visualisierung von Geo-Multimedia Inhalten

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1 EINLEITUNG

Der Mensch lebt in einem dreidimensionalen Universum und nimmt seine Umwelt auch räumlich wahr. Daher sind dreidimensionale Displaytechnologien insbesondere für Kartografie und Geoinformation interessant, denn die Visualisierung der Information kann hier aus der Perspektive des Nutzers erfolgen und ist nicht, wie bisher, dem räumlichen Vorstellungsvermögen des einzelnen überlassen. Damit diese Information aber so aufbereitet wird, dass dadurch auch eine leichtere Interpretierbarkeit gegenüber nicht-dreidimensionalen digitalen kartografischen Ausdrucksformen gewährleistet ist - was letztendlich auch einen Mehrwert für den Nutzer bedeuten würde - bedarf es einiges an Forschungsarbeit.

2 ARTEN VON 3D-DISPLAYS

Technologien, welche eine räumliche Darstellung erlauben, gliedern sich entsprechend ihrer Funktionsweise in folgende Kategorien:

Virtuell-dreidimensionale Systeme (pixelbasierte Systeme)

Diese nützen die Eigenschaft des menschlichen Gehirns, aus zwei perspektivisch leicht versetzten 2D-Abbildungen, die jeweils einem Auge vorgeschaltet werden, ein Raumbild als **dreidimensionale Illusion** zu erzeugen. Dazu werden gezählt:

- „Brille-plus-Bildschirm“-Systeme (z.B. Anaglyphenbrillen, Shutterbrillen, Systeme, die mit polarisiertem Licht arbeiten)
- Head-Mounted Displays (HMD)
- Autostereoskopische Displays (z.B. LCD-Displays mit Mehrfachansichten - Lentikulartechnik)

Real-dreidimensionale Systeme (im wesentlichen voxelbasierte Systeme (Voxel = volumetrische Pixel))

Hier wird ein dreidimensionales Abbild als quasi real existierender Körper erzeugt; d.h. die dreidimensionale Ausdehnung der Visualisierung erfolgt tatsächlich im realen Raum, und der Betrachter kann „um diese herumgehen.“ Voxelbasierte Systeme sind daher auch immer autostereoskopisch und benötigen keinen zusätzlichen Sehbehelf. Hierzu sind z.B. **volumetrische** und **holographische Displays** zu zählen. Eine Sonderform real-dreidimensionaler Systeme sind **sphärische Displays**, die etwa bei taktilen.Hypergloben und für Immersive Reality-Systeme (z.B. „Cybersphere“) eingesetzt werden (sind pixelbasierte Verfahren, jedoch mit realräumlicher (sphärischer) Ausdehnung der Displayoberfläche).

2.1 Virtuell-dreidimensionale Systeme

2.1.1 „Brille-plus-Bildschirm“-Systeme

Das älteste und wohl auch bekannteste Verfahren zur stereoskopischen Betrachtung ist das **Anaglyphenverfahren**. Es wurde schon Mitte des 19.Jhdts entwickelt und stützt sich auf die Verwendung von Farbfiltern. Als Ausgangsbasis dient ein Stereobildpaar, wobei das linke Bild rot und das rechte Bild in der Komplementärfarbe Cyan (bzw. Blau oder Grün) eingefärbt wird. Die beiden Bilder werden dann überlagert und mittels Rot-Grün- bzw. Rot-Blau- (Cyan)-Brille betrachtet. Dadurch, dass auf Grund der Farbfilter das linke Auge nur die Bildanteile aus dem linken Bild und das rechte Auge nur die aus dem rechten Bild wahrnimmt, entsteht ein stereoskopischer Eindruck. Bei der digitalen Bildbearbeitung geht man so vor, dass zunächst aus dem linken Bild der Rot-Kanal extrahiert wird. Dann wird der Rot-Kanal des rechten Bildes gelöscht und jener aus dem linken Bild eingefügt. Der Vorteil dieser Methode ist die schelle und einfache bzw. kostengünstige Erzeugung eines 3D-Eindrucks, jedoch ist eine realistische Farbdarstellung nicht möglich und die Augen ermüden schnell. Insgesamt wird der 3D-Eindruck als eher unnatürlich wahrgenommen.

Wesentlich fortschrittlicher ist da schon der Einsatz einer **Polarisationsbrille**. Hier wird von zwei Projektoren, deren Objektive so zueinander angeordnet sind, dass sie dem menschlichen Augenabstand entsprechen, jeweils ein um 90° unterschiedlich polarisiertes Bild ausgestrahlt. Eine Filterbrille sorgt dafür, dass wiederum nur das dem linken bzw. rechten Auge entsprechende Bild den Filter passieren kann. Bei diesem System kann der Betrachter das Bild bzw. den Film in Echtfarben sehen; nachteilig ist jedoch ein gewisser Verlust an Polarisation und dass bei dieser Technik gleich zwei (bei Filmen synchronisierte) Projektoren erforderlich sind (teuer!). Eingesetzt wird dieses Verfahren hauptsächlich in diversen Themenparks bzw. auch für IMAX-3D-Filme.

Die **Pulfrichbrille**, 1922 von Carl Pulfrich erfunden, nützt im Wesentlichen die Tatsache, dass das Gehirn länger braucht, um dunkle Szenen zu verarbeiten und hat deshalb unterschiedlich helle Filter für das linke und das rechte Auge. Sie ist, ähnlich der Anaglyphenbrille, sehr einfach herzustellen. Nachteilig ist die Tatsache, dass nur Bewegtbilder auf diese Weise stereoskopisch wahrgenommen werden können, weshalb das Verfahren auch für das Fernsehen von Zeit zu Zeit immer wieder genutzt wurde. Darüber hinaus wird diese Methode auch für spezielle 3D-Computermonitore eingesetzt.

Für das menschliche Auge erscheinen blaue Objekte tiefer als rote (Chromastereopsis). Die **ChromaDepth-Brille** bewirkt eine Separation der Spektralkomponenten, sodass bei Grün-Anteilen die Fokussierung optimal ist, während Rot weniger (längere Wellenlänge; die Linse ist konvexer und die Objekte erscheinen näher) und Blau mehr gebrochen wird (kürzere Wellenlänge; die

Linse ist weniger konvex und Objekte werden als weit weg empfunden). Von Nachteil ist auch hier, dass zur Erzeugung des 3D-Effekts auf eine Echtfarbendarstellung verzichtet werden muss.

Eine moderne, aber relativ aufwendige Technologie sind **Shutterbrillen**. Über einen Infrarot-Emitter wird die Shutterbrille mit dem Bildaufbau des Monitors synchronisiert; d.h. es wird abwechselnd das linke bzw. das rechte Auge abgedeckt (polarisierte Brille), sodass immer nur das „richtige" Auge das entsprechende Teilbild zu sehen bekommt. Da der ständige Wechsel zwischen zwei leicht versetzter Ansichten effektiv die Bildrate halbiert, war dieses Verfahren noch bis vor kurzem ausschließlich Monitoren mit Bildröhre (CRT – Cathode Ray Tube) vorbehalten, da nur diese mit einer ausreichend hohen Bildwiederholfrequenz betrieben werden konnten (ab 120 Hz). Shutterbrillen sind bislang die einzige Möglichkeit, um stereoskopische 3D-Grafik auch auf einem herkömmlichen Monitor mit unverfälschten Farben darzustellen. Die Halbierung der effektiven Bildrate nimmt das Auge jedoch als störendes Flimmern wahr, sodass ein längerer Aufenthalt vor dem Bildschirm zur Ermüdung des Betrachters führt. Bekannt wurde diese Technik vor allem durch den Einsatz bei Computerspielen (z.B. Elsa 3D Revelator).

2.1.2 Head-Mounted Displays (HMD)

HMDs werden insbesondere für Virtual Reality- bzw. Augmented Reality-Systeme benötigt. Hier dient die Brille nicht nur der Erzeugung des stereoskopischen Effekts, sondern ist zugleich auch der Bildschirm. Über eine Spezialoptik vor jedem Auge erfolgt die gleichzeitige Projizierung zweier horizontal leicht versetzter Bilder. Der Vorteil dieser Displays ist die hohe Mobilität und das Eintauchen in die (virtuelle) stereoskopische Abbildung, da der Nutzer nicht durch sonstige optische Reize aus der realen Umgebung irritiert wird, sondern visuell nur das Abbild am Display wahrnimmt. Von Nachteil sind das relativ begrenzte Blickfeld, die (derzeit) noch zu geringe Auflösung der Displays, sowie die Tatsache, dass auch hier nach einer gewissen Zeit Ermüdungserscheinungen zu erwarten sind.

2.1.3 Autostereoskopische Displays

Wegen der Anwenderfreundlichkeit sind in Zukunft wohl eher jene Sichtgeräte interessant, die ohne Verwendung zusätzlicher Sehhilfen auskommen. Besonders das Segment der Autostereoskopischen Displays ist 2003/2004 von einer signifikanten Erweiterung der Produktpalette gekennzeichnet. Nahezu alle namhaften Displayerzeuger brachten in diesem Zeitraum eine autostereoskopische Variante eines Monitors auf den Markt. Dabei wurden aus technologischer Sicht unterschiedliche Lösungsansätze realisiert, die unterschiedlichen Anforderungen genügen und jeweils ihre spezifischen Vor- und Nachteile aufweisen. Autostereoskopische Technologien im Bereich der virtuell-dreidimensionalen Systeme sind **Richtungsmultiplex-Verfahren**. Diese unterscheiden sich primär in der Technik der Bildtrennung. Folgende Gliederung der Richtungsmultiplex-Verfahren orientiert sich an Klaus SCHENKE und Siegmund PASTOOR [SCH-02] vom Heinrich-Hertz-Institut für Nachrichtentechnik in Berlin:

- **Beugungsbasierte Ansätze** (Linsenraster Displays – Lentikulartechnik, zwei Teilbilder, Pixelebene plus Linsenraster-Platte, drei Betrachtungszonen für ungestörte Stereowiedergabe, Einschränkungen: Ein-Personen-Display, Head-Tracker notwendig, Halbierung der horizontalen Auflösung, 60% der Helligkeit geht verloren, Barriere-Streifen sind sichtbar, Entwickler: Heinrich-Hertz-Insititut für Nachrichtentechnik, Berlin bzw. A.C.T. Kern GmbH (Prototyp „Cabrio Screen"), Uni Kassel – IPM Institut)
- **Brechungsbasierte Ansätze** (LCD-Display mit Prismenmaske plus Feldlinse und Kollimator, Entwickler: TU Dresden (Dresden 3D))
- **Reflexionsbasierte Ansätze** (Retro-reflektives Verfahren – einfallendes Licht wird über Spiegelsystem in die ursprüngliche Richtung reflektiert, Vorteil: volle Auflösung, Einschränkungen: Ein-Personen-Display, Head-Tracker notwendig, Helligkeit auf 25% reduziert)
- **Parallaxenbasierte Ansätze**
  - *„Einfache" Parallaxenbarriere* (nur ein Stereobildpaar, Vorteil: horizontale Auflösung wird im Vergleich zu Multiview-Parallax-Barrieren „nur" halbiert, Einschränkungen: Ein-Personen-Display (nur im „Sweet Spot" stereoskopisches Sehen möglich), Hersteller: z.B. Sanyo)
  - *Multiview-Parallax-Barrieren* (mehrere Teilbilder unterschiedlicher Perspektive werden horizontal nebeneinander angeordnet, wellenlängenselektives Filter-Array (WLSFA = drei Farbfilter für Rot, Grün und Blau) blockt je nach Betrachtungswinkel die Komplementärfarben der Subpixel jedes Teilbilds ab, üblich sind derzeit acht Bildpaare, möglich sind – je nach Displayauflösung – beim aktuellen Stand der Technik bis zu 24 Perspektiven, Vorteil: Mehr-Personen-Display, Mehrfachansichten- (Multiview-) Display, Einschränkungen: deutliche Verringerung der horizontalen Auflösung, Reduzierung der Helligkeit, starkes Übersprechen, Hersteller: Opticality Corp. bzw. X3D Technologies GmbH und div. Lizenznehmer (siehe Abb.1))
  - *Parallaxbeleuchtungstechnik* (ein spezielles Beleuchtungsraster befindet sich hinter den LCD-Zellen, Vorteil: umschaltbar zwischen 2D / 3D, Einschränkungen: Ein-Personen-Display („Sweet Spot"), Halbierung der horizontalen Auflösung, deutliche Helligkeitsverluste im 3D-Modus, Hersteller: DTI, Sharp)
  - *Moving-Slit Verfahren* (ein CRT-Monitor zeigt zeitsequentiell vollständige Bilder unterschiedlicher Perspektive (16 Perspektiven mal 60Hz = 960Hz), eine Feldlinse bildet den Schlitz in das Betrachterauge ab, über jede Schlitzposition werden n Streifenbilder dargestellt, die Streifenbilder korrespondieren über alle Schlitze, in einem Schlitz sieht man Teilbilder aus n Perspektiven, Entwickler: Holotron)

Am weitesten verbreitet sind derzeit **Parallaxenbarriere**- und **Linsenbasierte Systeme**, die zum Teil schon Serienreife erlangt haben und bei dem zu erwartenden Preisverfall für derartige Displays in den nächsten Jahren mit hoher Wahrscheinlichkeit den Markt erobern werden.

2.2 Real-dreidimensionale Systeme

Zu den Real-dreidimensionalen Systemen sind alle voxelbasierten Verfahren, das sind **elektro-holographische** und **volumetrische Verfahren**, sowie – als Sonderform – **sphärische Displays** zu zählen. Im Unterschied zu den voxelbasierten 3D-Sichtgeräten wird bei sphärischen Displays der 3D-Eindruck durch die Form des Sichtgerätes selbst wiedergegeben. Für voxelbasierte Verfahren kann folgende Kategorisierung vorgenommen werden (vergl. auch[SCH-02]) :

- **Elektro-holographische Displays** (Laser-Scanner-Spiegel-System mit vertikalem Diffusor, Einschränkungen: monochrom, erforderliche Datenrate extrem hoch, nur computergenerierte Modelle darstellbar, Entwickler: MIT Media Lab)
- **Volumetrische Verfahren** (Einschränkung: Die dargestellten Objekte erscheinen transparent, da die Vordergrund-Voxel das Licht des Hintergrundes nicht absorbieren können)
    - *Vector-Scan-Verfahren* (Laserscanner, Doppelhelix aus weißbeschichtetem Kunststoff, 40 000 Voxel je Farbe, Entwickler: Uni Stuttgart)
    - *Raster-Scan-Methode* („Perspecta“: 200 radial versetzte Bilder, 768 x 768 Pixel, acht Farben, Bildfrequenz 20Hz, 90 Mio. Voxel (siehe Abb.3), Entwickler: Actuality Systems)

Zu den ersten Prototypen eines sphärischen Displays zählt das **„Fully Immersive Spherical Projection System“ (**auch als „Cybersphere“ bzw. als „SPIN“ (**S**pherical **P**rojection **In**terface) bezeichnet (Abb. 2); Hersteller: VR Systems UK). Entwickelt wurde dieses in Verbindung mit Immersive Reality-Systemen zur Überwindung der begrenzten Bewegungsfreiheit (z.B. Reichweite des Head-Tracking-Systems). Kern dieses sphärischen Projektionssystems ist eine lichtdurchlässige Kugel (Durchmesser 3,5 m), welche in einer Vorrichtung gelagert ist, die eine Rotation der Kugel in allen Richtungen erlaubt. Der Betrachter gelangt über einen verschließbaren Einstieg in das Innere der Kugel und versetzt durch seine Bewegung die Kugel in Rotation. Dadurch, dass in der Kugel praktisch kein visueller Kontakt zur Außenwelt besteht, taucht der User gleichsam in die virtuelle Umgebung ein, die auf diese Kugel projiziert wird.

3 EINSATZMÖGLICHKEITEN IN KARTOGRAPHIE, GEOINFORMATION UND RAUMPLANUNG

Insbesondere mit Hilfe autostereoskopischer Displays mit Mehrfachansichten (z.B. der Firma X3D Technologies GmbH) ließen sich bestehende Vertreter virtueller Hypergloben, virtuelle Tellurien und Planetarien, aber auch virtuelle Blockbilder (etwa zur Visualisierung geologischer Schichten), Gelände-, Landschafts-, und Stadtmodelle, bis hin zu einzelnen Bauwerken, Denkmälern, usw. mit relativ geringem Aufwand und zu vergleichsweise geringen Kosten mit in hohem Maße realistischer optischer Raumtiefe realisieren. Dies könnte in manchen Fällen sogar die Anfertigung von realen Modellen, etwa im Bereich der Architektur und Stadtplanung, überflüssig machen; vor allem dann, wenn es darum geht, in möglichst kurzer Zeit ein räumliches Modell zur Verfügung zu haben bzw. mehrere Varianten eines Modells derselben Geometrie mit unterschiedlichen Texturen - etwa zu Vergleichszwecken - heranziehen zu können. Im Übrigen könnten dabei, verglichen mit der Anfertigung realer Modelle, Produktions- und Materialkosten gespart werden (auch auf Grund des geringeren Zeitaufwandes bei einer digitalen Realisierung). Neue Formate, wie z.B. X3D-OpenGL-Enhancer (steht nicht in Verbindung zum offenen Standard der 3D-Modellierungssprache X3D), bieten sogar die Möglichkeit, mit Hilfe des OpenGL-Grafikstandards digitale 3D-Modelle per User-Interface auf einem herkömmlichen Bildschirm interaktiv zu drehen und zu bewegen, während gleichzeitig mehrere Personen auf einem zweiten, mit wellenlängenselektivem Filterarray beschichteten TFT- oder Plasma-Display das Objekt aus unterschiedlichen Perspektiven stereoskopisch betrachten können, wie es ansonsten nur mit realen Modellen möglich ist. Die Firma X3D Technologies GmbH etwa gibt auf ihrer Webseite bekannt, dass unter Einsatz des OpenGL-Enhancers zahlreiche, weit verbreitete (Web3D-)Standards (wie z.B. VRML, Shockwave3D, ...) unterstützt werden. Interessant ist auch die Tatsache, dass mit Hilfe von Tools dieser Firma („X3D zWarper“) 2D-Bilder mittels Tiefenkarte in 3D-Ansichten konvertiert werden können (Nachteil: die Objekte erscheinen nicht plastisch, sondern eher wie Kulissen ohne räumliche Tiefe). Nichtsdestotrotz müsste es mit dieser Technik möglich sein, bildbasierte (fotografische) virtuelle Rundgänge auf der Basis interaktiver 360°-Panoramen und -Objekte (QTVR, iPIX, ...) für eine autostereoskopische Präsentation aufzubereiten.

Abb.1: Auf X3D-OpenGL-Enhancer basierende, interaktive autostereoskopische Applikation, links: herkömmliches Display mit User Interface, rechts: autostereoskopische Visualisierung mittels Multiview-Parallax-Barrieren (www.4d-vision.de bzw. www.opticalitycorporation.com)

Für den Bereich digitaler Globen sind besonders sphärische Displays von Bedeutung. Derartige Sichtgeräte sind Voraussetzung für die Realisierung von taktilen Hypergloben. Bei ihnen ist das Sichtgerät zugleich Globenkörper - ähnlich wie dies bei analogen Globen der Fall ist [RIE-04]. Beim „Fully Immersive Spherical Projection System" („Cybersphere"), ebenfalls als sphärisches Display realisiert, befindet sich der Nutzer inmitten der Kugel; d.h. diese umgibt ihn von allen Seiten (Immersive Reality) und die Abbildung auf die Sphäre erfolgt von außen mit Hilfe von vier (fünf, bei einer zusätzlichen Projektion von oben) Projektoren. Um eine korrekte Geometrie bei der Abbildung auf die Kugeloberfläche sicherzustellen, müssen die zu projizierenden Bilder allerdings vorher entsprechend verzerrt werden. Mit einem derartigen System könnte etwa zu Simulationszwecken mit Sicherheit ein Maß an Realismus beim Begehen virtueller Landschaften erreicht werden, wie es sonst kaum möglich wäre. Allerdings erreichen derzeitige VR-Systeme beim Echtzeit-Rendering noch nicht das fotorealistische Niveau der diversen 3D-Modellierungs- und Animationssoftwarepakete. Es ist aber wohl nur noch eine Frage der Zeit, bis entsprechende Programme bzw. entsprechend leistungsstarke Supercomputer dafür zur Verfügung stehen. Ein Immersive Reality-System wie „Cybersphere" scheint jedoch für den Massenmarkt einerseits zu kostspielig zu sein, anderseits wird dafür sehr viel Platz benötigt. So wird in absehbarer Zeit wohl eher im Bereich der kostengünstigeren DesktopVR-Systeme ein Innovationsschub zu erwarten sein - ausgelöst durch den zu erwartenden Preisverfall bei autostereoskopischen TFT- und Plasma-Displays.

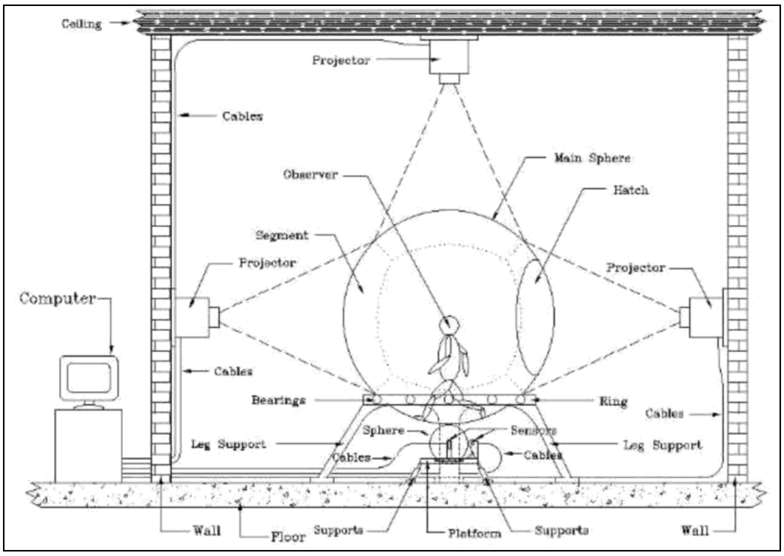

Abb.2: „Cybersphere" - sphärisches Display für Immersive Reality Systeme (www.vr-systems.ndtilda.co.uk)

Die voxelbasierten real-dreidimensionalen Visualisierungssysteme sind die jüngste Entwicklungsstufe bei autostereoskopischen Displays. Es gibt bisher de facto nur diverse Prototypen volumetrischer bzw. holographischer Displays, die sich in unterschiedlichen Entwicklungsstadien befinden. Deren Einsatz in den Geowissenschaften ist sicherlich ein langfristiges Ziel, zumal einzig bei dieser Form der Visualisierung die dargestellten Inhalte wie ein reales Modell, ohne dass dafür ein spezielles User-Interface bereitgestellt werden muss, interaktiv studiert werden können, indem der Betrachter einfach um das elektronische Objekt herumgehen kann. Gegenüber realen Modellen hätten diese den Vorteil, dass mit den vorhandenen Daten kurzfristige Aktualisierungszyklen bzw. Modifikationen des digitalen Modells mit relativ geringem Aufwand möglich wären. So könnte etwa ein volumetrisches Modell einer Landschaft über Internet quasi bearbeitet und geupdatet werden bzw. könnten Wissenschaftler oder auch nur Interessenten, die sich nicht am selben Ort befinden, über das Web – so ferne sie über ein entsprechendes Display mit Anschluss an das Internet verfügen – das realräumlich-dreidimensionale Modell unabhängig von ihrem Aufenthaltsort studieren. Das elektronische Modell braucht somit, im Gegensatz zu einem materiellen, nicht transportiert zu werden und man läuft auch nicht Gefahr, dass es beschädigt wird. Vor allem aber zur dreidimensionalen Visualisierung dynamischer Sachverhalte scheinen volumetrische bzw. holographische Displays besonders geeignet zu sein (z.B. räumliche Darstellung des An- und Abflugverkehrs im Nahbereich von Flughäfen). Das weltweit erste kommerzielle volumetrische Display in Form einer Kugel („Perspecta") wurde bereits der Öffentlichkeit vorgestellt. Über ein System aus rotierenden Spiegeln bzw. über einen rotierenden Diffusorschirm werden 200 radial versetzte Bilder (768 x 768 Pixel, acht Farben, Bildfrequenz: 20Hz) zur Erzeugung von 90 Mio. Voxel genutzt. Als Anwendungsgebiete der Displays werden von der Firma medizinische, militärische und georäumliche Visualisierungen angeführt.

Abb.3: „Perspecta" – erstes kommerzielles volumetrisches Display (www.actuality-systems.com)

Zusammenfassend können folgende Anforderungen an das „ultimative" 3D-Display formuliert werden [SCH-02], [KAP-04]:

- Hohe Bildqualität (Orts- und Farbauflösung, Kontrast usw.)
- Autostereoskopisch und freier Blick von allen Seiten
- Multiview- / Multiuser- fähig
- Kein optisches übersprechen
- Umschaltbar zwischen 2D und 3D
- Kompakte Bauform (Flachdisplay)
- preiswert

4 AUSBLICK

Derzeit ist ein klarer Trend zu autostereoskopischen Lösungen zu beobachten. Die Vorteile derartiger Systeme sind vor allem darin zu sehen, dass einerseits das Betrachten der stereoskopischen Darstellung nicht wie bei den „Brille-plus-Bildschirm"-Systemen zur Ermüdung der Augen führt, was insbesondere bei einer langen Verweildauer vor dem Bildschirm wichtig ist (z.B. bei der fotogrammetrischen Auswertung eines Luftbildpaares) und dass andererseits bestimmte autostereoskopische Techniken es mehreren Personen gleichzeitig erlauben, den 3D-Effekt wahrzunehmen, weshalb solche Systeme sich auch hervorragend für Präsentationszwecke eignen würden. Man kann davon ausgehen, dass – wie so oft - zunächst vor allem für autostereoskopische Displays aufbereitete Computerspiele gleichsam als Pioniere auf den Markt drängen werden, um der ohnehin hart umkämpften Spiele-Branche einen neuen Impuls zu geben. Aktuelle Sichtgeräte verfügen allerdings noch nicht über eine entsprechende Auflösung, um den Betrachtungsabstand reduzieren zu können und den Verlust an horizontaler Auflösung, vor allem bei Systemen mit Mehrfachansichten, einigermaßen in Grenzen zu halten. Doch auch hier zeichnet sich bereits eine Lösung ab, da hochauflösende Displays zunehmend für den Normalverbraucher erschwinglich werden und derzeit die technologische Entwicklung insbesondere bei LCD / TFT-, Plasma- und DLP-Displays enorme Fortschritte macht. Ist einmal ein gewisser Verbreitungsgrad autostereoskopischer Displays erreicht, so werden sicherlich auch andere Anwendungsbereiche verstärkt darauf reagieren. Insbesondere jene Wissenschaften, bei denen der Raum bzw. die Visualisierung räumlicher Sachverhalte im Vordergrund steht (Geowissenschaften, Kartographie, Raumplanung, Astronomie, ...), könnten von einer derartigen Entwicklung enorm profitieren. Man stelle sich etwa vor, wie auf diese Art ganze Stadtmodelle in öffentlichen Gebäuden einem breiten Publikum stereoskopisch vorgeführt werden könnten. Ebenfalls ein enormes Potenzial können real-dreidimensionale Visualisierungssysteme aufweisen. Allerdings steckt hier die Entwicklung eher noch in den Kinderschuhen. Volumetrische und holographische Displays bergen für die Zukunft sicherlich ein enormes Potenzial als Präsentations- und Informationsmedium, da sie – so wie materielle Modelle – auch ohne Interaktionskomponente aus allen Richtungen studiert werden können, indem der Nutzer sich um die Visualisierungsform herum bewegt. Im Bereich der Geowissenschaften könnten außerdem globale Phänomene anhand von Hypergloben, die dann auch wirklich eine realräumliche Ausdehnung aufweisen würden, visualisiert werden.

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Display – Anbieter (Auswahl):

www.vr-systems.ndtilda.co.uk	VR Systems – Cybersphere
www.actuality-systems.com	Actuality Systems – volumetrisches Display
www2.automation.siemens.com	Siemens – Multiview-Parallax-Barrieren Displays
www.ddd.com	Dynamic Digital Depth – Parallaxenbarriere Displays
www.sharp3d.com	Sharp - Parallaxbeleuchtungstechnik
www.dti3d.com	Dimension Technologies Inc. - Parallaxbeleuchtungstechnik
www.actkern.info	A.C.T. Kern GmbH & Co. KG – Linsenraster Displays, Lenticulartechnik
www.4d-vision.de	X3D Technologies GmbH, Opticality Corp. - Multiview-Parallax-Barrieren Displays, X3D-Tools
www.opticalitycorporation.com	Opticality Corp. - Multiview-Parallax-Barrieren Displays, X3D-Tools
www.seethree.at	SeeThree – diverse 3D-Displays, österreichischer Vertriebspartner für X3D Technologies

Informationssysteme kultureller Objekte im virtuellen Umfeld – eine kartografische Betrachtung

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1 EINLEITUNG

Denkmäler und Kulturgüter sind stille Zeugen der kulturellen Entwicklung und Identität eines Kulturraumes oder einer Region. Ihre Verwaltung zum Schutz und zur Instandhaltung, Beachtung im Planungs- und Widmungsprozess und Vermittlung für eine historisch interessierte Öffentlichkeit ist eine zentrale und gesetzlich verankerte Aufgabe zuständiger Behörden und Institutionen [BDA01]. Im Zusammenhang mit dieser Öffentlichkeitsarbeit ist die Umstellung der Arbeitsmethodik vom "Analogen" zum "Digitalen" noch in Durchführung und ein besonders bedachter Prozess, da in Anbetracht des umfassenden Datenbestandes enormer Arbeitsaufwand bei Umstellungen der Methodik und Arbeitsweise aufzubringen ist.

Alleine an die Technik besteht daher die Forderung nach anpassbaren, portierbaren (erneuerbaren) und erweiterbaren Formaten, die zukünftigen Entwicklungen und Ansprüchen gerecht werden können. Proprietäre und veraltete Lösungen bei Datenbanksystemen erfordern gegenwärtig oftmals Ergänzungen der Struktur und des Formates, die die Öffnung für eine Internet-Verfügbarkeit und Kombination mit anderen Datenbanken ermöglichen.

Aus der Sicht von Widmungs- und Planungsverfahren scheint es sinnvoll, geeignete Informationssysteme zur Verfügung zu haben, die über geschützte und schützenswerte Objekte und Denkmäler Auskunft geben und diese Information anschaulich vermitteln können. Durch einen, wenngleich auch inhomogenen, räumlichen Bezug des Datenbestandes scheint besonders die Kartografie ein wirksames Werkzeug für die Informationsvermittlung zu sein. Mit dem Einsatz virtueller Realität und besonderer Mensch-Computer Schnittstellen können weitere Wege der Informationserschließung beschritten und angeboten werden, die möglicherweise den Wirkungsgrad und das Verständnis herkömmlicher räumlicher Informationssysteme erhöhen.

2 ALLGEMEINE DARSTELLUNG ZUM ZWECK VON „MULTIMEDIALEN“ KULTUR-DATENBANKEN

Die kulturelle Identität einer Gesellschaft wird durch historische Geschehnisse, Ausprägungen, Strömungen und deren Überlieferung in die Gegenwart geformt. Sieht man Identität als psychologisches Konzept, werden bestehende äußere Merkmale einer Gruppenidentität als eigenes Wesensmerkmal, als eigene Identität angenommen [Wiki01]. Der zeitliche Transfer (von der Vergangenheit in die Gegenwart) eines kulturellen Merkmales kann durch bestehende Repräsentanzen (Objekte) bewusst gemacht und exploriert werden. Dieser steht im direkten Zusammenhang mit dem Erhalt von materiellen und immateriellen Kulturobjekten der literarischen, graphischen und architektonischen Kunst- und Anwendungsformen. Die Beurteilung und Interpretation dieser überlieferten Objekte ermöglicht den Einblick in Vergangenes und ist generell Grundlage für ein breiteres Verständnis. Es wird leicht erkennbar, dass das fortwährende Bestehen und der Zugang zu solchen Kulturobjekten oder Denkmälern ein wichtiges Element für die kulturelle Beschreibung einer Region und Bevölkerung und so ein wichtiger Faktor für dessen Wirtschaft und Fremdenverkehr sein kann.

Denkmalschutz und kulturelles Erbe sind gesamtgesellschaftliche Anliegen, deren Erfolg auf integratives Engagement der Behörden, beteiligter Öffentlichkeit und unterstützender Eigentümer basiert [BDA01]. Die Zusammenarbeit, Aktivitäten und Verknüpfungen der Interessen dieser drei Gruppen zum Erhalt und der Dokumentation des Kulturgutes sind grundlegend für die Nutzung und das Bewusstsein der eigenen kulturellen Identität. Die Behörde kann die rechtlich verankerten Funktionen und Schutzmaßnahmen nicht delegieren und muss diese behördlichen Aufgaben selbst ausüben, der Eigentümer kann in seiner Position den Denkmalschutz ermöglichen (private Anlagen können nur mit Zustimmung des Eigentümers unter Denkmalschutz gestellt werden) und die Öffentlichkeit bestätigt durch ihre Beteiligung die Wichtigkeit einer Sache.

Geht man vom Interesse zum Bewusstsein an den eigenen kulturellen Wurzeln bei den beteiligten Parteien (Behörde, Öffentlichkeit, Eigentümer) aus, kann ein öffentlich zugängliches (WWW) und leicht verständliches (kartografisches) Informationssystem für die Vermittlung der und den Zugang zu raumbezogenen Kulturinformationen von Nutzen sein.

Denkmäler umfassen eine breite Palette von Elementen, auch wenn nur materielle Objekte in Betracht gezogen werden. Eine Festlegung auf ortsfeste Elemente (im Gegensatz zu beweglichen Kunstobjekten) erleichtert Verwaltungsmechanismen (über die Zuordnung zu Verwaltungseinheiten) und die Verortungsfrage für die Kartografie. Bei beweglichen Objekten muss die Verortungsbasis (Herstellungsort, Handelsort, Gebrauchsort, ...) definiert und beschrieben werden. Die Dokumentation, Erhaltung und Restaurierung ortsfester Denkmäler wird vom Bundesdenkmalamt nach internationalen Kriterien durchgeführt [BDA01]. Diese Arbeit ist generell öffentlich zugänglich und verlangt in nächster Zukunft einen öffentlichen Zugang oder eine Plattform im WWW.

Im Gegensatz zur Denkmalpflege liegt die Zuständigkeit der Ortsbildpflege bei den betroffenen Verwaltungseinheiten, Landeshauptmann oder Bürgermeister. Diese entscheiden über die Anbringung und das Ausmaß von Werbeflächen und genehmigen die architektonische Ausformung von Neubauten, sofern diese nicht gesetzlich eingeschränkt ist. Aber selbst in Schutzzonen gibt es Möglichkeiten, die Erhaltungsfunktion des Denkmalamtes zu umgehen. Wird beispielsweise in einer Schutzzone eine Abbruchgenehmigung erteilt, ist das Denkmalamt für den Neubau nicht mehr zuständig [§2a Denkmalschutzgesetz, Stand 1999]. Dann entscheidet das Ortsbildverständnis des Bürgermeisters oder seiner Berater über die neue Erscheinung. Besonders in diesem Fall wäre zur Steigerung des Verständnisses und der Bewusstseinsbildung des eigenen Kulturgutes „Ortsbild“ der unumgängliche Einsatz eines immersiven kartografischen Informationssystems hilfreich. Zumindest wäre eine zugängliche Initiative nach dem Vorbild ISOS in der Schweiz [www.isos.ch] ein nutzbringendes Werkzeug.

Die Dokumentation, Verwaltung und Vermittlung schützenswerter Bereiche und Objekte ist ein wichtiger Schwerpunkt in der Archäologie und den historischen Wissenschaften. Aktuelle Projekte diverser Veranstaltungen (CAA, VAST, CIPA, ...) zeigen momentan ein digitales Aufnehmen – die Dokumentation – von historisch interessanten Objekten. Hierzu werden photogrammetrische Auswerteverfahren verfeinert und Prozessabläufe automatisiert. Großteils ist das angestrebte Ziel eine digitale Kopie des Originalobjekts, um eine breitere wissenschaftliche Bearbeitung und Interpretation zu ermöglichen. Der Zugang und die Verteilung der digitalen Objekte erfolgt häufig über das Internet oder sonstige digitale Medien.

Betrachtet man diese Dokumentationstätigkeit und Datenschaffung aus der Sicht der Langzeitarchivierung, wird die Notwendigkeit von potentiellen Zugängen zu den einzelnen Daten, die eine gute Strukturierung und Durchsuchbarkeit anbieten, ersichtlich. Neben der Lebensdauer von physischen Speichermedien, Laufwerken und proprietären Datenformaten ist eine unübersichtliche, inhomogene und unstrukturierte Datenmenge das größte Problem der Langzeitarchivierung. Bereits heute kann man beobachten, dass digitale Dokumente in einer unüberschaubaren Datenflut nicht aufgefunden werden. In diesem Aspekt sind die Autoren überzeugt, dass ein kartografisches Informationssystem durch seine Ausnützung der räumlichen Strukturen, Dimensionen und deren Suchmöglichkeiten einen grafischen multilingualen Zugang zu den Daten der Archäologie und des Kulturgüterschutzes (mit räumlichem Bezug) anbieten kann. Die Überlegungen basieren auf der menschlichen Wahrnehmung, der Wissensverarbeitung und den Prozessen der Wissensstrukturierung [Jobst04]. Entsprechende Schnittstellen zwischen Mensch und Computer zur effizienten und immersiven Informationsübertragung werden dabei vorausgesetzt.

Gegenwärtig sind textbasierte, somit sprachabhängige, Datenbanksysteme oder auch Geografische Informationssysteme (für raumbezogene Daten) als Verwaltungs- und Analyse-Werkzeuge im Einsatz. Zumeist setzt ihre Anwendung spezielle Kenntnisse zur Programmbedienung voraus. Die Applikation und ihre Struktur werden oftmals auf einen bestimmten Bereich (räumliche Ausdehnung, Inhalt, o.ä.) eingeschränkt und verwenden angepasste Datenstrukturen. Für ein nachhaltiges Informationssystem mit kartografischer Informationsvermittlung sollte eine flexible Datenstruktur – zumindest ein einheitlicher Standard der Datenbeschreibung – für eine mögliche Kombination unterschiedlicher Systeme angestrebt werden.

3 GEGENWÄRTIGER STAND VON KULTUR-OBJEKT INFORMATIONSSYSTEMEN

Seit der Etablierung jener akademischen Disziplinen, die sich mit dem kulturellen Erbe befassen, also – grob gesagt – seit der zweiten Hälfte des 19. Jahrhunderts, werden Materialsammlungen angelegt, die einen möglichst umfassenden Zugang zum jeweiligen Forschungsgegenstand ermöglichen sollen. Diese Corpora [Exampl04], ursprünglich in Buchform vorgelegt und durch immer neue Bände aktualisiert und erweitert, werden in den letzen Jahren vermehrt auf digitale Publikationsformen umgestellt bzw. um solche erweitert. Als Beispiele seien hier für das Gebiet der Klassischen Archäologie die Web-Datenbank des Beazley Archives in Oxford [Beazley04], die Arachne-Datenbank zur antiken Plastik, Köln [Arachne04], oder Ubi Erat Lupa, eine Datenbank zu römischen Steindenkmälern, Wien [UEL04], genannt; für das Gebiet der Epigraphik etwa die Datenbank Clauss/Slaby in Frankfurt [CLAUSS04] oder die Epigraphische Datenbank Heidelberg [EDH04]. Daneben wurden Plattformen geschaffen, z.B. die Bilddatenbank des Perseus-Projektes [PDL04] oder die Website des Stoa-Consortiums [Stoa04], auf welcher digital aufbereitetes Text- und Bildmaterial abrufbar ist.

Es ist absehbar, dass in naher Zukunft bereits ein guter Teil der Materialsammlungen nur mehr in Form von elektronischen Ressourcen verfügbar sein wird. Die Gründe dafür liegen auf der Hand: Es ist schlichtweg einfacher und billiger, Material, das ohnehin schon üblicherweise seit den Achtziger Jahren des letzten Jahrhunderts in Datenbanken erfasst und strukturiert wird, auch in Form von Web-Datenbanken zu publizieren, zumal diese Form der Veröffentlichung nicht nur den potentiellen Benutzerkreis vervielfacht, sondern auch weitaus mächtigere und effizientere Methoden zur Exploration der verfügbaren Information anbietet.

Angesichts der großen Zahl und des bisweilen enormen Umfanges der "digitalen Corpora" stellt sich nun aber die Frage nach einem gemeinsamen Zugang zu dem darin verfügbaren Wissen. Eine Unzahl von unabhängigen und vollkommen verschieden strukturierten Datenquellen soll unter gemeinsamen Aspekten abgefragt, die erzielten Ergebnisse sollen abgeglichen und miteinander dargestellt werden können. Traditionell wurden die Corpora durch aufwendig erstellte Indizes und Konkordanzen erschlossen. Ein Weg, der unter den neuen Gegebenheiten nur bedingt Erfolg versprechend erscheint. Zwar stehen zur verbalen Exploration schon umfassende Thesauri und Strukturierungshilfen wie AAT [AAT04] oder MDA [MDA04] online zur Verfügung, in der Praxis unterscheiden sich die einzelnen Datenquellen durch unterschiedliche Forschungsansätze und fachliche, nationale und persönliche Besonderheiten der Autoren(teams) dermaßen stark, dass ein gemeinsames Vokabular kaum Konsens finden wird. Überdies müsste dieses erst aufwendig erstellt und implementiert werden.

Als Alternative wird hier die Integration der Daten über den Verortungsaspekt vorgeschlagen, mit anderen Worten: Man macht sich den Umstand zu Nutze, dass (fast) alle materiellen Gegenstände aus dem Bereich des kulturellen Erbes von ihrer Herstellung bis zur modernen Aufstellung bzw. Verwahrung eine Vielzahl von verortbaren Bezugspunkten aufweisen. Durch den zunehmenden Einsatz von GIS und die Referenzierbarkeit der Bezugspunkte in Bezug auf Online-Ressourcen wie ADL [ADL04] oder TGN [TGN04] erscheint dieser Ansatz durchaus plausibel. Der Schwerpunkt verlagert sich dabei von der verbalen Exploration von Information über Wortlisten hin zu einer grafischen

Benutzerschnittstelle, die in vielen Kulturwissenschaften eine lange und ehrwürdige Tradition hat, zur Landkarte. Verteilungskarten dienen seit jeher der Visualisierung von Ergebnissen der archäologischen und kunsthistorischen Disziplinen. Die nun zur Verfügung stehenden technischen Möglichkeiten lassen aber einen neuen Aspekt in den Vordergrund treten: Hier dient die Karte zusätzlich als mächtiges und flexibles Werkzeug auf der Suche nach Information. Ein eingehender Blick auf vorhandene technische Lösungen im Internet zeigt zum Großteil schlechtes und rundum unbrauchbares Kartenmaterial (durch Scannen digitalisierte Papierkarten). Einige Implementationen lassen allerdings das Potential einer solchen Benutzerschnittstelle sehr wohl erkennen. Dazu zählen unter anderem verschiedene Projekte von ECAI [ECAI04], wo interaktive, via Zeitleiste veränderbare Karten angeboten werden, oder das Elektronische Denkmalmanagement in Niedersachsen [EDMN04], das – zur Zeit nur im Intranet verfügbar – bereits beeindruckende Visualisierungen vorhandener Datenbestände für Anwendungen im Bereich e-Government zu liefern vermag.

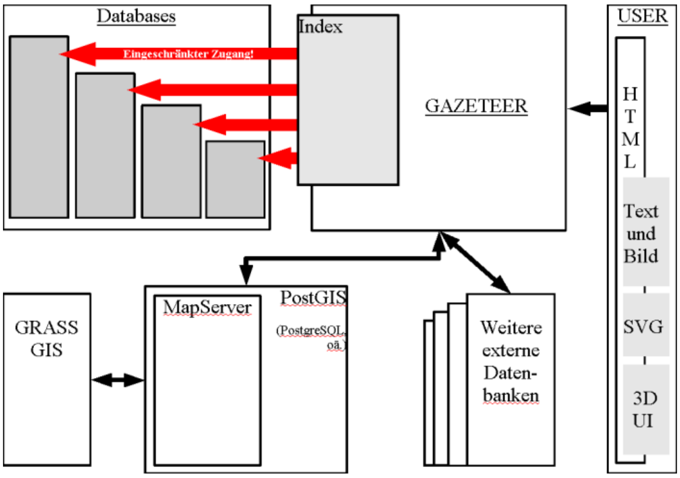

Abbildung 1: Struktur eines kartografischen Gazeteer

4 INFORMATIONSVERMITTLUNG MIT RÄUMLICHEM BEZUG

Allgemein dient ein Informationssystem der rechnergestützten Erfassung, Verarbeitung, Analyse, Verbreitung und Vermittlung von Information [Wiki01]. Die Datenbank ist also nur ein Bestandteil des kompletten Ganzen. Folgt man Panyr (1986) [Panyr86] und formalisiert die Beschreibung eines Informationssystems, kann diese als 7-Tupel dargestellt werden: Informationssystem IS = (A,W,Q,I,E,U,D); wobei A die Inputfunktion zum Aufbau der internen Repräsentation, W die interne Repräsentation per se, Q die Inputmenge als Menge der zugelassenen Problemformulierungen (Suchfragen), I die Outputfunktion (Ergebnisfunktion), E die Outputmenge aller möglichen Problemlösungen, U die Updatefunktion der internen Repräsentation (entspricht einer Lernfunktion) und D die Dialogkomponente, das Interface, darstellt.

Aus dieser formalen Struktur wird erkennbar, dass der für den Benutzer sichtbare Teil, das User Interface, nur einem Teil zugeteilt ist. Der Informationsinhalt und -umfang ist jedoch von dem Großteil der Tupel abhängig. Für ein kartografisches Informationssystem, in dem eine bestimmte angefragte Information vermittelt werden soll, müssen dementsprechende Problemformulierungen, Outputfunktionen und Updatefunktionen implementiert sein und passend zu diesen für die effiziente Vermittlung eine Dialogkomponente beschrieben oder modelliert werden. Diese Verknüpfung der Funktionen mit den verwendeten Mengen könnte grundsätzlich als Selektion oder Anpassung des Informationssystems an Schwerpunkte und Aufgaben gesehen werden, die vom Modellierenden, in diesem Fall dem Kartografen, durchgeführt wird.

Sobald sich der Entwickler auf Schwerpunkte konzentriert und bestimmte Aufgaben ermöglicht, sollte es seine Pflicht sein, die Bedürfnisse und Verhalten der Anwendergruppe zu berücksichtigen und nicht nur technische Möglichkeiten zu realisieren. Somit könnte ein besseres Verständnis von den Anwendern gegenüber der Anwendung und des Systems erwartet werden, wenn eine ebenso (in der Entwicklung) beachtete Mensch-Computer Schnittstelle vorausgesetzt wird [Dransch02]. Die Gleichstellung von Informationssystem und menschlicher Einheit ist für theoretische Überlegungen bei der Entwicklung von Benutzerschnittstellen in der kognitiven Wissenschaft eine übliche und angesehene Vorgehensweise. Vom Standpunkt des Entwicklers eines IS werden die theoretischen Betrachtungen zwar als Grundlagen verwendet, jedoch erscheint dieser Vergleich durch die selbst durchgeführte Dateninterpretation, den Bau der Funktionalitäten und Freigabe von Interaktivitäten kontrovers.

Die Interpretation, Vereinfachung und Hervorhebung räumlich bezogener Daten in der topografischen und thematischen Kartografie stützt sich auf das gut dokumentierte Regelwerk der Semiologie. Abhängig vom graphischen Ausgabegerät sind für die visuelle konfliktfreie Darstellung Mindestdimensionen und -abstände der Elemente erforderlich. Mit Berücksichtigung dieses Regelwerkes kann ein hoher Wirkungsgrad der visuellen Informationsübertragung erreicht werden [Bertin74]. Unter demselben Aspekt, bestimmte Informationsteile für eine bessere Übertragung zu betonen und hervorzuheben, kann der Einsatz von multimedialen Technologien gesehen werden. Diese betonen mit anderen Übertragungskanälen der menschlichen Sensorik die gewünschte Information. So kann der Betroffene die

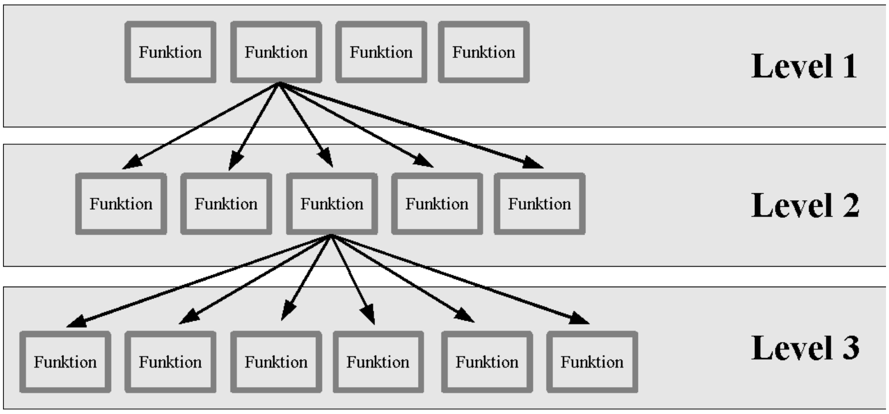

Abbildung 2: Strukturierung der Funktionen nach Wissensstand

Übertragungsart seinen individuellen Aufnahmeeigenschaften anpassen. Multimedia dient somit als unterstützendes Werkzeug für die Informationsübertragung [Gartner et al 02].

Aus vorangegangenen Überlegungen ist der „Wirkungsgrad" eines IS vom Verständnis und der Anwendbarkeit durch den Benutzer abhängig. Üblicherweise wird diese Anwendergruppe bei der Modellierung der Benutzerschnittstelle in Experten und Laien unterteilt. Diese Klassifizierung erscheint zunächst sinnvoll, verlangt jedoch nach einer näheren Beschreibung des Fachbereiches und dementsprechend einer weiteren Unterteilung. Die Ersteller eines raumbezogenen Informationssystems werden Experten in der Geodatenverarbeitung und Geomedientechnik sein und meistens durch das Fachwissen ihres Bereiches keine Schwierigkeiten mit der Anwendung des IS haben. Fachexperten aus anderen Bereichen, wie z.B. Archäologen, setzen sich auch mit raumbezogenen Daten auseinander. Sie müssen aber nicht unbedingt Fachwissen im Geo-Bereich besitzen, um ihre Arbeiten durchführen zu können (bei Bedarf werden „Geo-Experten" konsultiert). Dementsprechend sind die Experten aus anderen Fachbereichen für die Geodatenverarbeitung als „Laien" anzusehen.

Man erkennt die Schwierigkeit bei der Benutzerklassifizierung, wenn der räumliche Bezug mit seinen fachspezifischen Besonderheiten (Projektion, geodätisches Datum, Bezugsellipsoid) als Werkzeug im Informationssystem anderer Disziplinen herangezogen wird. Nachdem Kartografie als Hilfsmittel zur Vermittlung raumbasierter Informationen verwendet wird, besteht die Anforderung bei einem solchen IS, die Input- und Outputmengen und -funktionen so in die Dialogkomponente einzubauen, dass diese je nach Ausprägung der Wissensbasis zugänglich werden [Abbildung 2]. Einen möglichen Lösungsweg für diese Einteilung bildet eine hierarchische Funktionenstruktur, wobei die Funktionen eines höheren Wissensstandes schwerer zugänglich sind als Basisfunktionen, die auch für weniger versierte Benutzer verfügbar sind.

Die Informationsvermittlung vom IS zum Benutzer kann als „Geo-Kommunikation" bezeichnet werden. Nach Grundsätzen der Kommunikationstheorie kann nur jene Information vermittelt und übertragen werden, die in die Wissensstruktur und -basis des Benutzers aufgenommen werden kann (also Teil der Insel des Wissens ist) [Hills02, Yates89]. Je größer die Überschneidung der „Wissensbasen" von Sender und Empfänger, umso erfolgreicher die Kommunikation, somit die Übertragung der Information. Sucht man also nach der größten gemeinsamen Basis für die Vermittlung von raumbezogenen Daten, findet man sich in der Beschreibung des Raumes wieder, der durch die menschliche Sensorik und Wahrnehmung geprägt ist und wird [siehe auch Jobst04b]. Die unterschiedlichen Beschreibungen des Raumes sind zu einem gewissen Maß abstrahiert und reichen von textlichen Beschreibungen über grafische Abbildungen bis zu virtuellen Welten. Letzteres wird für die Vermittlung großmaßstäblicher Situationen immer häufiger eingesetzt. Eine Begründung dieses beliebten Einsatzes ist möglicherweise der geringe Abstraktionsgrad und damit ein leichteres Verständnis der präsentierten raumbezogenen Information.

Die technische Ausformung der Benutzerschnittstelle ist ein weiterer Aspekt bei der Informationsvermittlung. Beispielsweise können mit geeigneten technischen Hilfsmitteln, wie stereoskopischer Brillen, echte räumliche Eindrücke geschaffen werden, während herkömmliche Bildschirme die dritte Dimension nur wieder auf einer Ebene abbilden, also eine Pseudo 3D Darstellung verwenden. Die Ausformung der Benutzerschnittstelle und ihre Verwendung der menschlichen Wahrnehmungsparameter trägt also auch einen wichtigen Teil zu der räumlichen Informationsvermittlung bei.

Über den Raumbezug der verwalteten Informationen, in diesem konkreten Fall kulturelle Objekte, kann ein geografisch-grafischer Zugang und somit eine grafische Strukturierung dieser Daten durchgeführt werden. Wenngleich für die Einbindung der Daten besonderes Expertenwissen der Geodatenverarbeitung erforderlich ist, sollte besonders nach kartografischer Modellierung die Informationsexploration und -vermittlung effizienter gestaltet werden können.

5 DATENVIELFALT UND GRAFISCHE VARIABLE

Das kartografische Informationssystem kultureller Objekte soll mit seinem „Gazeteer" auf unterschiedlichste Kulturgüter-Datenbanken zugreifen und deren Inhalt mittels grafischer Oberfläche zugänglich und explorierbar machen. Die grafischen Variablen Form, Farbe und Größe für diese punkthaften Kartenelemente sind einerseits schnell aufgebraucht (da durch die Zusammenführung der DB eine Vielzahl gleichrangiger Objekte vereint werden) und beanspruchen andererseits den größten Teil der grafisch verfügbaren Fläche, da für ihre Erkennbarkeit eine Mindestgröße und nur geringe Überlappung aneinander liegender Elemente zugelassen werden darf.

Ein denkbarer Lösungsweg dieser grafischen Problematik ist die Rasterflächenbildung. Viele Punkte werden zu einer flächenhaften Darstellung verrechnet und mittels Intensität oder Farbverlauf visualisiert. Im Resultat können die einzelnen Objekte nicht mehr wahrgenommen werden, da nur eine Verteilung dargestellt wird. Abhängig von der Formulierung der Frage für den Zugang zu den Daten könnte diese Darstellung ausreichend sein und damit Konflikte der punkthaften Darstellung lösen helfen. Je mehr Objektdaten flächenhaft visualisiert werden können, desto mehr Freiraum bleibt für die Verwendung von weiteren Punkten und Linien (Objekte und Topografie).

Bei digitalen Karten haben sich Bildschirme (mit multimedialer Unterstützung) als weit verbreitetes Übertragungsmedium etabliert. Die Informationsvermittlung ist also zum großen Teil grafisch. Die verfügbare Fläche für die visuelle Übertragung ist bei einem Bildschirm mit der Bildschirmdiagonale und seiner Auflösung begrenzt. In jedem Fall ist die Ausgabe am Billdschirm gemäß den technischen Bauteilen (Streifenmaske, Strichmaske) gerastert, auch wenn in der Anwendung Vektorformate verwendet und dargestellt werden. Somit werden alle sichtbaren Elemente aus einzelnen Pixeln zusammengesetzt. Zur Verdeutlichung der begrenzten Fläche sei folgendes Beispiel angeführt:

Angenommen sei eine Bildschirmauflösung von 1024x768 Pixel. Dann stehen nur 786.432 Bildpunkte für die Informationsübertragung zur Verfügung. Eine punkthafte Signatur als Quadrat verwendet mindestens 4x4 Pixel plus einen Rahmen, um von anderen Elementen unterscheidbar zu sein. Die Gesamtfläche zur Minimaldarstellung eines Quadrates benötigt demnach 6x6, also 36 Pixel [Neudeck01]. Die Anzahl der darstellbaren Elemente ist nach dieser Rechnung mit 21845 begrenzt, wobei damit keine zusätzliche Information (über Topografie) oder gar andere Formen und Größen berücksichtigt werden können.

Soll die grafische Ausformung der Karte das Portal zu den Datenbankinformationen bilden, steht die Modellierung der „Inputfunktionen" (Abfragemöglichkeiten, Inputmenge) und die daran hängende visuelle Aufbereitung im Mittelpunkt. Das Idealbild einer Karte für den Bildschirm könnte möglicherweise durch die Lösung einer Extremwertaufgabe mit den Parametern der zu übertragenden Information festgelegt werden.

6 VERORTUNGSPROBLEMATIK

Viele der bestehenden Datenbanken kultureller Objekte berücksichtigen nicht die Koordinaten (Lage und Höhe) der Objekte als geografische Referenz. Vielmehr wurden und werden teilweise politische Grenzen und Grundstücke zur Verortung verwendet. Daraus ergibt sich eine temporale Problematik einerseits und die Ungenauigkeit der geografischen Referenz andererseits.

Die temporale Problematik steht im Zusammenhang mit Grundstücks-, Adress- und Namenänderungen. Eine eindeutige Bezugsfläche kann nur dann angegeben werden, wenn historische (vergangene) Zustände verfügbar sind.

Die Unsicherheit der geografischen Referenz basierend auf politischen Grenzen ergibt sich im besten Fall allein durch variierende Grundstücksgrößen. Die Position des Objektes auf einem Grundstück entzieht sich bereits der Kenntnis. Werden andere politische Grenzen als Bezugspunkt (besser: Fläche) verwendet, also Gemeinde, Bezirk oder gar Land, entstehen bei der Kombination von diesen unterschiedlichen Referenzen besondere Inhomogenitäten der Lagegenauigkeit, die den Kartografen vor eine besondere Herausforderung stellt und eine Lösung in der Visualisierung erfordert.

7 NAHE ZUKUNFT UND MEDIALE VISION

Gegenwärtige Intentionen für die Verwaltung kultureller Objekte lassen große Erwartungen für den Einsatz der Kartografie als multilinguales Portal zur Datenexploration und -selektion entstehen. Die Kartografie kann dieser Aufgabe höchstwahrscheinlich gerecht werden, wenn die damit verknüpften Probleme gelöst werden können.

Die Entwicklung der Benutzerschnittstellen scheint den Einsatz von multimedialen Elementen in der Kartografie zu unterstützen. Die breite Verwendung von mobilen Endgeräten mit Ton, Kamera und Farbdisplay ist ein Grundstein für eine allgegenwärtige Multimediakartografie. Projektstudien in Richtung größerer und sparsamer Displays unter dem Schlagwort „elektronisches Papier" können erste Erfolge aufweisen. Zweifärbige Lösungen sind bereits am Markt erhältlich. Ebenso gibt es Forschungsschwerpunkte im Bereich „Augmented Reality", die durch ihre Kombination von Realität und virtuellen Objekten für einen kartografischen Zugang und die Vermittlung kultureller Objekte hilfreich sein können.

Der kulturelle Verwaltungsapparat wird durch die virtuellen Möglichkeiten nicht seiner Tätigkeit enthoben. Der Schutz und die Pflege kulturell wertvoller Objekte müssen weiterhin durchgeführt werden, um folgenden Generationen die regionale Identität erfahrbar machen zu können. Der digitale Zugang bietet seinerseits intensivere Präsentationsmöglichkeiten, wenn neuartige Benutzerschnittstellen verwendet werden, und kartografische Hilfsmittel als unterstützende Werkzeuge bei der Wissensvermittlung durch Strukturierung mit räumlichen Parametern.

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[PDL04] The Perseus Digital Library, http://www.perseus.tufts.edu/
[Stoa04] The Stoa Consortium, http://www.stoa.org/
[AAT04] Art & Architecture Thesaurus Online (AAT), http://www.getty.edu/research/conducting_research/vocabularies/aat/
[MDA04] Archaeological Objects Thesaurus (MDA), http://www.mda.org.uk/archobj/archcon.htm
[ADL04] Alexandria Digital Library (ADL), http://webclient.alexandria.ucsb.edu/client/gaz/adl/index.jsp
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Umgang mit dem Ungewissen – Simulationsmodelle im Umwelt- und Naturschutz

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1 EINLEITUNG

Simulationsmodelle zur Modellierung von Lebensräumen sind im Umwelt- und Naturschutz von zunehmender Relevanz. Die Autoren haben sich mit unterschiedlichen Möglichkeiten der Modellierung und Visualisierung von Eingriffen und Auswirkungen von Maßnahmen auseinandergesetzt. Als Beispiel wird der Wespenbussard, eine Anhang-I Art* der Vogelschutzrichtlinie (VS-RL) in der Gemeinde Dechantskirchen im Steirischen Joglland beschrieben.

Die Ausweisung von Natura 2000-Gebieten und die damit verbundenen Pflichten erfordern den Nachweis des Erhaltungszustandes der Schutzobjekte, eine effiziente und rasche Umsetzung von Managementplänen und das Monitoring von unterschiedlichen Tier- und Pflanzenarten der FFH- und Vogelschutzrichtlinie (vgl. ELLMAUER 2004). Dem Vogelschutz kommt im Themenbereich des Naturschutzes nicht zuletzt deswegen eine zentrale Rolle zu, weil der Schutz der Vögel und ihrer Lebensräume in der Regel auch zahlreichen anderen Arten zugute kommt (KARNER et al. 1997). Im Zuge der Realisierung von Plänen oder Projekten in Schutzgebieten wird der Lebensraum der unterschiedlichen Vogelarten verändert. Diese Veränderungen bewirken oftmals eine Einschränkung des Lebensraumes und können im schlimmsten Falle zu einer Verdrängung einer Vogelart im betreffenden Gebiet führen. Derartige erhebliche Beeinträchtigungen sollen in Natura 2000-Gebieten durch das Instrumentarium der Naturverträglichkeitsprüfung (NVP) verhindert werden.

In großen Gebieten ist die flächendeckende Kartierung von Vogelarten im Rahmen der genannten Schutzverpflichtungen sehr zeitaufwändig und mit hohen Kosten verbunden. Eine Eingrenzung der Habitate mit Hilfe einer Modellierung kann helfen, die Arbeit eines Ornithologen effizienter zu gestalten (BOGNER, FUCHS 2004). In jüngerer Zeit wurde das GIS (Geoinformationssystem) wiederholt erfolgreich bei der Darstellung potenziell geeigneter sowie zur Detailanalyse tatsächlicher genutzter Vogelhabitate eingesetzt (vgl. GOTTSCHALK 1995; RASS, WIEDNER 1998; THOMPSON et al. 2004). Habitate von Anhang-I Arten der Vogelschutzrichtlinie wurden bereits auf unterschiedliche Weise bewertet (vgl. BOGNER 1999, GOLOB et al 1999, GALLAUN et al. 2004; vgl. auch ELLMAUER 2004). Neben der Modellierung von Lebensräumen ermöglicht ein Simulationsmodell jedoch auch die Simulation der Auswirkungen von Eingriffen und Maßnahmen auf das Habitat verschiedener Vogelarten..

2 HABITATMODELLIERUNGEN

2.1 Anwendungen von Modellierungen

Im Zuge der Erstellung des Managementplans, im Rahmen der Natura 2000-Berichtspflicht sowie für Naturverträglichkeitsprüfungen werden Aussagen über Verbreitung und Bestandsgröße der Anhang I-Arten der Vogelschutzrichtlinie benötigt. Um diese Aussagen treffen zu können, sind in der Regel ornithologische Kartierungen notwendig. Die Modellierung der Verbreitung einer Anhang I-Art kann zwei unterschiedliche Beiträge hierzu leisten:

Fall 1: Die Lebensräume einer Art werden modelliert. Im Anschluss daran muss die Art in allen als potenziell geeignet ausgewiesenen Flächen kartiert werden.

Fall 2: Im Anschluss an die Modellierung erfolgt eine Kalibrierung mit Hilfe einer ornithologischen Kartierung auf Teilflächen (Ermittlung gebiets- und lebensraumtypischer Siedlungsdichten) und darauf basierend eine Hochrechnung des Bestands für das Gesamtgebiet.

Die Modellierung einer Art gemäß Fall 2 erfordert gewisse Bedingungen:

Die Art muss potenziell geeignete Lebensräume annähernd gleichmäßig besiedeln.

Die Art darf nicht reliktär oder sehr lückig im Gebiet verbreitet sein. Ist dies gegeben, ist eine Bestandshochrechnung auf ein größeres Gebiet unmöglich und liefert keine zufriedenstellenden Ergebnisse. Eine Habitatmodellierung ermöglicht jedoch das leichtere Auffinden von Reliktvorkommen vor Ort.

Das Untersuchungsgebiet muss eine ausreichende Größe aufweisen. In einem Gebiet der Größenordnung der Gemeinde Dechantskirchen (2.395 ha) ist dies nur für einigermaßen häufig auftretende Kleinvögel gewährleistet. Vögel mit weitläufigen Revieren können bei der Modellierung nur mit geringer Wahrscheinlichkeit erfasst werden.

Als Ergebnis einer Modellierung werden Flächen mit unterschiedlicher Habitateignung ausgewiesen. Eine punktuelle Verortung des Vorkommens einer Art kann durch eine Modellierung nicht erfüllt werden.

2.2 Vor- und Nachteile aus ornithologischer Sicht

Gegenüber der üblichen (nicht GIS-unterstützten) ornithologischen Kartierung in einem Untersuchungsgebiet bringt eine Habitatmodellierung folgende Vorteile:

* Der Anhang I der Richtlinie 79/409/EWG vom 2. April 1979 über die Erhaltung der wildlebenden Vogelarten listet jene in den Mitgliedstaaten heimischen Arten auf, die hier gemäß den Bestimmungen der Richtlinie insbesondere durch die Einrichtung von Schutzgebieten (Special Protection Areas im Rahmen des Schutzgebietsnetzwerks Natura 2000) einen besonderen Schutz genießen. Die Richtlinie hat neben dem Schutz auch die Nutzung (Jagd, Handel) dieser Arten zum Gegenstand.

Eine wohlüberlegte Kombination von Modellierung und Kartierung lässt bei vorgegebenem Budgetrahmen die fachlich besten Ergebnisse erwarten. In sehr großen Gebieten ist eine direkte Kartierung aller vorkommenden Anhang-I Arten im Gesamtgebiet oder auch nur in allen potenziell geeigneten Teilflächen schwer durchführbar und sehr teuer. In solchen Gebieten ist eine Modellierung mit nachfolgender Teilkartierung und Hochrechnung ein effizienter Weg, Aussagen zu den Bestandsgrößen der einzelnen Anhang-I Arten treffen zu können.

Durch die klare Definition der benötigten Parameter für die verschiedenen Arten werden jene Einschränkungsschritte nachvollziehbar, die in der üblichen Kartierung vom Ornithologen vor Ort mehr oder minder intuitiv und subjektiv getroffen werden. Auch bei einer reinen ornithologischen Kartierung wird nicht überall nach allen Arten gesucht, sondern der Experte schränkt nach seiner Erfahrung und seinem Wissen die möglichen Flächen schon vor der Kartierung ein.

Die Ergebnisse einer Modellierung sind durch die vorangegangene Parametrisierung und die kausalen Zusammenhänge stets nachvollziehbar. Viele für die Erhaltung einer Anhang-I Art notwendigen Maßnahmen zur Erhaltung und Verbesserung des natürlichen Lebensraumes können unmittelbar aus den Kausalzusammenhängen abgeleitet werden.

Langfristig gesehen liefert die Darstellung potenziell geeigneter Lebensräume – bei entsprechender „Eichung" durch eine direkte ornithologische Kartierung – die realistischeren Ergebnisse, da die Kartierung in einer Brutsaison immer nur den Charakter einer Momentaufnahme aufweist.

Die Darstellung potenziell geeigneter Habitate kompensiert die bei direkten Kartierungen in großen Gebieten kaum vermeidbaren Übersehfehler.

Als wesentliche Nachteile einer Modellierung gegenüber einer reinen ornithologischen Kartierung sind unter anderem zu nennen:

Ausreißer werden nicht berücksichtigt. Ausreißer sind jene Individuen einer Vogelart, die ein für die Art untypisches Habitat besiedeln.

Durchziehende Vögel werden zum Großteil nicht erfasst.

Bei einer Modellierung mit nachfolgender Teilkartierung und Hochrechnung ist die genaue Verortung der tatsächlichen aktuellen Vorkommen nur in den kartierten Teilflächen gewährleistet.

3 HABITATMODELLIERUNG IN EINEM TEILGEBIET DES STEIRISCHEN JOGLLANDES

Im Untersuchungsgebiet Dechantskirchen im Natura 2000-Gebiet „Teile des steirischen Jogl- und Wechsellandes" wurden Habitatmodellierungen zu fünf Anhang-I Vogelarten der Vogelschutzrichtlinie bearbeitet. Modelliert wurden die Horst- und Nahrungslebensräume von Schwarzstorch (*Ciconia nigra*), Wespenbussard (*Pernis apivorus*), Heidelerche (*Lullula arborea*), Wachtelkönig (*Crex crex*) und Neuntöter (*Lanius collurio*). Aufgrund der vorhandenen Daten zur Landnutzung und Biotopausstattung des Gebietes wurde die Konzentration auf Anhang I-Vogelarten gelegt, deren Lebensraum entweder zur Gänze in der offenen (waldfreien) Kulturlandschaft liegt oder zumindest teilweise (z.B. als Nahrungslebensraum) offene Kulturlandschaftstypen umfasst. Ziel der Modellierungen war es, Teilflächen des Untersuchungsgebietes in denen die Arten zu erwarten sind auszuweisen.
Die Lebensraumansprüche der jeweiligen Art wurden parametrisiert und in einem GIS ausgewiesen. Die Ergebnisse der Modellierungen wurden anschließend durch eine ornithologische Kartierung geeicht und verifiziert. Im Anschluss an die Modellierung wurden die Auswirkungen von unterschiedlichen Maßnahmen sowie von Veränderungen der Kulturlandschaft auf das Vorkommen der einzelnen Vogelarten simuliert.

Im Folgenden gehen wir auf die Modellierung des Wespenbussards näher ein.

3.1 Ablauf der Modellierung

Der Lebensraum des Wespenbussards wurde in 5 unterschiedlichen Arbeitsschritten modelliert.

Parametrisierung von Lebensraumansprüche der Vogelart durch Experteninterviews

Umsetzung der Parameter im GIS

Modellierung der Horst- und Nahrungslebensräume in einem Raster GIS

Eichung der Modellierung durch eine vogelkundige Kartierung

Simulation der Auswirkungen von geplanten Maßnahmen und Eingriffe

3.1.1 Parametrisierung von Lebensraumansprüchen der Vogelart durch Experteninterviews

Ziel der Experteninterviews war, die Standortansprüche des Wespenbussards zu parametrisieren, um das ornithologische Wissen so gut wie möglich mathematisch umzusetzen. Dabei wurden basierend auf der art- und regionalspezifischen Fachliteratur (z. B. BAUER, BERTHOLD 1996; HAAR 1997; GLUTZ VON BLOTZHEIM 2001) und auf persönlichen Erfahrungen limitierende Grundbedingungen (Constraints) für die Habitateignung und Bedingungen für eine besondere Habitateignung (Factors) unterschieden. Die Grundbedingungen müssen erfüllt sein, um das Vorhandensein einer Art zu ermöglichen. Bedingungen für eine besondere Habitateignung können optional zutreffen und die Wahrscheinlichkeit des Antreffens einer Art erhöhen. Am Beispiel des Wespenbussards wurden die Parameter für den Horst- und Nahrungslebensraum wie folgt festgelegt:

Kriterien für		Anmerkung
Habitateignung (Constraints)	**Besondere Habitateignung (Factors)**	
Horststandort: • Wald bis 1.300 m • Nicht in Schattenlage	• Alter nicht intensiv genutzter Waldbestand • Besondere thermische Gunstlage • Klamm- und Schluchtgebiete • Ruhelage (> 300 m Entfernung zu Siedlung und Hauptverkehrsträgern	
Nahrungslebensraum: • Grünland bis 1.300 m • Mäßig intensive bis extensive Nutzungstypen • Nicht in Schattenlage (NW-NE)	• Nähe (< 1.000 m) zu besonders geeigneten Horststandorten • Besondere thermische Gunstlage • Besonders gut strukturiertes Grünland • Ruhelage (> 300 m Entfernung zu Siedlung und Hauptverkehrsträgern)	• Antreffwahrscheinlichkeit steigt mit der Flächengröße (besonders) geeigneter Habitate, d.h. bei „Clusterung“ geeigneter Einzelflächen zu einem möglichst großflächigen Habitatkomplex

Abb. 3: Modellierungsparameter Wespenbussard

3.1.2 Umsetzung der Paramater im GIS

Als Dateninputs standen Schwarz-Weiß-Orthophotos, ein digitales Höhenmodell, eine Bodenkarte, Struktur- und Waldelemente, sowie eine Kulturlandschaftskartierung zur Verfügung. Bei der Kulturlandschaftskartierung wurde der Dauersiedlungsraum nach einem vorgegebenen Kartierungsschlüssel klassifiziert und aufgenommen. Die Landnutzungsformen wurden in 14 unterschiedliche Klassen unterschieden und in drei Intensitätsgrade eingestuft.

Tabelle 1 Landnutzungsparameter

Landnutzungstyp	Intensitätsgrad
Brache	extensiv
Aufforstungen	extensiv
Extensiv Weide verbuscht	extensiv
Extensiv Weide	extensiv
Extensiv Grünland	extensiv
Kulturweide	mäßig intensiv
Streuobstwiese	mäßig intensiv
Mähwiesen	mäßig intensiv
Wechselgrünland	intensiv
Stilllegungsfläche	intensiv
Acker alternativ	intensiv
Intensiv-Obstbau	intensiv
Acker Getreide	intensiv
Acker (Mais)	intensiv

Die benötigten Parameter wurden mit dem Raster GIS, IDRISI Kilimanjaro, erstellt. Dabei kamen Reklassifizierungen, Überlagerungen, Distanzberechnungen und Einsatz von Pufferbereichen zur Verwendung.

Tabelle 2 Aufbereitung der Parameter im GIS

Grundbedingungen (Constraints)	
Wald bis 1.300 m Seehöhe	Überlagerung des digitalen Höhenmodells (DHM) mit den Waldbeständen des Untersuchungsgebietes (Nadel, Laub, Mischwald). Alle Wälder über einer Seehöhe von 1.300 m werden bei der Modellierung außer Acht gelassen.
Nicht in Schattenlage	Aus dem DHM wurde eine Expositionskarte erstellt. Durch eine Klassifizierung wurden alle südexponierten Flächen (SO – SW) ausgewählt. Daraus erhält man die sonnenexponierten und als Habitat geeigneten Flächen.
Grünland bis 1.300 m Seehöhe	Zusammenfassen der Landnutzungstypen: Extensiv Weide, Kulturweide, Streuwiese, Mähwiese, Extensiv Grünland, Weide verbuscht und Stillegungsflächen. Eine anschließende Überlagerung mit dem digitalen Höhenmodell ergibt den Parameter Grünland.
Bedingungen für eine besondere Habitateignung (Factors)	
Mäßig intensive bis extensive Nutzungstypen	Aus der Kulturlandschaftskartierung wurden all jene Flächen ausgewählt, die durch eine extensive bis mäßig intensive Nutzung charakterisiert werden (Brache, Aufforstung, Extensiv Weide verbuscht, Extensiv Weide, Extensiv Grünland, Kulturweide, Streuobstwiese, Streuwiese und Mähwiese). Eine Addition all jener Flächen ergibt den Parameter „mäßig intensive bis extensive Nutzungstypen“.
besondere thermische Gunstlage	Hierzu werden Flächen gezählt, welche eine Hangneigung über 7° aufweisen und in südexponierter Lage sind. Es wurde somit eine Neigungskarte für das Untersuchungsgebiet erstellt und wiederum durch eine Klassifizierung bearbeitet. Die Überlagerung von Exposition und Neigung ergab den Parameter „Thermische Gunstlage“.
Ruhelage (> 300 m Entfernung zu Siedlung und Hauptverkehrsträgern)	Eine Pufferung der wichtigen Verkehrsverbindungen und Siedlungsgebiete mit einem Radius von 300 Meter ergibt den Parameter „Ruhelage“.
Gut strukturiertes Grünland	In der Landschaft vorkommende Strukturelemente, wie Baumreihen, Einzelbäume, Hecken, Baumhecken, Feldraine, Einzelsträucher, ... wurden zusammengefasst und mit einem Puffer von 100 Meter versehen. Alles Grünland, das bis zu einer Entfernung von 100 Meter zu den Strukturelementen vorkommt, wird in weiterer Folge als „gut strukturiertes Grünland“ bezeichnet.

3.1.3 Modellierung der Horst- und Nahrungslebensräume

Der erste Schritt der Modellierung bestand in einer Standardisierung und Fuzzifizierung der Eingangsdaten. Mittels einer Fuzzifizierung können ungenaue, aber im Sprachgebrauch übliche Aussagen wie: der Vogel kommt etwa in 600 – 1200 Meter Mindestabstand zu Lärmquellen vor, bei der Modellierung berücksichtigt werden. Fuzzy-Logic ist eine Methode, bestimmte Aspekte der menschlichen Sprache in technische Systeme umzusetzen (DRÖSSER 1994). Diese Einschätzungen können zur effektiven und effizienten Problemlösung herangezogen werden; damit bietet die Fuzzy Set Theorie eine interessante Alternative zur bislang üblichen zum Teil unzulässigen Vereinfachung komplexer Zusammenhänge und Probleme (BAGNOLI et al 1998).

Das Modul MCE (Multi-criteria evaluation) im Idrisi Kilimanjaro ermöglicht die Zusammenführung von Grundbedingungen und besonderen Habitateignungsfaktoren mit unterschiedlichen Gewichtungen zu einer Habitateignungskarte.

Am Beispiel des Wespenbussards wurden die Faktoren für eine besondere Habitateignung mit einer beinahe gleichen Gewichtung versehen, da die einzelnen Factors von dem Experten als etwa gleichwertig bewertet wurden. Die Ergebniskarten wurden ins ArcGIS importiert und als Layer über die ÖK (österreichische Karte 1: 50.000) gelegt. Diese Eignungskarten dienten als Grundlagen für die vogelkundliche Kartierung.

Die Ergebnisse der Modellierung werden in drei Klassen der Habitateignung unterteilt (gering, mittel, hoch). Die Überlagerung mit der ÖK ermöglicht eine überschaubare Darstellung der Ergebnisse.
Die folgenden Darstellungen befinden sich im nördlichen Teil der Gemeinde Dechantskirchen und zeigen den modellierten Nahrungs- und Horstlebensraum des Wespenbussards.

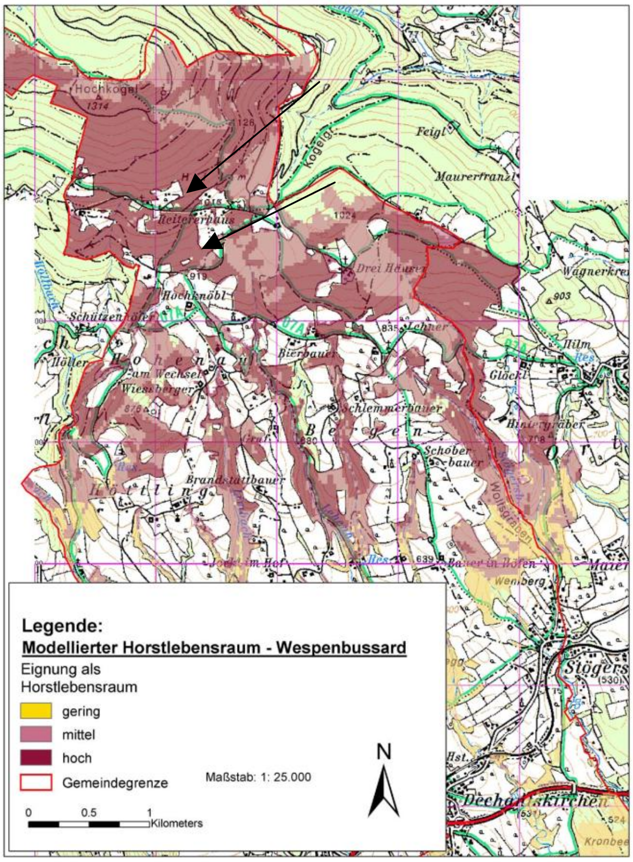

Abbildung 4 Modellierter Horststandort

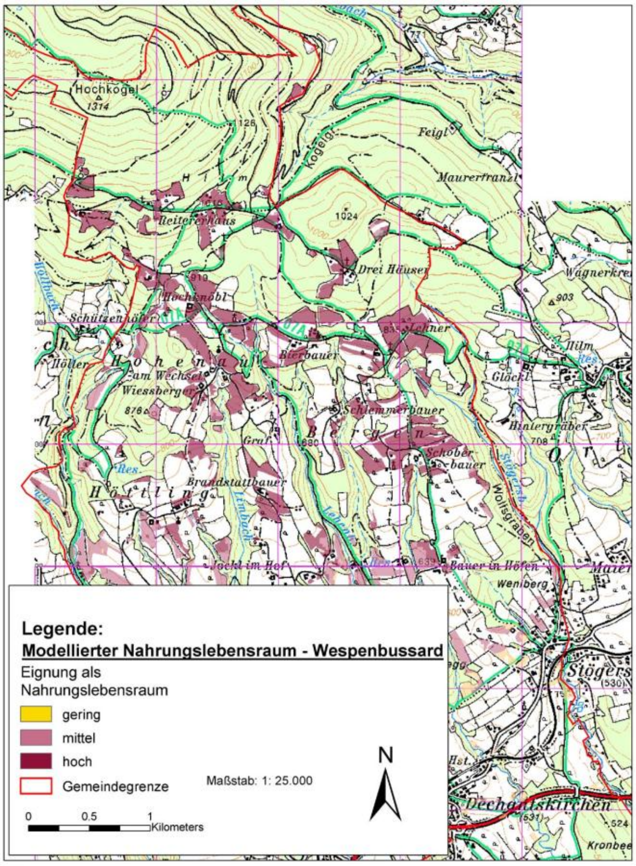

Abbildung 3 Modellierter Nahrungsstandort

3.1.4 Verifizierung der Modellierung durch eine ornithologische Kartierung

Diese modellierten Horst- und Nahrungslebensraumkarten waren Grundlagen einer anschließenden ornithologischen Kartierung. Das Vorkommen des Wespenbussards wurde an bei der Modellierung mit hoher Eignung versehenen Flächen verifiziert (schwarze Pfeile in Abb. 2). Im Nordwesten des Untersuchungsgebietes wurde aufgrund dieser Vorkommensnachweise ein Revier lokalisiert. Die Fundorte zeichnen sich durch eine vielfältige und kleinräumige Landschaftsgliederung mit südlicher Exposition und nährstoffarmen Hangwiesen aus. Der Ornithologe bestätigte, dass bei der Modellierung die geeigneten Lebensräume des Wespenbussards als potenzielle Flächen ausgewiesen wurden.

3.1.5 Visualisierung von Maßnahmen und Eingriffen

Die Modellierung von Habitaten von unterschiedlichen Vogelarten erleichtert die vogelkundliche Aufnahme und ermöglicht die Darstellung von Auswirkungen unterschiedlicher Eingriffe in den betreffenden Lebensraum. Die Auswirkungen von unterschiedlichen Maßnahmen, Eingriffen und Veränderungen können ohne großen Mehraufwand an Zeit simuliert werden. Die Simulation von geplanten Maßnahmen auf bestimmte Schutzgüter kann als Entscheidungshilfe bei Planungen eingesetzt werden.

Am Beispiel des Wespenbussards wurden drei unterschiedliche Auswirkungen von Eingriffen simuliert:

Auswirkungen auf den Nahrungslebensraum des Wespenbussards durch

Szenario 1: Intensivierung der Nutzung landwirtschaftlicher Flächen im Nordosten des Untersuchungsgebietes.

Szenario 2: Entfernung von Strukturelementen in der Landschaft.

Auswirkungen auf den Horststandort des Wespenbussards durch

Szenario 3: Siedlungswachstum und Straßenausbau im nördlichen Bereich der Gemeinde Dechantskirchen.

Die Eingriffe bewirkten in allen drei Fällen eine starke Reduzierung der als Habitat geeigneten Flächen.

Szenario 1

Die Intensivierung der Landwirtschaft ergibt eine Veränderung der Grundbedingungen. Der Parameter „mäßig intensive bis extensive Nutzungstypen“ wurde hinsichtlich des Intensitätsgrades verändert. Einzelne landwirtschaftliche Flächen im nordöstlichen Bereich der Gemeinde wurden aus der Modellierung herausgenommen. Durch die erneute Kombination der Constraints und Factors ergibt sich eine neue stark veränderte Eignungskarte. Im Bereich der Intensivierung wird das potenzielle Vorkommen der Art ausgeschlossen da eine Grundbedingung für die Habitateignung verändert worden ist. Abbildung 3 zeigt den Vergleich zwischen dem modellierten Nahrungslebensraum des Wespenbussards ohne jegliche Einwirkungen von etwaigen Maßnahmen oder Eingriffen in die Kulturlandschaft und dem Szenario 1, einer Intensivierung der landwirtschaftlichen Nutzung. Der Kreis markiert den Bereich der Intensivierung

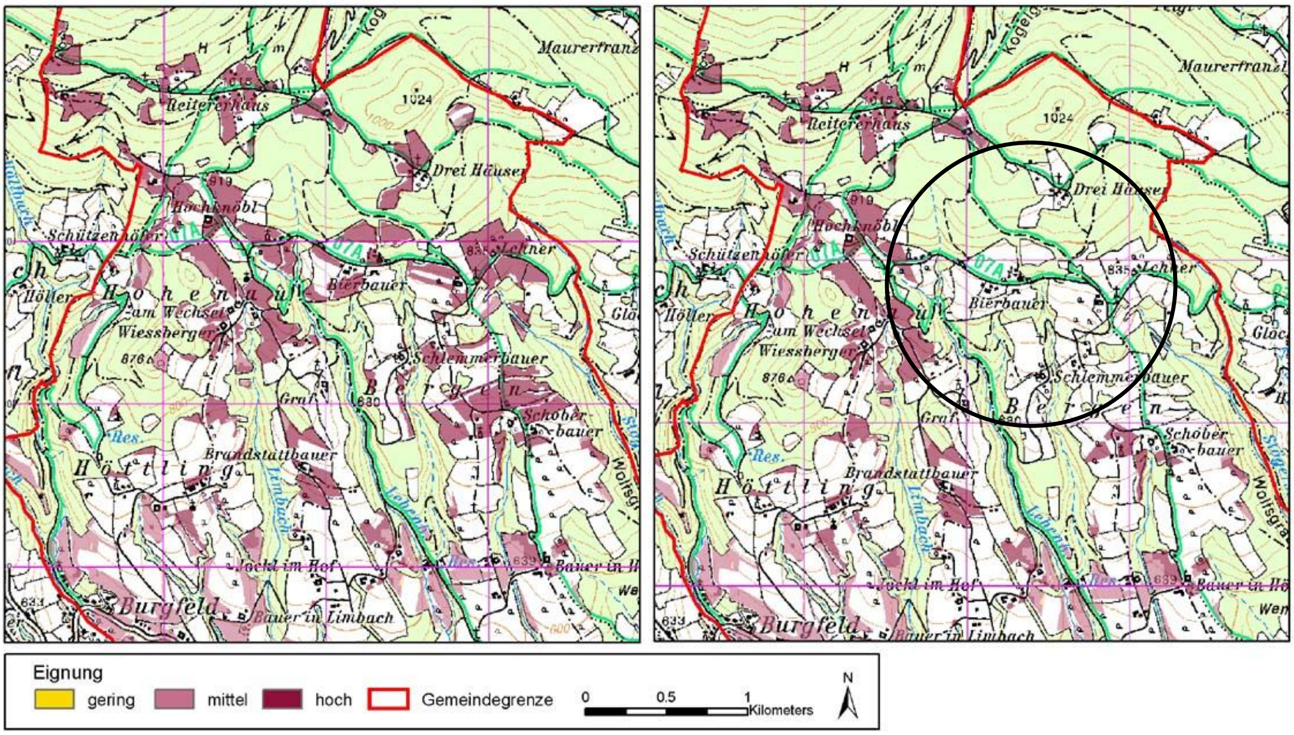

Abb. 5: Modellierter Nahrungslebensraum des Wespenbussards ohne Einwirkung von Maßnahmen (linke Abbildung) und Modellierung des Szenario 1(rechte Abbildung). Der Kreis markiert den Bereich der Intensivierung

Szenario 2

Um die Auswirkungen von Strukturverlust in der Landschaft auf das Vorkommen des Wespenbussards modellieren zu können, wurden in zwei Bereichen des Untersuchungsgebietes Strukturelemente aus den Ausgangsdaten entnommen. Dazu zählen Einzelgehölze, Sträucher, Hecken, Baumreihen und Baumhecken. Die nachträgliche Überlagerung des veränderten Rasterdatensatzes mit dem gepufferten Grünland ergibt einen veränderten Parameter „strukturreiches Grünland“.

Die Kombination der Constraints und Factors lässt eine deutliche Veränderung des potenziellen Nahrungsstandortes erkennen. Die Eignung der Habitate verringert sich in den betroffenen Bereichen. Im Unterschied zum Szenario 1 wird die Auswirkung jedoch nicht ganz so drastisch ersichtlich, da keine Grundbedingung, sondern ein Faktor der besonderen Habitateignung verändert worden ist.

Durch den Verlust an Strukturelementen in der Landschaft werden strukturreiche Grünlandkomplexe rar. Strukturreiches Grünland bedingt für den Wespenbussard eine besondere Habitateignung im Sinne des Nahrungsangebotes. Der Verlust an Strukturelementen bewirkt somit eine Verschlechterung des Nahrungslebensraums in den betroffenen Gebieten.

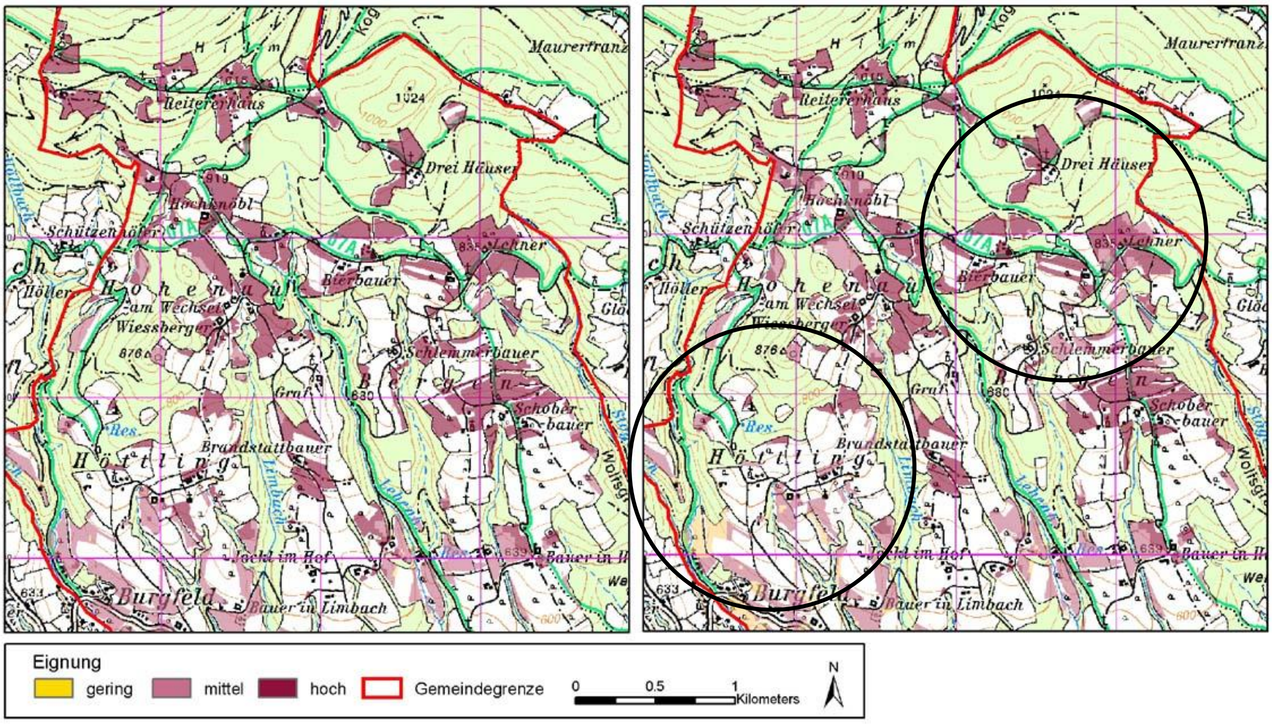

Abb. 6: Modellierter Nahrungslebensraum ohne Maßnahmen und Eingriffen (linke Abbildung) und Modellierung des Szenario 2 (rechte Abbildung). Die Kreise markieren den Bereich der Entnahme von Strukturelementen.

Szenario 3

Am Beispiel der Horstlebensraum Modellierung wird eine Zunahme der Siedlungsdichte und die Folgen eines Straßenbaus simuliert. Durch Hinzufügung von Siedlungen und der Erbauung einer imaginären Hauptverkehrsanbindung und einer anschließenden Pufferung des Datensatzes, wird der Parameter „Ruhelage" verändert. Die erneute Kombination der Constraints und Factors ergibt eine deutlich veränderte Eignung des Untersuchungsgebietes als Horststandort für den Wespenbussards. Die Auswirkungen dieser Eingriffe auf den Lebensraum des Wespenbussards lassen sich sehr gut und anschaulich visualisieren, da der Wespenbussard Ruhelagen den Umgebungen von größeren Siedlungen und Verkehrswegen als Horststandort vorzieht. Die Entfernung zu potenziellen Ruhestörungen bilden somit einen optionalen Parameter für die besondere Habitateignung eines möglichen Horststandortes. Die folgenden Abbildungen zeigen die Veränderung des Horststandortes auf, die durch dieses Szenario hervorgerufen werden.

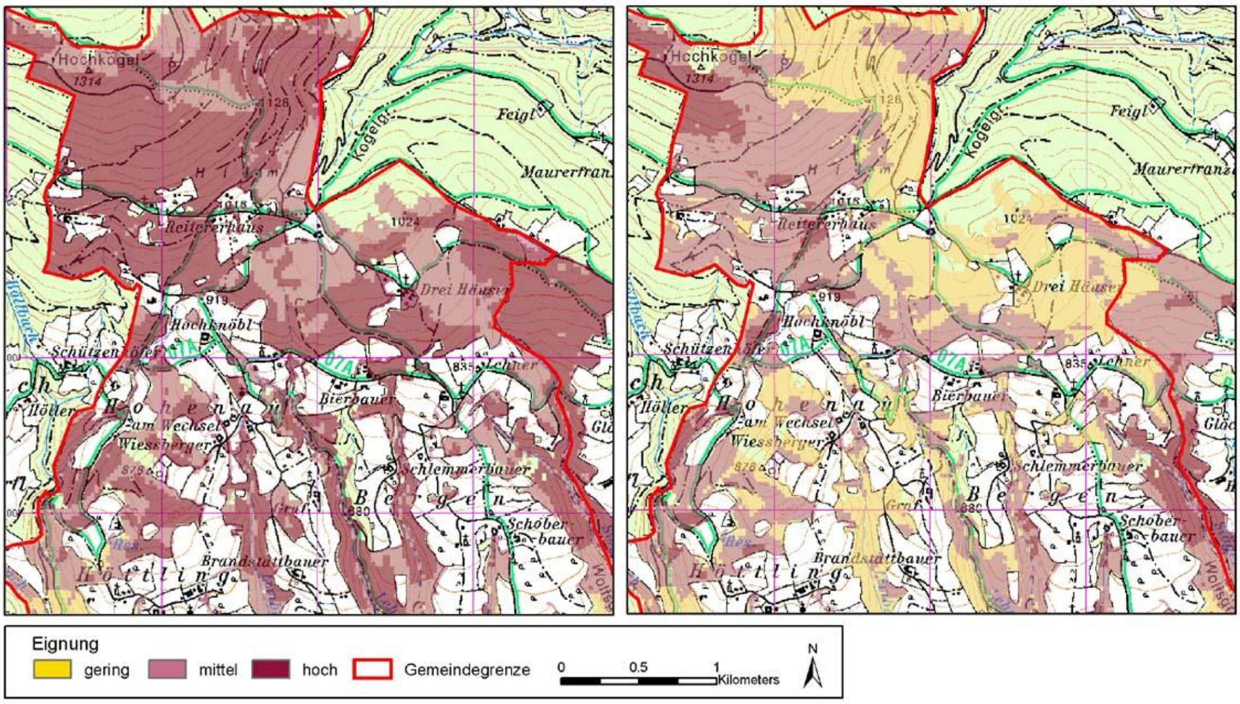

Abb. 7: Modellierter Horstlebensraum ohne Maßnahmen und Eingriffen (linke Abbildung) und Modellierung des Szenario 3 (rechte Abbildung)

3.1.6 Ergebnisse zu weiteren Vogelarten

Habitatmodellierungen und ihre Verifizierung durch ornithologische Kartierungen wurden neben dem Wespenbussard für einige weitere Vogelarten durchgeführt (s. Kap. 3). Die Modellierung ermöglichte unter anderem die effiziente Überprüfung potenziell geeigneter Lebensräume der Heidelerche, einer regional möglicherweise bereits ausgestorbenen Vogelart (SAMWALD, MAUERHOFER 1995); ein aktuelles Reliktvorkommen der Art im Untersuchungsgebiet Dechantskirchen konnte auf diesem Weg mit hoher Wahrscheinlichkeit ausgeschlossen werden. Wesentlich erleichtert wurde auch die Lokalisierung eines Reviers des Schwarzstorchs, das randlich in das Untersuchungsgebiet einstrahlt. Als teilweise erfolgreich und für eine Weiterentwicklung viel versprechend erwies sich der gewählte Modellierungsansatz für die Vogelarten Neuntöter und Wachtelkönig.

4 ZUSAMMENFASSUNG

Die GIS-unterstützte Habitatmodellierung von Vogelarten ermöglicht nicht nur das Aufzeigen geeigneter Lebensräume und damit die effizientere Erfassung von Vogelbeständen, sondern auch die näherungsweise Simulation der Auswirkungen von Eingriffen in den Lebensraum der Arten. Durch die Modellierung der unterschiedlichen Maßnahmen und Eingriffe in die Kulturlandschaft wurde die Sensibilität der Vogelarten hinsichtlich Störungen ihrer Habitate ersichtlich. Neben der Simulation von negativen Auswirkungen auf das Vorkommen einer Art können auch die Auswirkungen von Maßnahmen zum Schutz und zur Erhaltung von geschützten Arten visualisiert werden.

Die Simulationen ermöglichen somit die Unterstützung von Entscheidungen bei planungsrelevanten Fragen. Bereits vor der Ausführung geplanter Maßnahmen können die Auswirkungen anschaulich dargestellt werden.

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Das Modell der Gefahrenzonenplanung in der Raumentwicklung – real oder irreal?

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ZUSAMMENFASSUNG

Die Hochwässer 2002 haben es wieder einmal aufgezeigt: die Berücksichtigung von Naturgefahren in der Stadt- und Regionalplanung ist ein absolutes Muß! Wo das bisher nicht erfolgt ist, waren massive Schäden an Gebäuden, Infrastruktureinrichtungen und auch Schutzbauwerken die Folge.

Unterschiedliche Analyseprojekte, die Ursachen und Wirkungen dieser Katastrophenereignisse untersuchten, haben bestätigt, dass die Gefahrenzonenpläne der Wildbach- und Lawinenverbauung und der Bundeswasserbauverwaltungen wichtige Grundlagen-informationen für die regionale und überregionale Raumplanung liefern können und daher dort verstärkt Eingang finden sollen.

Der Vortrag soll – ausgehend von den Grundlagen der Gefahrenzonenplanung und dem dahinterliegenden Modell – darlegen, wie mittels laufender Beobachtung der Einzugsgebiete durch den Forsttechnischen Dienst für Wildbach- und Lawinenverbauung alle Voraussetzungen für weitreichende Planning und Decision Support Systeme geschaffen werden.

Die Weiterverarbeitung der erhobenen Naturraumdaten im digitalen Wildbach- und Lawinenkataster unter Heranziehung aller aktuell verfügbaren Daten anderer Fachdisziplinen (Laserscanning, Simulation, etc.) bietet auch die Möglichkeit, den Betroffenen im Rahmen unterschiedlicher Intensitäten der Bürgerbeteiligung deren Bedeutung im Rahmen des Schutzes vor Naturgefahren aufzuzeigen und sie somit zu Beteiligten zu machen. Dieser Schritt hilft auch anderen Planungsträgern, Verständnis für die Umsetzung aller notwendigen Schritte zur Realisierung eines umfassenden Systems der Risiko- und Schadensprävention zu finden.

Da ein integratives Planen nur in Kooperation mit anderen in Österreich flächig tätigen Organisationen sinnvoll umsetzbar ist, werden die ersten Schritte in diese Richtung – eine Kooperation zwischen Lebensministerium und Telekom Austria AG – dargestellt.

Den Abschluss des Vortrages bilden die Darstellung der Einsatzmöglichkeit der Kooperation in der Risikokommunikation und das Aufzeigen möglicher weiterer Entwicklungsschritte.

1 EINLEITUNG

Die Hochwässer 2002 haben es wieder einmal aufgezeigt: die Berücksichtigung von Naturgefahren in der Stadt- und Regionalplanung ist ein absolutes Muß! Wo das bisher nicht erfolgt ist, waren massive Schäden an Gebäuden, Infrastruktureinrichtungen und auch Schutzbauwerken die Folge.

Unterschiedliche Analyseprojekte, die Ursachen und Wirkungen dieser Katastrophenereignisse untersuchten, haben bestätigt, dass die Gefahrenzonenpläne der Wildbach- und Lawinenverbauung und der Bundeswasserbauverwaltungen wichtige Grundlagen-informationen für die regionale und überregionale Raumplanung liefern können und daher dort verstärkt Eingang finden sollen.

2 WAS IST DER GEFAHRENZONENPLAN DER WLV?

Der Gefahrenzonenplan des Forsttechnischen Dienstes für Wildbach- und Lawinenverbauung (kurz WLV) ist ein flächenhaftes Gutachten über die Gefährdung des "raumrelevanten Bereiches" durch Wildbäche, Lawinen und Erosion.

Als raumrelevanter Bereich sind jene Gebiete der Dorf- und Stadtstruktur zu verstehen, die bereits aktuell durch Siedlungen genutzt werden oder mittelfristig zu beplanende Gebiete darstellen. In vielen Fällen deckt er sich mit dem durch den Flächenwidmungsplan erfaßten Bereich.

Auf Basis einer sehr intensiven Geländeerkundung in Verbindung mit ev. vorhandenen Kartenwerken werden die naturräumlichen Grundthemen wie Geologie, Morphologie, Vegetation und Gewässerstruktur dargestellt. Durch die Befragung von Anrainern und die zusätzliche Auswertung von historischen Daten aus Chroniken versucht der Planverfasser ein Bild über die bisher abgelaufenen Ereignisse wie Hochwässer, Mur- und Erdströme und Lawinenabgänge zu erhalten. Auf die Ergebnisse dieser Recherche gestützt und anhand von Merkmalen der Ereignisse in der Natur (sogenannte "Stumme Zeugen") wird das Gefahrenpotential des Wildbaches oder der Lawine eingegrenzt. Eine genauere Quantifizierung der Hochwasser-, Geschiebe- und Unholzmengen sowie der Lawinenkubaturen erhält der Planverfasser in Verbindung mit der Auswertung von verschiedenen hydrologischen Meßgrößen auf Basis der gebietsspezifischen Parameter, die aus den anfangs erwähnten Themenkarten abgeleitet werden.

Aus all diesen Eingangsdaten wird das sogenannte Bemessungsereignis abgeleitet. Es handelt sich dabei im Falle eines Wildbaches um ein Ereignis, das als Reaktion auf einen entsprechenden Niederschlag in Verbindung mit der Geländemorphologie (Gefälle und Geologie) zu einem Abflußereignis führt, das im Gerinne in Abhängigkeit der verfügbaren Geschiebemengen und eventuellen Einstößen aus den Seitenhängen, beeinflußt von der Linienführung des Bachlaufes, ein Transportereignis auslöst. Aus dem so transportierten Wasser-Geschiebegemisch entsteht durch die Beimengung von Holz und eventuellen anderen Feststoffen in Abhängigkeit des Mischungsverhältnisses und beeinflußt durch die Gerinnemorphologie im Quer- und Längsverlauf entweder ein schwach bis stark geschiebeführendes Hochwasser oder eine Mure oder bei entsprechenden Verklausungsmöglichkeiten ein Murstoß.

Das so entstandene Bemessungsereignis trifft dann auf den Siedlungsraum und löst unterschiedliche Zerstörung und damit in der Folge Schäden aus.

3 RECHTLICHE UND ORGANISATORISCHE GRUNDLAGEN (QUELLE: RIS)

Bundesverfassungsgesetz 1930, Art. 10, Abs. 1, Zi. 10: Wildbachverbauung (inkl. Lawinen) ist Kompetenztatbestand des Bundes

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Forstgesetz 1975 [Bundesgesetz vom 3. Juli 1975, mit dem das Forstwesen geregelt wird, (BGBl. Nr. 440/1975)]

§ 8. Forstliche Raumpläne

(2) Forstliche Raumpläne sind
a) der Waldentwicklungsplan (§ 9),
b) der Waldfachplan (§ 10),
c) der Gefahrenzonenplan (§ 11).

§ 102. Organisation und Aufgaben der Dienststellen

(1) Der forsttechnische Dienst für Wildbach- und Lawinenverbauung hat sich in folgende Dienststellen zu gliedern:
a) in Sektionen mit dem Wirkungsbereich auf das Gebiet eines oder mehrerer Bundesländer,
b) in Gebietsbauleitungen mit dem Wirkungsbereich auf Teilgebiete eines Sektionsbereiches.

Die Dienststellen unterstehen dem Bundesminister für Land- und Forstwirtschaft, die Gebietsbauleitungen auch jener Sektion, der ihr Bereich zugehört.

Verordnung des Bundesministers für Land- und Forstwirtschaft vom 30. Juli 1976 über die Gefahrenzonenpläne, (BGBl. Nr. 436/1976)

Verordnung des Bundesministers für Land- und Forstwirtschaft vom 4. Dezember 1979 über den Aufgabenbereich der Dienststellen und des Bundesministeriums für Land- und Forstwirtschaft in Angelegenheiten der Wildbach- und Lawinenverbauung (BGBl. Nr. 507/1979)

§ 1. Der Gebietsbauleitung obliegen innerhalb ihres örtlichen Zuständigkeitsbereich folgende Aufgaben:
1. Ausarbeitung des Arbeitsplanes für Gefahrenzonenplanung, Projektierung, Verbauungstätigkeit und Betreuungsdienst;
2. Ausarbeitung von Gefahrenzonenplänen, Projekten und Kollaudierungsoperaten;
3. ...

4 DAS "RAUM-MODELL" DES GEFAHRENZONENPLANES

Wie bereits erwähnt, beschreibt der Gefahrenzonenplan der Wildbach- und Lawinenverbauung die reale Welt in Form von Aussagen über Art und Ausmaß der Gefährdungen durch Wildbäche, Lawinen und Erosion. Dabei werden auf Basis von genau definierten Kriterien bei Wildbächen und Lawinen für den jeweiligen Prozess, von dem eine Gefährdung ausgeht, Rote und Gelbe Gefahrenzonen und für gravitative Prozesse Braune Hinweisbereiche ausgewiesen. Die Kriterien wurden bei Wildbächen von den Teilprozessen Hochwasser, Erosion und Geschiebeablagerung, Nachböschung und Murablagerungen abgeleitet. Bei Lawinen sind die entscheidenden Kriterien der durch die Schneebewegung erzeugte Druck und die Höhe der Schneeablagerung.

Die Darstellung der Zonen und Bereiche erfolgt auf Grundlage des Katasters und ist damit parzellenscharf. In den letzten Jahren finden für die bessere Visualisierung und zur Orientierung vermehrt Orthophotos und teilweise auch Schichtenlinienpläne Verwendung, die mit dem Kataster und den Gefahrenzonen gemeinsam dargestellt werden können.

Dem Stand der Technik entsprechend werden auch – teilweise selbst entwickelte – Simulationsmodelle zur Berechnung der Bemessungsgrößen eingesetzt. Das Lawinenprognosemodell SAMOS z.B. verwendet dabei zur Ableitung der Schnee-ablagerungshöhen und der flächen- und höhenmäßigen Schneedruckverteilungen 3D-Höhenmodelle, für deren Erstelllung zunehmend auch die Verwendung von Daten aus Laserscanning erprobt wird.

5 BEOBACHTUNG VON UNVORHERSEHBAREN ENTWICKLUNGEN

Wie bereits aufgezeigt wurde, ist das Bemessungsereignis, das der Ausweisung von Gefahrenzonen zugrunde gelegt wird und lt. Verordnung über die Gefahrenzonenpläne eine theoretische Wiederkehrwahrscheinlichkeit von ca. 150 Jahren hat, das Ergebnis eines Niederschlags- / Abflussereignisses, das durch die Transportkapazität des Wassers auf Grund des entsprechenden Gefälles Geschiebe und Wildholz mitführt und im Extremfall in Form eines Murstoßes Schäden verursacht.

Durch die vielen Unsicherheiten einerseits in der Bestimmung der Eingangsdaten und andererseits in deren Verarbeitung bei der Ermittlung von Ereignisdauer und schadwirksamen Kubaturen von Wasser, Geschiebe und Schnee, ist das Bemessungsereignis im strengen mathematischen Sinn eigentlich eine Schätzung und unvorhersehbar per se.

Um in der Festlegung der Gefahrenzonen dennoch möglichst genaue Aussagen treffen zu können, erfolgte in den letzten 120 Jahren (Gründung des "Forsttechnischen Dienstes für Wildbach und Lawinenverbauung" im Jahre 1884) und erfolgt laufend eine Evaluierung von Gefahrenzonen anhand von abgelaufenen Ereignissen und wird auch großes Augenmerk auf die Beobachtung der Natur, in der ja die Ereignisse ihre Spuren ("Stumme Zeugen") hinterlassen, gelegt.

Auch das im Forstgesetz 1975 festgelegte, mehrstufige Genehmigungsverfahren, das auch eine aktive Bürgerbeteiligung vorsieht, ist durch die Vereinigung mehrerer unterschiedlicher Fachmeinungen im Zuge der einzelnen Genehmigungsschritte ein Garant für die fachlich bestmöglich objektivierte Ausweisung von Gefahrenzonen und Hinweisbereichen.

6 MONITORING VON ENTWICKLUNGEN

Im Forstgesetz 1975 ist im §11 festgelegt, dass ein Gefahrenzonenplan dann zu überarbeiten ist, wenn sich die Grundlagen oder deren Bewertung ändern. Diese Änderungen können in den Naturraumdaten der Einzugsgebiete stattfinden (Be- oder Entwaldung, Erosion, etc.) oder durch Verbauungsmaßnahmen ausgelöst werden oder durch Anpassung der bereits erwähnten Kriterien für die Beurteilung der Prozesse.

Um die möglichen Veränderungen auch beobachten zu können ist eine regelmäßige Präsenz in den Einzugsgebieten der Wildbäche und Lawinen erforderlich. Diese Präsenz ist durch das Netz der 34 Dienststellen der WLV, die über ganz Österreich verteilt sind und lückenlos alle Gemeinden und Bezirke mit Einzugsgebieten betreuen, gewährleistet. Laufende Tätigkeiten vor Ort umfassen dabei u.a. Erhebungen für Gefahrenzonenpläne, Projektierung von technischen und biologischen Schutzsystemen, Kollaudierung abgeschlossener Arbeiten, Sachverständigen- und Gutachtertätigkeit, Durchführung von Sofortmaßnahmen nach Ereignissen und die Mitwirkung bei Katastropheneinsätzen.

Auch der laufende Kontakt mit den primären Kunden, den Gemeinden, denen im eigenen Wirkungsbereich die Pflicht zur regelmäßigen Begehung und Kontrolle der Wildbäche obliegt, trägt zur umfassenden Kenntnis der aktuellen Situation in den Einzugsgebieten bei.

7 RAUMDATEN ALS GRUNDLAGE VALIDER MODELLE

Die laufende Beobachtung der Einzugsgebiete, die Tätigkeit der Mitarbeiterinnen und Mitarbeiter der WLV als Sachverständige und Gutachter, die Aufarbeitung von Ereignissen und in besonderem Maße auch die Erhebungen für Gefahrenzonenpläne bzw. die Weiterverarbeitung dieser Ergebnisse in Projekten für umfassende Schutzsysteme liefern eine Vielzahl unterschiedlichster Daten.

Die Verwaltung dieser Naturraum-, technischen, Finanz- und Verwaltungsdaten ist ein sehr aufwendiges Unterfangen. Um die Struktur der verteilten Daten zu vereinheitlichen und die Zugreifbarkeit zu vereinfachen werden die teils analogen (historischen) Daten und die file-basierten, digitalen Daten in den letzten Jahren Zug um Zug aufbereitet, um sie in den digitalen, datenbank-basierten Wildbach- und Lawinenkataster überzuführen. Dieser ist derzeit im Aufbau und wird in Zukunft das Kernstück aller Planungen und begleitenden Tätigkeiten im umfangreichen Aufgabenbereich der Mitarbeiterinnen und Mitarbeiter der Wildbach- und Lawinen-verbauung sein.

Über die intern zu erhebenden und zu verwaltenden Daten hinaus, werden vorhandene externe thematischen Ebenen in unterschiedlicher Art und Weise genützt und ergänzen die für eine vollständige Analyse der Naturraumprozesse notwendigen Parameter.

8 PLANNING UND DECISION SUPPORT SYSTEM – KLASSISCH

Die “klassische” und derzeit übliche Verwendung der in den Gefahrenzonenplänen der Wildbach- und Lawinenverbauung enthaltenen Naturrauminformationen ist bereits in **§1** der Verordnung über die Gefahrenzonenpläne definiert:

(1) Die Gefahrenzonenpläne sind insbesondere eine Grundlage für die Projektierung und Durchführung von Maßnahmen durch den Forsttechnischen Dienst für Wildbach- und Lawinenverbauung (kurz Dienststellen) sowie für die Reihung dieser Maßnahmen entsprechend ihrer Dringlichkeit und Tätigkeit der Angehörigen der Dienststellen als Sachverständige.

(2) Unbeschadet der Bestimmungen des Abs. 1 sind die Gefahrenzonenpläne nach Maßgabe der den Dienststellen gebotenen Möglichkeiten so zu erstellen, daß sie als Grundlage für Planungen auf den Gebieten der Raumplanung, des Bauwesens und des Sicherheitswesens -- bei Planungen auf letzterem Gebiet, soweit es sich um solche im Zusammenhang mit Evakuierungen, Verkehrsbeschränkungen oder um sonstige, der Sicherung vor Wildbach- und Lawinengefahren dienende Maßnahmen handelt -- geeignet sind.

Demnach sind die Gefahrenzonenpläne nicht nur Grundlage für interne Planungen und für die Sachverständigentätigkeit, sondern auch für Fragen der örtlichen Raumplanung und des Bau- und Sicherheitswesens. Besonders im letzteren Einsatzbereich gibt es bereits Ansätze, die Inhalte der Gefahrenzonenpläne für Alarm-, Evakuierungs- und Katastropheneinsatzpläne zu verwenden.

9 TELEKOM AUSTRIA AG WEBGIS – INNOVATIVES PLANUNGS- UND ENTSCHEIDUNGS-SUPPORTSYSTEM

Die Telekom Austria unterliegt so, wie andere Infrastrukturunternehmen auch, den Naturgefahren und daraus resultierenden Risiken. Analysen der Ereignisse vergangener Jahre (Bsp. Galtür 1999, Hochwasserjahr 2002, etc.) belegen, dass der Telekommunikationsinfrastruktur in der Bewältigung der jeweiligen Krisensituationen allerdings eine besondere Rolle zu Teil wird. Hilfsorganisationen, Betroffene, Krankenhausverwaltungen, öffentliche Verwaltungen, Einsatzleiter und Experten bestätigen, dass eine koordinierte und effektive Bewältigung der Krise nur mit einer aufrechten Krisenkommunikation möglich ist. Ist die Telekommunikationsinfrastruktur von der jeweiligen Krisensituation selbst ebenfalls betroffen, kommt es zu massiven Einschränkungen in der Leistungsfähigkeit der agierenden Organisationen und der Betroffenen.

Die Berücksichtigung von Expertisen aus dem Naturgefahrensegment (Erdbebenzonen, Gefahrenzonenpläne der WLV, Hochwasseranschlagslinien, etc.) ist deshalb in der Netzinfrastrukturplanung, Instandhaltung und für künftige Investitions-entscheidungen ein absolutes Muß!

9.1 Fact - Ausgangssituation

9.1.1 Telekommunikationsmarkt in Österreich

Die Telekom Austria AG ist der größte in Österreich tätige Kommunikationsanbieter für Telfenonie, Internet, Daten, IT Solutions und Multimediaanwendungen im Festnetz Segment (Wireline). Mit der Mobilkom Austria als 100% Tochter deckt die Telekom Austria Gruppe Technologien wie GSM, GPRS, UMTS und damit auch die mobile Telfonie und den mobilen Datenverkehr ab (Wireless).

Neben der Telekom Austria AG sind derzeit rund 40 alternative Netzbetreiber (Telekommunikationsabieter) im Mobil- und Festnetzsegment tätig. Diese nutzen zu einem großen Teil ebenfalls die flächendeckende Netzinfrastruktur der Telekom Austria AG.

Die Telekom Austria AG betreibt auf Basis internationaler Verträge, Abkommen und Verordnungen auch Transportnetzwerke von internationalem Interesse.

9.1.2 Besonderheiten

Die Telekom Austria AG notiert an den Börsen in Wien und New York. Die Telekom Austria Gruppe unterliegt neben allgemeinen für Aktiengesellschaften geltenden Erfordernissen (Aktiengesetz), auch speziellen gesetzlichen Bestimmungen, Richtlinien und (EU) Verordnungen (Bsp.: Telekommunikationsgesetz, EU-Richtlinien, Universaldienstverordnung, Zusammenschaltungsverordnungen, Sarbanes Oxley Act, besondere Ausfallshaftungen, etc.). Der Telekommunikationsmarkt wird von der Telekom-Control-Kommission (TCK) reguliert.

9.1.3 Auszug Geschäftsbericht – Daten (Stand 31.12. 2003 nur Österreich) und Netzinfrastruktur

Anzahl Festnetzanschlüsse (Wireline)	3.010.800
Internetkunden in Österreich	1.026.600
Kunden Mobilkommnikation (Wireless)	3.163.200
Marktanteil Wireline	55,3%
Marktanteile Wireless	43,3%

Festnetzkabelanlagen (Acccess- und Corenetz - Wireline)	280.000 Km
Zugangskanäle (Anzahl)	3.762.300
Netzknoten (Acccess- und Corenetz - Wireline)	670.000
davon Vermittlungsstellen (Netzknoten)	1.474

9.1.4 Nachhaltigkeit / Risk Management

Als inländisches Telekommunikationsunternehmen, das ein flächendeckendes Telekommunikationsnetz betreibt, trifft die Telekom Austria AG eine besonders hohe Verantwortung für den Wirtschaftsstandort Österreich und generell gegenüber der Öffentlichkeit.

Mit dem Nachhaltigkeitsbericht belegt die Telekom Austria AG ihr Engagement für Umwelt, Soziales, Wirtschaft und die Sicherung der bestehenden Wertestrukturen.

Risk Management als integrativer Teil und damit wenn man so will „*ein professioneller Umgang mit dem Unvorhersehbaren*“, wird deshalb von der Telekom Austria AG als verpflichtend angesehen.

9.1.5 Vulnerabilität Telekommunikationsanlagen

Analysen verschiedener Schadensereignisse (verschiedene Hochwassersituationen, Lawinenwinter 1999, Felssturz Ötztal 1983, etc.) haben eindrucksvoll belegt, dass -
- Beschädigungen der Netzinfrastruktur (regionale Betriebsstörungen und –unterbrechungen) immer gravierende Auswirkungen auf die Kommunikationsinfrastruktur haben.
- der „Untergang“ von Telekommunikationseinrichtungen (Netzinfrastruktur) nicht nur nachhaltige Auswirkungen auf die Telekom Austria AG selbst (HW 2002 - reiner Sachschaden ~ EUR 5 Mio.), sondern generell für die Wirtschaft und Öffentlichkeit hat.
- eine koordinierte Bewältigung der Krise, eine aufrechte Kommunikationsinfrastruktur erfordert.
- Naturgefahrenprävention an der Netzinfrastruktur z. T. möglich, für diese aber Expertisen des öffentlichen Sektors (Bsp. Gefahrenzonenpläne der WLV) als Datenbasis für die Priorisierung benötigt werden. (Budgetdruck, Risikokostenoptimum, etc)
- eine Datenzusammenführung „Netzdokumentation und Expertisen aus dem Naturgefahrensegment“ und damit die Schaffung eines EDV unterstützten Planning- and Decision Support System unerlässlich ist.

9.2 WebGIS Kurzbeschreibung

Die Telekom Austria AG entwickelt und betreibt seit 2 Jahren eine innovative EDV Plattform (WebGIS) zur einheitlichen und standardisierten Erfassung, Pflege und Betrachtung der gesamten Netzdokumentation.

Auf dieser Plattform werden Vektordaten (Schema- und Lagepläne, digitale Katastermappe DKM, etc.), Rasterdaten (Lagepläne, Skizzen, Bilder) und Sachdaten (Schaltstellen- und Netzdaten, Anlagendaten, Kabelfehlerdaten, etc.) zusammengeführt.

WebGIS ermöglicht-

- einen <u>einfachen und raschen</u> Zugriff (3000 User) über Browsertechnologie
- eine Gesamtsicht auf physikalische Netzdaten Core- (Leitungsnetz zwischen Netzknoten), Accessnetz (Leitungsnetz zwischen Netzknoten und Kunden) und diverse Geodaten - DKM (Digitale Katastermappe), Naturbestand, Teleatlas, etc.
- eine unternehmensweite Verfügbarkeit der physikalischen Netzdaten über Intranet (auch über mobile Arbeitsstationen!)
- eine homogene Publikation der gesamten Netzdokumentation unabhängig davon ob es sich um eingescannte- analoge Pläne oder digital erfasste Daten und Pläne handelt
- einen standardisierten Datenaustausch zwischen TA und Partnern (Bsp. Stadt Wien- DZLK/ Digitaler-, Zentraler- Leitungskataster, BEV – DKM, Städte, Gemeinden, etc.), Kunden (Geographische Netzbeauskunftung für Grabearbeiten, Bauverhandlungen, etc.) und Datenzulieferern
- die samthafte Ablöse von vorhandenen “Papierplänen”
- eine Minimierung von Schulungskosten (Weboberfläche)

9.3 Projekt GZ*Pro*

Die Telekom Austria AG arbeitet im Risk Management Projekt GZ*Pro* (GefahrenZonen Projekt - *Pro* – auch Proaktive Kommunikation) seit 2 Jahren an der Schaffung eines Planning- und Decision Support System für das Managemement im Risikofeld „Leistungsrisiken“ – Segment Naturgefahren.

Im Projektlauf sollen alle Expertisen aus dem Risk Management Naturgefahrensegment (Erdbeben, Hochwasser, Wildbach, Lawinen, Steinschlag, Erdrutsch und Murbruch, Blitzschläge, etc.) beschafft und für die Nutzung innerhalb der Telekom Austria AG aufbereitet werden.

GZPro Ziele

Oberste Prämisse ist die Sicherstellung der Betriebsverfügbarkeit (Wireline und Wireless)

Schaffung von Risk Management Basisdaten im Risikofeld Leistungsrisiken zur transparenten Darstellung der Risiken aus Naturgefahren und Bestimmung der Risikopotenziale

Priorisierte Umsetzung von Risk Management Maßnahmen (Bsp. Naturgefahrenprävention)

Im Zusammenhang Optimierung der Netzplanung, -instandhaltung und Investitionsentscheidungen

Optimierungen im Krisenmanagement (extern und intern)

Risikokommunikation und Kooperationen mit dem öffentlichen Sektor (Bsp.: Lebensministerium- Sektionen Forst und Wasser)

Interdisziplinäre Zusammenarbeit und Nutzung von Synergien (Bsp.: Abstimmung der Notfallpläne mit Landeswarnzentralen, Hilfsorganisationen, gemeinsame Projekte und Übungen, etc.)

Optimierung der Telekom Austria AG Versicherungsstrategie im Naturgefahrensegment

9.4 GZPro – WebGIS (Zusammenhang)

Das Projekt GZ*Pro* sieht neben den unter Pkt. 10.3 genannten Ziele die Integration der Expertisen aus dem Naturgefahrensegement in die WebGIS Plattform der Telekom Austria AG vor.

Über die Kooperation mit dem Lebensministerium konnten bereits Beispielpläne der Wildbach- und Lawinenverbauung (Gefahrenzonenpläne) und der Wasserbaudirektion Tirol beschafft und erfolgreich in die WebGIS Plattform migriert werden.

Eine erste Analyse der Verschneidungen hat das enorme Nutzenpotenzial, sowohl Telekom Austria AG intern als auch für den Öffentlichen Sektor, Krisenmananagement, Hilfsorganisationen und insbesondere beim Kooperationspartner erkennen lassen.

10 RISIKOKOMMUNIKATION

Das Planning- and Decision Support System WebGIS ist ein Vehikel mit dem fundierte Risikokommunikation möglich wird!

Es liefert die Basis für Szenarien und Modelle (credible worst cases)!

Schafft Transparenz (Identifikation, Analyse, Bewertung) bei Risiken aus Naturgefahren!

Ermöglicht die Einschätzung- von Eintrittswahrscheinlichkeiten und Auswirkungen (- der Risikopotenziale)!

Ist Basis für Consultingaktivitäten!

Erlaubt Rückschlüsse für Betroffene, Gemeinden, Länder, Landeswarnzentralen, etc!

Fördert den Dialog und die Diskussion über Risiken aus Naturgefahren bei allen Beteiligten.

11 AUSBLICK

Der Vortrag zeigt durch seine theoretische Beleuchtung des Gefahrenzonenplanes der WLV und die praktische Anwendung im WebGIS der Telekom Austria AG eindrucksvoll, dass es sich um ein reales Modell handelt. Es ist ein Modell, das in nachvollziehbarer Art und Weise einen wichtigen Teil der natürlichen Risikoquellen, nämlich jene der alpinen Naturgefahren, beschreibt und Aussagen über die beurteilten Prozesse in qualitativer und quantitativer Hinsicht enthält.

Damit ist die Basis für eine Nutzung dieser Daten nicht nur für Unternehmen wie die Telekom Austria AG gegeben, sondern werden in den nächsten Jahren intensive Gespräche zu führen sein, um möglichst allen in Österreich im Natur- und Kulturraum tätigen Planungsinstitutionen die Inhalte der Gefahrenzonenpläne der WLV und der Bundeswasserbauverwaltungen näher zu bringen, verständlich zu machen und damit die Bereitschaft zu verstärken, diese unverzichtbaren Planungsgrundlagen möglichst umfassend für alle Fragestellungen der Stadt- und Regionalplanung zu nutzen.

Dynamisierung von Plan- und Beteiligungsverfahren durch moderne Informations- und Kommunikationssysteme (IuK-Systeme) – am Beispiel des Portals www.fnpinform.de[44]

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1 EINLEITUNG: INFORMATIONSTECHNOLOGIEN IN DER BAULEITPLANUNG

Mit Inkraftttreten des Europarechtsanpassungsgesetz Bau, kurz EAG Bau, im Juli 2004 wird den Kommunen in Deutschland erstmals seitens des Gesetzgebers die Möglichkeit eröffnet, moderne Informationstechnologien und hier vor allem das Internet ergänzend in Plan- und Beteiligungsverfahren der Bauleitplanung einzusetzen.

„Mit dieser fakultativen Bestimmung wird die völker- und europarechtliche Tendenz der Nutzung neuer Medien aufgegriffen, die insbesondere aus Artikel 5 Abs. 3 der Aarhus-Konvention und der zu ihrer Umsetzung auf EU-Ebene erlassenen Richtlinie 2003/4/EG [...] über den (frühzeitigen und effektiven) Zugang der Öffentlichkeit zu Umweltinformationen [...] hervorgeht.“[45]

Intention des Gesetzgebers zum entsprechenden § 4a Abs. 4 EAG Bau ist es folglich, insbesondere die Beteiligung der Öffentlichkeit und Behörden in Verfahren der Bauleitplanung zeitlich zu optimieren und verfahrenstechnisch zu vereinfachen.[46]

2 STATUS QUO: LANGWIERIGE PLANVERFAHREN - MANGELNDER ÜBERBLICK UND FEHLENDE STANDARDS IM BEREICH IUK-SYSTEME

Angesichts langwieriger und starrer Aufstellungs- bzw. Beteiligungsverfahren v.a. in der kommunalen Flächennutzungsplanung macht die gesetzgeberische Zielsetzung der Effizienzsteigerung bzw. Dynamisierung unter Ausnutzung neuer informationstechnischer Möglichkeiten grundsätzlich Sinn und ist – auch aus Sicht der Planungspraxis – in der Sache zu begrüßen.

Auf Anwenderseite, so auch bei Mitarbeitern in Stadtplanungsämtern und kommunalen Bauverwaltungen, herrscht jedoch noch große Unsicherheit in Bezug auf die Einsatzmöglichkeiten moderner Informationstechnologien sowie den dadurch tatsächlich erzielbaren „Mehrwert“ für Plan- und Beteiligungsverfahren der Bauleitplanung. Die damit verbundenen Chancen, Risiken und deren Konsequenzen werden häufig falsch eingeschätzt bzw. sind noch weitestgehend unbekannt.

Im Folgenden wird dies am Verfahren der Flächennutzungsplanung im Kontext von Wissensdefiziten und im Hinblick auf die gerade erst anlaufende Standardisierung und Zertifizierung der auf dem Markt befindlichen Systeme und Technologien zusammenfassend dargestellt.

2.1 Hintergrund und Ermittlung der fachlichen Grundlagen

Ein an der Technischen Universität Kaiserslautern unter der Federführung von Prof. Dr.-Ing. Gerhard Steinebach (Lehrstuhl Stadtplanung) in Kooperation mit Prof. Dr. Paul Müller (Arbeitsgruppe Integrierte Kommunikationssysteme, Fachbereich Informatik) laufendes Forschungsprojekt[47], beschäftigt sich seit Anfang 2003 mit Fragen der Verfahrensqualität in der kommunalen Flächennutzungsplanung und untersucht hierbei in erster Linie die ablauf- und damit zeitbezogenen Defizite in der aktuellen Planungspraxis sowie den Stand des Einsatzes moderner IuK-Systeme zur Dynamisierung der zu langwierigen Plan- und Beteiligungsverfahren.

Zum Zweck der Grundlagenermittlung wurde im Sommer/Herbst 2003 eine in dieser Form erste, landesweite Kommunalbefragung in Rheinland-Pfalz durchgeführt.[48] Diese basierte auf einem standardisierten Fragebogen zum Stand der Flächennutzungsplanung und zum Einsatz neuer Technologien und Systeme in der öffentlichen Verwaltung bzw. räumlichen Planung. Die hohe Rücklaufquote von über 63 % ermöglichte die Ableitung gesicherter Ergebnisse.

Diese wurden durch Experteninterviews – v.a. in den Modellgemeinden Koblenz, Wörth am Rhein sowie der Verbandsgemeinde Waldfischbach-Burgalben – aus qualitativer Sicht ergänzt. Der fachliche Austausch bei mehreren internationalen und nationalen Seminaren bzw. Tagungen vervollständigt die aktuelle Wissensbasis des Forschungsprojektes.[49]

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44 Das Portal befindet sich derzeit im Aufbau und ist daher noch nicht online verfügbar. Die Freischaltung im Internet ist für das kommende Frühjahr 2005 vorgesehen.

45 Bundesministerium für Verkehr, Bau- und Wohnungswesen: Begründung zum EAG Bau, Allgemeiner Teil, Berlin 3. Juni 2003, S. 26.

46 Vgl. Bundesministerium für Verkehr, Bau- und Wohnungswesen: Begründung zum EAG Bau, Allgemeiner Teil, Berlin 3. Juni 2003, S. 26.

47 Titel des Forschungsprojekts: „Dynamisierung und Flexibilisierung von Planverfahren der Stadtplanung durch moderne Informations- und Kommunikationssysteme“.

48 Die Veröffentlichung der Ergebnisse der Kommunalbefragung in Rheinland-Pfalz ist im Rahmen des Endberichts zum Forschungsprojekt für Sommer 2005 vorgesehen.

49 U.a. CORP 2004/Februar 2004 in Wien; KomCom – Die IT-Messe für den Public Sector 2004/Februar 2004 in Hannover; CeBIT 2004/März 2004 in Hannover; Fachtagung des Difu “Die Stadt und ihre Bürger – neue Kommunikations- und Beteiligungsstrategien”/Mai 2004 in Berlin; 6th Symposium of the International Urban Planning and Environmental Association (IUPEA)/September 2004 in Louisville/Kentucky, USA.

2.2 Ergebnisse der Kommunalbefragung und Experteninterviews

2.2.1 Landesweite Kommunalbefragung

Die Kommunalbefragung ergab für die Situation im Bundesland Rheinland-Pfalz ein ernüchterndes Bild: Die Erkenntnisse der Difu-Studie aus dem Jahr 1996[50] zur Länge der Aufstellungsverfahren in der Flächennutzungsplanung und zu den Verzögerungsursachen konnten in vollem Umfang für den Untersuchungsraum sowie den Zeitpunkt 2003 bestätigt werden. Demnach sind die gültigen Flächennutzungspläne in fast 40 % der teilnehmenden rheinland-pfälzischen Gemeinden 14 Jahre und älter; die Neuaufstellungsverfahren dauerten im Median 6,25 Jahre. Als Hauptverzögerungsfaktoren konnten in der folgenden Reihenfolge die Behandlung der Planung in den lokalpolitischen Gremien, die Beteiligung der Träger öffentlicher Belange und die Abstimmung mit den sonstigen Fachbehörden identifiziert werden. Im Rahmen der beiden letztgenannten Verzögerungsfaktoren ergeben sich vor dem in Rede stehenden Hintergrund und nach Auffassung der Arbeitsgruppe – im Gegensatz zur Behandlung der Planung in den politischen Gremien – durchaus Potenziale einer Dynamisierung durch die Integration moderner IuK-Systeme.

Diese Potenziale bleiben jedoch bislang weitestgehend ungenutzt. Die Kommunalbefragung ermittelte für das Bundesland Rheinland-Pfalz die neue Erkenntnis, dass ein zielgerichteter Einsatz der neuen informationstechnischen Möglichkeiten in der Planungspraxis kaum stattfindet. Nur wenige der teilnehmenden rheinland-pfälzischen Gemeinden (ca. 18 %) besitzen eine integrierte Strategie zur Einführung bzw. zum weiteren Ausbau des Einsatzes moderner IuK-Systeme und in lediglich 15 bis 20 % der Gemeinden werden diese – z.B. zum verteilten Aufgaben- und Dokumentenmanagement innerhalb der Verwaltung, zur systematischen Auswertung von Geodaten und/oder der webtauglichen Visualisierung komplexer Planinhalte etc. – überhaupt eingesetzt.[51]

2.2.2 Ergänzende Experteninterviews

Im Rahmen von Experteninterviews in den drei Modellgemeinden wurde die Ursache für den zögerlichen Einsatz moderner IuK-Systeme in der Flächennutzungsplanung deutlich: Es mangelt mittlerweile nicht mehr – wie noch in den 1990er Jahren – an der Neuentwicklung von Planungs- und Beteiligungssoftware, sondern es ist vielmehr eine nahezu unüberschaubare „Flut“ an Systemen und Technologien auf dem Markt. Neben kommerziellen und dabei in der Regel recht kostenintensiven Angeboten, die nicht in allen Fällen durch ihre Qualität und Zuverlässigkeit überzeugen, gewann in den letzten Jahren zudem der Bereich der Open Source Produkte, also derjenigen Software, die aufgrund eines offenen Quellcodes von ihrem Anwender verändert und damit an die eigenen Bedürfnisse angepasst werden kann, an Bedeutung.

Vor dem Hintergrund der Forderung nach Qualitätsorientierung und -sicherung muss es nun zukünftig vor allem darum gehen, das vorhandene Angebot im Bereich der Planungs- und Beteiligungssoftware zu evaluieren und anschließend im Zuge der Anpassung an neue gesetzliche und sonstige fachliche Anforderungen zielorientiert weiterzuentwickeln. Im Sinne der Zukunftsfähigkeit sollte diese Weiterentwicklung bezüglich der inhaltlichen und sonstigen Funktionalitäten der Produkte eine möglichst flexible und gleichzeitig dauerhafte Gestaltung anstreben. Nur so kann mittel- und langfristig verhindert werden, dass immer neue Produkte auf dem Markt erscheinen, die innerhalb kürzester Zeit von der Realität und ihren sich kontinuierlich ändernden Anforderungen überholt werden.

2.2.3 Zwischenfazit: Keine systematische Erfassung und mangelnder Überblick

Den Kommunen und privaten Planungs- und Ingenieurbüros fehlt angesichts der auf dem Markt befindlichen Produktmenge sowie abgestimmt auf ihre sehr spezifischen, sich im Verlauf des Planungsprozesses wandelnden Bedürfnisse eine systematische Erfassung der Potenziale und Grenzen vorhandener Systeme und Lösungen sowie ein dazu gehörender umfassender Überblick bspw. in Form einer aktuellen und kontinuierlich fortzuschreibenden Softwarebewertung.

Eine bessere Kommunikation zwischen Praktikern und Wissenschaftlern in Bezug auf Good Practices mit Vorbildfunktion wird vor diesem Hintergrund als dringend erforderlich angesehen. Der mangelnde Austausch zwischen Anwendern und Entwicklern führt heute in der Konsequenz zu einer nicht immer bedarfsgerechten bzw. sogar benutzerfremden Weiterentwicklung der informationstechnischen Möglichkeiten und ist somit im Hinblick auf die vertanen Chancen im höchsten Maße kontraproduktiv.

Eine Marktstudie mit integrierter Softwarebewertung zu den heute vorhandenen IuK-Systemen für die Verfahrensbeschleunigung von Planungen könnte zudem vor dem Hintergrund knapper öffentlicher Kassen als Entscheidungshilfe in der Diskussion um die Anschaffung neuer Soft- oder Hardware dienen und diese Entscheidungsfindung nachhaltig qualifizieren.

2.3 Fehlende Standardisierung und Zertifizierung

Des Weiteren zeigten die Recherchen im Rahmen des Forschungsprojektes, dass im letzten Jahrzehnt versäumt wurde, die auf den Markt kommenden Systeme und Lösungen einer umfassenden Standardisierung bzw. Zertifizierung zu unterziehen. Diese Problematik wurde jedoch mittlerweile erkannt. Eine nicht kleine Anzahl aktueller Initiativen auf Bundes- und Landesebene arbeitet mit verschiedenen Schwerpunkten an kurzfristigen Lösungen zur einheitlichen Integration elektronischer Informations- und Kommunikationsmöglichkeiten in vorhandene Verwaltungsstrukturen und „klassische“ Plan- und Beteiligungsverfahren.

Noch beherrschen allerdings kommunale Insellösungen – v.a. im Bereich der Geographischen Informationssysteme – die Situation in der Planungspraxis. Aufgrund der fehlenden Standardisierung treten an den Systemschnittstellen in der interkommunalen bzw. interbehördlichen Kommunikation regelmäßig Probleme auf: Beim Daten- bzw. Dateitransfer zwischen den verschiedenen Akteuren

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50 Vgl. Bunzel, Arno und Meyer, Ulrike: Die Flächennutzungsplanung – Bestandsaufnahme und Perspektiven für die kommunale Praxis; in: Difu-Beiträge zur Stadtforschung 20, Berlin 1996.

51 Die Veröffentlichung der Ergebnisse der Kommunalbefragung in Rheinland-Pfalz ist im Rahmen des Endberichts zum Forschungsprojekt für Sommer 2005 vorgesehen.

der Bauleitplanung gehen wertvolle Informationen verloren, die erst wieder mühsam und teilweise mit hohem Zeitaufwand nachgearbeitet werden müssen.

Auch im Bereich der Visualisierung und Kommunikation planerischer Inhalte über das neue Medium Internet hat sich bislang noch kein einheitlicher Qualitätsstandard kommunaler Webauftritte durchsetzen können. Größtenteils zufriedenstellende Ergebnisse findet man bspw. bei den jährlichen Internetpreisträgern des Informationskreises für Raumplanung (IfR e.V.) oder den jährlich auf der CeBIT bekannt gegebenen Preisträgern des E-Government-Wettbewerbs unter der Schirmherrschaft des Bundesinnenministeriums sowie im benachbarten europäischen Ausland (u.a. Holland, Großbritanien, Skandinavien).

Im Folgenden werden exemplarisch einige der existierenden Standardisierungsoffensiven im Bereich E-Government mit Bezug zu Verfahren der räumlichen Planung bzw. im Bereich der Vereinheitlichung von Geodaten und Geographischen Informationssystemen sowie kommunalen Datenstrukturen kurz vorgestellt.

2.3.1 SAGA-Richtlinie[52]

Das Bundesinnenministerium hat im Dezember 2003 den neuen SAGA-Standard 2.0 (Standards und Architekturen für E-Government-Anwendungen) veröffentlicht und legte damit einen weiterentwickelten Katalog für den reibungslosen digitalen Informationsfluss zwischen der Bundesverwaltung, der Wirtschaft und den Bürgern vor. Das SAGA-Dokument schreibt technische Grundstrukturen und Standards beim E-Government fest und stellt damit die Interoperabilität und Sicherheit im Datenaustausch zwischen den Kommunikationspartnern und IT-Anwendungen in den Vordergrund. Inzwischen hat sich dieser Standard nicht nur in der Bundesverwaltung durchgesetzt; das Dokument wird auch die Grundlage für einen gemeinsamen Standard von Bund, Ländern und Gemeinden bilden.

2.3.2 Deutschland-online[53] und Medi@komm-Transfer[54]

Der Beschluss über verbindliche Zielmarken der Initiative Deutschland-online im Sommer 2004 beinhaltet darüber hinaus die weitergehende strategische Bündelung derzeit noch parallel existierender E-Government-Initiativen von Bund, Ländern und Kommunen. Durch ein verstärktes gemeinsames Vorgehen im Rahmen der vielfältigen E-Government-Vorhaben und beim Aufbau interoperabler Infrastrukturen auf den verschiedenen administrativen Ebenen will die Initiative bis zum Jahr 2010 eine vollständig integrierte E-Government-Landschaft in Deutschland schaffen. Im Rahmen des partnerschaftlichen Austauschs von Erfahrungen und Vorgaben sollen dabei vorhandene Ressourcen und Know-How – bspw. im Bereich des Aufbaus behördenübergreifender Geoinformationssysteme sowie des Bauwesens allgemein – optimal genutzt und Parallelentwicklungen zukünftig vermieden werden.

Um den Transfer der übergeordneten Vorgaben der Initiative Deutschland-online in die „kommunale Fläche" zu unterstützen, besteht eine enge Verknüpfung mit der Maßnahme Medi@Komm-Transfer: Das Bundesministerium für Wirtschaft und Arbeit beabsichtigt hiermit, die Entwicklung von E-Government bundesweit zu beschleunigen und zu harmonisieren sowie die Position des E-Government-Standorts Deutschland im internationalen Wettbewerb zu verbessern. Durch die Verknüpfung besonders vielversprechender kommunaler und regionaler Initiativen zu einem länderübergreifenden E-Government-Netzwerk soll der Transfer von Know-How erleichtert, Standards weiterentwickelt und Selbstorganisationsprozesse für die weiterführende Ausbreitung angestoßen werden. Medi@komm-Transfer verfolgt u.a. die Festlegung von Standards in den Themenfeldern E-Government (u.a. Geoinformationssysteme und E-Procurement), Internetportale (u.a. Content Management Systeme), Fachverfahren (u.a. Meldewesen), Interne Dienste (u.a. elektronisches Reporting) und E-Participation im Rahmen formeller Bauleitplanverfahren.

2.3.3 Forschungsprojekt „Intelcities"[55]

Im Rahmen des europaweiten Forschungsprojektes „Intelcities" arbeitet das Fraunhofer-Institut für Sichere Telekooperation (SIT) mit IT-Dienstleistern und Städten wie Berlin und Dresden daran, kommunale Geodatenbestände wirtschaftlich nutzbar zu machen und stellt dabei u.a. ökonomische Interessen von Kommunen in den Vordergrund. Ziel ist die Schaffung von Standards und Plattformen zum einfachen und sicheren Datenaustausch so genannter Geo-Informationen. Dabei spielen Fragen des Datenschutzes, des Rechtemanagements und der IT-Sicherheit eine wichtige Rolle. Am Ende steht als ein Teilziel des Forschungsprojektes, dass Stadtplanungsprozesse durch die parallele Datennutzung vereinfacht und beschleunigt werden. Gleichzeitig lassen sich auf kommunaler Seite Kosten reduzieren oder sogar durch den Verkauf von Geodaten neue Einnahmequellen finden.

2.3.4 Arbeitsgruppe GIS der Landesplanung und -pflege im Bundesland Rheinland-Pfalz

Die Arbeit der AG GIS basiert auf einem Erlass über das Informationsmanagement der Landespflegeverwaltung in Rheinland-Pfalz vom August 2002. Ziel dieses Erlasses ist es, eine effiziente Erhebung, Verarbeitung und Weitergabe der von Landespflegeeinrichtungen genutzten digitalen Informationen und Daten zu erreichen. Insbesondere der Informations- und Datenaustausch untereinander und gegenüber Dritten soll geregelt und die jeweilige Verantwortung festlegt werden. Im Zuge der Schaffung eines gemeinsamen Datenpools zur Erfüllung der landespflegerischen Aufgaben sollen auch die Anforderungen an den Datentransfer zur Bundesregierung bzw. zur Europäischen Kommission berücksichtigt werden. Die für diese Aufgaben verwendeten digitalen Datenbestände bestehen in der Regel aus geographischen Informationen, die in Geographischen Informationssystemen verarbeitet und deren zugehörige Sachdaten in entsprechenden Datenbanken verwaltet werden.

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52 Näheres hierzu im Internet unter: http://www.kbst.bund.de/E-Government/-,182/SAGA.htm (Stand 18.11.2004).

53 Näheres hierzu im Internet unter: http://www.deutschland-online.de/ (Stand 03.01.2005).

54 Näheres hierzu im Internet unter: http://www.mediakomm-transfer.de/Content/de/Homepage/Homepage__node.html (Stand 03.01.2005).

55 Näheres hierzu im Internet unter: http://www.sit.fraunhofer.de/intelcities (Stand 14.10.2004).

Die beschriebenen Bemühungen markieren den Beginn eines standardisierten Ausbaus und der dauerhaften Pflege eines auf den Erkenntnissen der Standards des Open GIS Consortiums[56] aufbauenden digitalen Landschaftsinformationssystems als Informations-, Planungs- und Entscheidungsgrundlage für alle Experten, die aktuelle Daten zum Status Quo und zur Entwicklung der Umwelt in Rheinland-Pfalz benötigen.[57]

2.3.5 Zwischenfazit: Abgestimmte Standardisierung und Qualitätssicherung als zentrale Aufgaben der nächsten Jahre

Die exemplarisch ausgewählten Initiativen zur Standardisierung und Qualitätssicherung im Bereich von E-Government-Anwendungen und sonstigen IuK-Systemen für die räumliche Planung haben als gemeinsames Ziel, die erwähnten Versäumnisse der letzten Jahre nachzuholen und stellen somit wichtige Schritte in die richtige Richtung dar. In Bezug auf die Umsetzbarkeit der derzeit entwickelten Vorgaben bleibt jedoch zu hoffen, dass diese trotz zum Teil ähnlicher Themenfelder am Ende ein in sich konsistentes System ergeben werden.

Dabei ist von besonderer Bedeutung, dass die erarbeiteten Standards in den spezifischen Bedürfnis- und Problemlagen der Anwender mit einem für diese nachvollziehbaren Nutzen „verortet“ werden. Dies bedeutet eine starke Orientierung der Vorgaben an den vorhandenen Defiziten in Plan- und Beteiligungsverfahren in der Praxis kommunaler Bauleitplanung. Verlässliche und unabhängig vergebene Zertifikate werden den Kommunen letztendlich auch die Entscheidung über Investitionen in neue technische Hilfsmittel erleichtern und eine transparentere Kosten-Nutzen-Analyse je nach spezifischer Aufgabenstellung ermöglichen.

3 DAS INTERNETPORTAL WWW.FNPINFORM.DE

Die Entwicklung des Internetportals www.fnpinform.de ist eine Konsequenz der in Kapitel 2 dargestellten Erkenntnisse. Mit der Produktentwicklung in seiner Grundstruktur und deren schrittweiser Fortentwicklung soll eine umfassende Informations- und Kommunikationsplattform zum Thema *Flächennutzungsplanung online* geschaffen werden, die zukünftig einen vermehrten und je nach spezifischer Planungssituation des Benutzers bedarfsgerechten Erfahrungs- und Know-how-Transfer zwischen Fachleuten aus Forschung und Praxis ermöglicht.

Dabei ist die Pflege und Weiterentwicklung des Portals über das Ende des zugrunde liegenden Forschungsprojektes hinausgehend durch die Übergabe der Geschäftsaufgaben an die Entwicklungsagentur Rheinland-Pfalz e.V.[58], einem Joint-Venture des Ministeriums des Innern und für Sport des Bundeslandes Rheinland-Pfalz und der Technischen Universität Kaiserslautern, sicher gestellt.

3.1 Zielsetzung

Ziel des Internetportals www.fnpinform.de ist es, die Ursachen der hohen Verfahrensdauer in der Praxis der Flächennutzungsplanung sowie die Potenziale und Grenzen einer Dynamisierung, sprich Beschleunigung der Verfahren u.a. durch den Einsatz moderner IuK-Systeme als Ergebnisse der Forschungsarbeiten aufzuzeigen. Vor dem Hintergrund der langfristigen Zielsetzung einer umfassenden Qualifizierung der Verfahren werden über die zeitliche Dimension hinausgehend auch inhaltliche Aspekte der Flächennutzungsplanung im Rahmen des neu entwickelten Grundkonzepts der so genannten „Verfahrenslagen“ mit berücksichtigt (Näheres hierzu im unten stehenden Kapitel 3.3.1).

Das Internetportal stellt dabei nicht nur aktuelle Informationen zum Angebot an IuK-Systemen für die Flächennutzungsplanung zur Verfügung, sondern zeigt auch methodische und rechtliche Hintergründe auf und bietet im Rahmen thematischer Foren Platz für den Austausch zwischen Fachleuten aus Forschung und Praxis.

www.fnpinform.de hat bezogen auf die oben beschriebene Zielsetzung keinen Anspruch auf eine umfassende Darstellung aller am Markt vorhandenen Produkte und Lösungen, sondern möchte vielmehr Erfolgsfaktoren für die Dynamisierung von Flächennutzungsplanverfahren aufzeigen und hierzu exemplarisch Good Practices und Initiativen sowie aktuelle Produkte und Anbieter vorstellen, Probleme und Defizite diskutieren sowie mögliche Konsequenzen aufzeigen.

3.2 Zielgruppe

Das Portal richtet sich in erster Linie an Praktiker, die sich mit dem Thema Flächennutzungsplanung befassen und dabei an Möglichkeiten einer zukunftorientierten Weiterentwicklung der Verfahren sowie der Methoden zur Erarbeitung der fachlichen Inhalte durch den Einsatz moderner IuK-Systeme interessiert sind.

3.3 Inhaltliches Grundkonzept und technische Struktur

3.3.1 Inhaltliches Grundkonzept der Verfahrenslagen

Das Grundkonzept des Internetportals www.fnpinform.de basiert auf einem von Prof. Dr. Paul Müller erarbeiteten Framework an Web-Applikationen, das als Regionalportal KLinform für die Region Kaiserslautern und die Westpfalz entwickelt wurde und im Jahr 1999 den Hauptpreis des damals zum ersten Mal veranstalteten Multimedia-Wettbewerbs des Landes Rheinland-Pfalz gewann. Dieses Regionalportal wurde konzipiert nach dem sozialwissenschaftlichen Ansatz der so genannten „Lebenslagen“, der für

56 Näheres hierzu im Internet unter: http://www.opengeospatial.org/ (Stand 03.01.2005).

57 Näheres hierzu im Internet unter: http://www.naturschutz.rlp.de/infomanagement.html (Stand 18.11.2004).

58 Näheres hierzu im Internet unter: http://www.ea.rlp.de (Stand 04.01.2005).

bestimmte Lebenssituationen und -umstände von Bewohnern, Besuchern, Unternehmen in einer Stadt oder Region spezifische Informationen nach Themen- bzw. Problemgebieten bedarfsgerecht bündelt und diese über das Internet bereit stellt.[59]

Im Rahmen der hier beschriebenen Forschungsarbeiten wurde dieser Lebenslagenansatz aufgegriffen und erstmals systematisch auf den Bereich der Flächennutzungsplanung in Form so genannter „Verfahrenslagen" übertragen, die insbesondere dem mehrdimensionalen Charakter eines Planverfahrens und seiner einzelnen „Etappen" gerecht werden können.

Das bedeutet, dass eine Gemeinde, die sich im Aufstellungsverfahren zu einem Flächennutzungsplan befindet, verschiedene Phasen (= Verfahrenslagen) durchläuft, in denen sich jeweils sehr spezifische äußere Umstände und Rahmenbedingungen sowie daraus resultierende fachliche Anforderungen an Planinhalte und Verfahrensweisen ergeben. Diese wurden u.a. aus dem Leistungsbild Flächennutzungsplan der HOAI[60] abgeleitet und sind außerdem mit Anforderungen an die zum Einsatz kommenden technischen Hilfsmittel verbunden. Im Rahmen der Forschungsarbeiten erfolgte eine Einteilung des Aufstellungsverfahrens der Flächennutzungsplanung in sechs unterschiedliche Phasen bzw. Verfahrenslagen – von den ersten Vorarbeiten und dem Aufstellungsbeschluss über die frühzeitige und förmliche Beteiligung der Öffentlichkeit und Behörden zu den Planentwürfen bis hin zur Genehmigung des Planes durch die höhere Verwaltungsbehörde als Voraussetzung für dessen Inkrafttreten.

Je nach Verfahrenslage können dabei in erster Linie inhaltliche Aspekte und die damit zusammenhängenden Anforderungen an die Funktionalitäten technischer Systeme (z.B. Zusammentragen, Aggregation und Auswertung von Daten) oder aber vorrangig verfahrens- bzw. ablaufbezogene Aspekte wie die Durchführung der gesetzlich vorgeschriebenen Beteiligung der Behörden und sonstigen Öffentlichkeit über das Internet den Handlungsspielraum der planenden Gemeinde und damit auch die Einsatzmöglichkeiten von IuK-Systemen zur Beschleunigung der jeweiligen Phase bestimmen.

Das Portal www.fnpinform.de berücksichtigt diese Zusammenhänge und bündelt Informationen und Inhalte bedarfsgerecht nach den Anforderungen der einzelnen Verfahrenslagen und erleichtert damit den Benutzern (in erster Linie Kommunen) den Überblick über die ihnen zur Verfügung stehenden Hilfsmittel für eine Dynamisierung des Verfahrens. Der Schwerpunkt von www.fnpinform.de liegt dabei auf der Befassung mit den ersten Verfahrenslagen im Flächennutzungsplanprozess, da hier die meisten Defizite im Hinblick auf die Dauer der Phasen und gleichzeitig die größten Potenziale einer Dynamisierung durch den Einsatz moderner Informations- und Kommunikationstechnologien festgestellt werden konnten (s.o.).

3.3.2 Technische Struktur und Funktionalitäten

Aus technischer Sicht beinhaltet das zugrunde liegende Framework KLinform mit seiner komplexen Server- und Client-Struktur, die in Folge der strikten Verwendung von Open Source Software kostengünstig realisiert werden konnte, eine Fülle von Funktionalitäten, die im hier beschriebenen Zusammenhang zunächst eine lediglich untergeordnete Rolle spielen, jedoch die flexible Erweiterbarkeit des Portals und damit seine Zukunftsfähigkeit sicher stellen sollen.[61]

Die Funktionalität der Personalisierungskomponente „Mein FNPinform" wird eine dynamische Anpassung der Zusammenstellung und Darstellung von Informationen nach den Interessen des jeweils angemeldeten Benutzers ermöglichen.

Derzeit im Test befindliche weitere Applikationen sind u.a. Groupeware-Komponenten und Geographische Informationssysteme auf Basis von Open Source Standards.[62]

Des Weiteren ist die direkte Verlinkung der einzelnen Verfahrenslagen des Portals zu thematisch relevanten Datenbeständen der Fachbehörden und Träger öffentlicher Belange der räumlichen Planung in Rheinland-Pfalz vorgesehen, die zu einer Verbesserung des Informationsflusses zwischen Trägern der Fachplanung einerseits und der Bauleitplanung andererseits inkl. der zu erwartenden Synergieeffekte in Bezug auf die Aktualität räumlicher Planung beitragen soll.

3.4 Dialogstruktur

Ein erfolgreiches themenbezogenes Internetportal basiert auf der Aktualität seiner Inhalte und der fachlichen Breite der Beiträge getragen von kompetenten Akteuren. Die Inhalte von www.fnpinform.de bauen daher auf der kontinuierlichen Zusammenarbeit einer Vielzahl von Akteuren aus der Planungspraxis und Forschung auf.

Die derzeitige Zusammenstellung des Internetportals erfolgt u.a. im engen Austausch mit Vertretern aus den drei Modellgemeinden, der obersten rheinland-pfälzischen Planungsbehörde sowie mit Vertretern der Struktur- und Genehmigungsdirektionen Nord und Süd als Träger öffentlicher Belange. Diese Akteure kommentieren und bewerten die inhaltlichen Beiträge und deren Praxisrelevanz, den Aufbau des Internetportals und die vorhandenen und geplanten Funktionalitäten im Rahmen gemeinsamer Workshops.

In Zukunft ist darüber hinaus das Zusammentragen von eigenständig verfassten Erfahrungsberichten der oben genannten Akteure vorgesehen, die zudem im Rahmen thematischer und akteursgruppenspezifischer Foren über das Internetportal die Möglichkeit erhalten sollen, in einen kontinuierlichen Dialog zueinander zu treten.

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59 Weiterführende Literatur und Informationen zum Lebenslagenansatz in den Sozialwissenschaften u.a. im Internet unter: http://www.gender-mainstreaming.net/gm/Wissensnetz/instrumente-und-arbeitshilfen,did=16594.html (Stand 10.01.2005).

60 Vgl. Verordnung über die Honorare für Leistungen der Architekten und der Ingenieure (HOAI), BGBl I 1976, 2805, 3616, neugefasst durch Bek. v. 4. 3.1991 I 533; zuletzt geändert durch Art. 5 G v. 10.11.2001 I 2992; Teil V Städtebauliche Leistungen, § 37.

61 Näheres zur technischen Realisierung des Frameworks KLinform in: Hillenbrand, Markus und Reuther, Bernd: "Building Blocks for Web Applications", in IMSA 2003, Hawaii.

62 Näheres hierzu in: Müller, Jochen; Henrici, Dirk und Müller, Paul: "Computer-aided Process for Urban Land Use Planning", in 30th EUROMICRO, Rennes, France, September 2004.

3.5 Bisherige Inhalte des Internetportals

Wie bereits erwähnt, liegen die inhaltlichen Schwerpunkte des Internetportals auf der Aufarbeitung der Dynamisierungspotenziale in den ersten Verfahrenslagen des Flächennutzungsplanprozesses. Hierbei stehen insbesondere die Unterstützung einer beschleunigten und damit möglichst effizienten Bestandsaufnahme und Analyse aktueller raumrelevanter Informationen und deren zeitnaher Austausch zwischen Kommunen und Fachbehörden und damit die ergänzend über das Internet durchgeführte Behörden- (bzw. Öffentlichkeits-)beteiligung im Vordergrund des Interesses.

Vor diesem Hintergrund sind die neue, durch das EAG Bau eingeführte Anforderung des Monitorings in der Bauleitplanung sowie die technischen Möglichkeiten zur Realisierung der so genannten „Bringschuld“ der Fachbehörden in Bezug auf die Beobachtung der Umweltauswirkungen von Bauleitplänen weitere inhaltliche Schwerpunkte des Portals.

Die Darstellung von Hintergründen zum Thema E-Government im Sinne der Modernisierung bzw. Effizienzsteigerung von Verwaltungsarbeit und -prozessen fungiert als inhaltliche Klammer diverser Beiträge des Portals.

Eine Studie zum Angebot an IuK-Systemen für die Flächennutzungsplanung im Allgemeinen bietet einen aktuellen Überblick der auf dem Markt befindlichen Produktgruppen und ihrer Potenziale bzw. Grenzen.

Das Portal stellt u.a. die folgenden Informationen und Analysen zur Verfahrenslage „Vorarbeiten“ sowie im Rahmen der Rubrik „BauGB“ zur Verfügung:

3.5.1 <u>Portalrubrik „Verfahrenslagen“ – Erfolgsfaktoren der Dynamisierung in der Verfahrenslage der allgemeinen Vorarbeiten bis zum formellen Aufstellungsbeschluss</u>

Viele Gemeinden sehen in der Phase der Vorarbeiten zum eigentlichen Aufstellungsverfahren noch nicht die Vorteile der frühzeitigen Erarbeitung eines umfassenden und integrierten Kommunikationskonzepts zur Steuerung des Planungsprozesses. Ohne eine solch ablaufbezogene und inhaltliche Verfahrenskonzeption besteht jedoch die Gefahr, dass der Austausch von Informationen bzw. die Abstimmung und Diskussion von fachlichen Teilfragen vor dem Hintergrund der Vielzahl an Akteuren unnötig viel Zeit in Anspruch nehmen. Auch die frühzeitige Integration der politischen Entscheidungsträger in die einzelnen Arbeitsschritte des Planaufstellungsverfahrens wird häufig vernachlässigt und führt dann in der Folge zu vermeidbaren Verzögerungen.

Für Kommunen, die sich in der Verfahrenslage „Vorarbeiten“ befinden, steht außerdem die effiziente Bestandsaufnahme und Analyse der relevanten Daten und Informationen zur Siedlungsentwicklung im Gemeindegebiet im Vordergrund. Probleme bereiten hier vor allem die sehr heterogene und unterschiedlich stark strukturierte „Datenlandschaft“ der laufenden örtlichen sowie überörtlichen Raumbeobachtung. Gerade die Tatsache, dass heutzutage sowohl digitale als auch analoge Informationen in die Erarbeitung eines Flächennutzungsplans integriert werden müssen, kostet häufig wertvolle Zeit. Die Forderung nach einer umfassenden Digitalisierung aller räumlich relevanten Datenbestände erscheint vor dem Hintergrund der Potenziale der elektronischen Datenverarbeitung wichtiger den je. Ein weiteres Problem in Bezug auf die digitale Datenerfassung und -auswertung stellt die Vielfalt der zum Einsatz kommenden Softwareprodukte dar, die bislang zu wenig auf eine Harmonisierung der Schnittstellen im Sinne der Kompartibilität der Daten und deren effiziente Nutzung ausgerichtet sind.

Die aktuelle Novelle des Baugesetzbuchs mit der Einführung der Umweltprüfung als selbtsverständlichen Bestandteil aller Flächennutzungs- bzw. Bebauungsplanverfahren wird die verfahrensbezogenen Anforderungen in der Phase der Vorbereitung noch weiter erhöhen. Im Rahmen des erforderlichen Scopings zur Umweltprüfung (Ermittlung von Umfang und Detaillierungsgrad der Umweltprüfung) erfährt die effiziente und zeitnahe Auswertung aller zur Situation der Umwelt im Plangebiet vorliegenden Daten einen hohen Bedeutungszugewinn. Eine entsprechende Vernetzung der zuständigen Akteure, die bezogen auf den heutigen Sachstand noch ausbaufähig erscheint, könnte hier zu qualitativen Verbesserungen und erheblicher Zeitersparnis im Planverfahren beitragen.

In diesem Kontext muss auch auf die Grundvorstellung des Gesetzgebers über die materielle und formelle Qualifizierung der Planung durch die Beteiligung der Behörden und sonstigen Träger öffentlicher Belange hingewiesen werden. Die durch das novellierte BauGB in § 4 Abs. 3 erneut hervorgehobene Verpflichtung der Fachbehörden, die bei ihnen vorliegenden, für die Ermittlung und Bewertung des Abwägungsmaterials relevanten Informationen der Gemeinde zur Verfügung zu stellen („Bringschuld“ der Fachbehörden)[63], wird in der Planungspraxis nur dann funktionieren, wenn die oben geforderte technische Vernetzung und Standardisierung in der Datenerfassung und -auswertung tatsächlich umgesetzt wird.

<u>Erfolgsfaktoren einer Dynamisierung der Verfahrenslage „Vorarbeiten“</u>

Zentraler Erfolgsfaktor für einen effizienten Verfahrensablauf ist die frühzeitige Erarbeitung eines **integrierten Kommunikationskonzepts** unter Berücksichtigung der Informations- und Kommunikationsbedürfnisse und -anforderungen aller am Verfahren beteiligten bzw. von ihm betroffenen Akteure. Insbesondere die Akteure aus der kommunalen Politik und sonstigen Öffentlichkeit sollten in dieses Konzept und seine Erarbeitung zu einem möglichst frühen Zeitpunkt eingebunden werden. Das Kommunikationskonzept sollte sowohl klassische Informations- und Kommunikationsmethoden (Runde Tische etc.) als auch die besonderen Potenziale des Einsatzes moderner Medien (Internet, Email, Servertechnik etc.) berücksichtigen und sie zu einem komplementären Gesamtkonzept zur Koordination des Planungsprozesses zusammenführen.

Angesichts der Komplexität von Planverfahren gerade auf der gesamtstädtischen Ebene der Flächennutzungsplanung ist neben der erwähnten Erarbeitung eines integrierten Kommunikationskonzepts auch die Steuerung des Planungsprozesses in Form eines umfassenden **Planungsmanagements** von hoher Bedeutung. Planungsverfahren und deren Workflow unterstützende Management- und Steuerungssysteme stellen demnach eine sinnvolle Ergänzung sonstiger raumbezogener Informationssysteme in der Flächennutzungsplanung dar.

63 Vgl. Steinebach, Gerhard: Informations- und Kommunikationssysteme im Verfahren der Bauleitplanung - zugleich ein Beitrag zum Entwurf des Europarechtsanpassungsgesetz Bau; in Zeitschrift für deutsches und internationales Bau- und Vergaberecht, Heft 1/2004, 2004, S. 16ff.

Der Ausbau der kommunikationstechnischen Infrastruktur zur **Vernetzung** der kommunalen und sonstigen Akteure (insb. Behörden) im Planverfahren ist ein weiterer zentraler Erfolgsfaktor für einen schnelleren Datentransfer und somit eine effizientere Gestaltung der Arbeitsprozesse. Eine solche Vernetzung könnte im Bundesland Rheinland-Pfalz bspw. auf der Grundlage des existierenden rlp-Netzes geschaffen werden. Durch die Etablierung geeigneter, zugangsüberwachter Plattformen (Kenn- und Passwortvergabe) wäre eine entscheidende Vereinfachung des Datenaustauschs inkl. der erforderlichen Absicherung gegenüber unerlaubten Zugriffen gegeben.

Im engen Zusammenhang mit dem Erfolgsfaktor Vernetzung steht die Forderung nach der Schaffung **dezentraler Zugriffsmöglichkeiten auf Originaldaten** der Flächennutzungsplanung, die zuvor nach einheitlichen, **standardisierten Kriterien** erfasst wurden (Stichworte: virtuelle Datenbank, Data-Warehouse, generische Verknüpfung). Um den dezentralen Zugriff auf Originaldaten zu unterstützen und bisherige Informationsverluste beim Datenaustausch zu reduzieren, ist die Suche nach einer geeigneten Middleware, die den notwendigen Integrationsaufwand zwischen heterogenen kommunalen GIS-Applikationen und einem Content Management System (CMS) reduziert, als unerlässliche Aufgabe weiterer Forschungsarbeiten anzusehen.

3.5.2 Portalrubrik „BauGB“

Für die Rubrik „BauGB“ ist folgender Aufbau vorgesehen:

- Schilderung der rechtlichen Ausgangslage (insb. Inkrafttreten des EAG Bau am 20. Juli 2004),
- Übersicht der zentralen verfahrensbezogenen und inhaltlichen Neuerungen (u.a. Umweltprüfung aller Bauleitpläne, Monitoring der Umweltauswirkungen von Bauleitplänen, Zweistufige Behördenbeteiligung, Internetbeteiligung der Behörden und sonstigen Öffentlichkeit, Revisionsklausel für Flächennutzungspläne etc.) auf der Basis diesbezüglicher Fachartikel[64],
- Darstellung der zu erwartenden Konsequenzen dieser Neuerungen für Plan- und Beteiligungsverfahren der Bauleit- bzw. Flächennutzungsplanung anhand der Erkenntnisse des vom Deutschen Institut für Urbanistik (Difu) im Jahr 2003 durchgeführten Planspiel zur BauGB-Novelle,
- Auswertung von Erfahrungsberichten und Beschreibung von Good Practices, bspw. Internetpreisträger des Informationskreises für Raumplanung (IfR e.V.).

4 AUSBLICK

Die bisherigen Zwischenergebnisse des Forschungsprojektes und die darauf aufbauende Produktentwicklung des Informations- und Kommunikationsportals www.fnpinform.de beinhalten im Kern die folgende Erkenntnis: Eine zukunftsorientierte Weiterentwicklung von Verfahren der Bauleitplanung im Sinne der geforderten Effizienzsteigerung und Dynamisierung durch den zielgerichteten Einsatz moderner IuK-Systeme ist im dargestellten Umfang möglich. Langfristig kann dabei jedoch nicht die Beschleunigung der Verfahren das alleinige Ziel sein, sondern es sollte vielmehr eine umfassende Qualifizierung der Verfahren im Sinne der Verbesserung der heutigen Planungspraxis angestrebt werden.

Die Zusammenstellung und Diskussion aktueller Erfahrungsberichte, rechtlicher Hintergründe, laufender Standardisierungsbemühungen, aktueller Methoden, Produkte und Lösungen „verortet“ in den jeweiligen Verfahrenslagen der Benutzer des Internetportals www.fnpinform.de sollen letztendlich einen Beitrag zu einer insgesamt höheren – sowohl zeitbezogenen als auch inhaltlichen – Verfahrensqualität in der kommunalen Bauleitplanung leisten. Diese höhere Verfahrensqualität – sinnvoll und zielorientiert unterstützt durch den Einsatz moderner IuK-Systeme – wird letztendlich, so die These, auch die Qualität und Aktualität der Ergebnisse der Flächennutzungsplanung entscheidend prägen, die demzufolge eine verbesserte Rechtssicherheit und Steuerungskraft erreichen können.

Diese Wirkungen einer aktuelleren Flächennutzungsplanung und ihrer Darstellungen wären des Weiteren mit positiven Konsequenzen für den Abstimmungsbedarf mit anderen Planungen (insb. den raumbezogenen bzw. querschnittsorientierten Fachplanungen, wie bspw. der Landschaftsplanung) verbunden und könnten eine große Chance im Sinne der Qualifizierung des Gesamtssystems der räumlichen Planung bedeuten.

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64 U.a. von Steinebach, Gerhard: Informations- und Kommunikationssysteme im Verfahren der Bauleitplanung – zugleich ein Beitrag zum Entwurf des Europarechtsanpassungsgesetz Bau; in Zeitschrift für deutsches und internationales Bau- und Vergaberecht, Heft 1/2004 und Battis/Krautzberger/Löhr: Die Änderungen des Baugesetzbuchs durch das Europarechtsanpassungsgesetz Bau (EAG Bau 2004); in NJW 2004 (Heft 36) u.v.m.

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Internetgestützte Beteiligungsverfahren in der Raumplanung – Ressourceneinsparung und zentraler Baustein einer e-Democracy-Strategie

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1 EINLEITUNG

Beteiligungsverfahren bei Planungsvorhaben, seien es Bürgerbeteiligungen oder Beteiligungen der Träger öffentlicher Belange, werden in Zunkunft eine noch wichtigere Rolle spielen, als dies bisher schon der Fall ist. Zwei EU-Richtlinien sind hier richtungsweisend: Die sogenannte Öffentlichkeitsbeteiligungsrichtlinie (Richtlinie 2003/35/EG des Europäischen Parlaments und des Rates vom 26.05.2003) und die sogenannte Plan-UP-Richtlinie (Richtlinie 2001/42/EG des Europäischen Parlaments und des Rates vom 7.06.2001). Aber auch die Wasserrahmenrichtlinie sieht eine umfassende Öffentlichkeitsbeteiligung vor.

Je nach Planungsvorhaben verfolgen solche Beteiligungsverfahren sehr unterschiedliche Ansätze und damit auch sehr unterschiedliche Techniken. Im Kern geht es dabei jedoch immer um mehr Planungstransparenz und eine verstärkte Teilhabe der Bürger an politischen Entscheidungen.

Zwei wesentliche Verfahrenstypen markieren dabei die Eckpunkte: Einerseits die diskursorientierten, nicht formellen Beteiligungen, die dazu dienen, Interessen und Wünsche der Bürger sowie deren Kreativität bereits im Vorfeld von Planungsvorhaben einzufangen. Hierbei handelt es sich meist um kleinräumige Planungen mit unmittelbarer Auswirkung auf das Wohn- und Lebensumfeld von Bürgern, die öffentlich diskutiert werden. Diese Diskussionsplattformen werden moderiert und es findet ein Austausch zwischen allen Beteiligten statt.

Auf der anderen Seite stehen solche Beteiligungsverfahren, bei der häufig im Rahmen von formellen Verfahren Planungen für umfangreiche oder großräumige Vorhaben (Raumordnungsverfahren zu Autobahn- oder Flughafenbau, landes- bzw. Regionalplanung etc.) beteiligt werden. Im Gegensatz zu den Diskussionsverfahren geht es hierbei darum, Einwände, Bedenken und Anregungen zu einer Planung dem Planunsgträger (häufig verbunden mit der Verpflichtung der Abwägung) mitzuteilen. Eine allgemeine und öffentliche Diskussion findet in der Regel nicht statt. Vor dem Hintergrund der o.g. EU-Richtlinien zur Öffentlichkeitsbeteiligung werden bereits jetzt schon viele Verfahren öffentlich beteiligt, für die zur Zeit nur eine Behördenbeteiligung vorgeschrieben ist. Anders als bei den diskursiven Verfahren sind hierfür z.T. äußerst umfangreiche Planungsunterlagen in mehr oder weniger normierter Form bereit zu stellen und von den Beteiligten zu sichten und zu kommentieren. Diese Art von Beteiligungsverfahren sollen Gegenstand der weiteren Betrachtungen sein.

2 INTERNET-BETEILIGUNGSVERFAHREN

Einig sind sich Planer und Politiker, dass im Zuge von erheblichen Mittel- und Personaleinsparungen der öffentlichen Hand zukünftig Beteiligungsverfahren nur mit massiver Nutzung des Internets als Massenmedium effizient durchgeführt werden können. Durch die stark steigende Verfügbarkeit von PC und Internet im öffentlichen und privaten Bereich (van Eimeren, 2004) sowie zunehmend kostengünstige und breitbandige Internetzugängen haben sich die Kommunikationsmöglichkeiten und –gewohnheiten der Bevölkerung in den letzten Jahren drastisch verändert. Diesen und weiteren zukünftigen Veränderungen müssen Behörden bei der Gestaltung ihrer Kommunikations- und Interaktionsformen mit den Bürgern aber auch untereinander Rechnung tragen, um sich nicht plötzlich in einer kommunikativen Isolierung wiederzufinden.

Vielerorts werden z.T. bereits seit Jahren e-Government-Projekte, häufig mit Unterstützung von Initiativen der Bundesregierung, eingerichtet. So lange diese jedoch nicht mehr als eine Internetpräsenz mit der Reservierung von PKW-Wunschkennzeichen und der Anmeldung zur Hundesteuer umfassen, haben sie nur symbolischen Charakter.

Die oben erwähnten Beteiligungsverfahren in Diskussionsform werden schon seit einigen Jahren internetgestützt durchgeführt. Hier liegen aus einer großen Zahl von durchgeführten Verfahren aus sehr unterschiedlichen Themenfeldern eine ganze Reihe von Erfahrungen vor.

Für die internetgestützte Übermittlung von Einwänden und Bedenken zu Raumplanungsverfahren hingegegen fehlten bisher durchgängige und praxiserprobte Methoden.

2.1 Beteiligungs-Phasen

Grundsätzlich sind bei einem formalisiertem Beteiligungsverfahren drei verschiedene Phasen unterscheidbar:

Bereitstellung der Planungsunterlagen,

Kommunikation zwischen Beteiligten und Behörden und

(behördeninterner) Abwägungsprozess.

Ziel eines internetgestützten Beteiligungsverfahrens muss es daher sein, alle drei Beteiligungs-Phasen so im Internet abzubilden, dass sich sowohl für die Beteiligten als auch für die Vorhabenträger ein Vorteil ergibt.

Von den bisher im Internet realisierten Verfahren wurden jedoch immer nur Teilschritte abgedeckt, so dass Verfahrens- und vor allem Medienbrüche die Akzeptanz erschwerten und das innovative Potential des Internets nur teilweise ausgenutzt wurde. Auch die Nutzung von E-Mail als zentraler Kommunikationskanal ist zunehmend durch Viren, Würmer und Spam-Mails beeinträchtigt, so dass unter Umständen gewünschte Mails durch restriktive Filter der Mailserver aussortiert werden. Und schließlich stellt der (unverschlüsselte) E-Mail-Verkehr eine Sicherheitslücke dar, die vergleichsweise aufwändig abgesichert werden muss. Erst der weitgehende Ersatz von E-Mail durch eine vom Internetprotokoll unabhängige Kommunikation schließt diese Lücke.

2.2 Technische Realisierung

Die Durchführung von Beteiligungsverfahren bei Raumplanungen über das Internet sind besonders geeignet, um partizipative Ansätze von Politik und Verwaltung in die Fläche zu tragen und publik zu machen. An die Realisierung von internetgestützten Beteiligungsverfahren in der Raumplanung werden jedoch erhöhte Anforderungen gestellt, da die drei oben skizzierten Beteiligungsphasen sehr unterschiedliche technische Umsetzungen erfordern. Unter anderem müssen folgende Aspekte berücksichtigt werden, um eine medienbruchfreie und einheitliche Integration aller drei Beteiligungsphasen zu erreichen:

Online-Präsentation von großformatigem und gut lesbarem (hochauflösendem) Kartenmaterial

Online-Präsentation von umfangreichen Texten, Tabellen, Bildern etc.

Erstellung von Einwendungen zu einzelnen Textpassagen unter Beibehaltung des Bezuges

Erstellung von zeichnerischen Einwendungen zum Kartenmaterial unter Beibehaltung des Bezuges

Einfache Handhabbarkeit

Geringe Hard- und Softwareranforderungen

Eindeutige Zuordnung von Einwendungen zu einem Einwender als Grundlage der Kommunikation

Sichere Übermittlung der Einwendungen

Datenbankgestützte Verwaltung und Bearbeitung der Einwendungen

Flexible Anpassungsmöglichkeit an verschiedene Verfahrensanforderungen

Möglichst niedrige Kosten

3 BETEILIGUNG-ONLINE

Im Rahmen eines Forschungsvorhabens wurde von der Ingenieurgesellschaft entera aus Hannover in Zusammenarbeit mit Institut für Landespflege und Naturschutz der Universität Hannover für den Interaktiven Landschaftsplan Königslutter im Jahr 2003 (siehe Vortrag B. Warren-Kretzschmar, A. Neumann: Interactive Landscape Planning - Results of a pilot study in Königslutter am Elm) erstmalig ein internetbasiertes Beteiligungsverfahren entwickelt und erprobt. In diesem Verfahren wurden die oben genannten Aspekte realisiert und alle drei Verfahrensphasen medienbruchfrei in einem durchgängigen und einheitlichen System integriert (Hachmann, 2004).

Die im Rahmen des Forschungsvorhabens konzipierten Basismodule wurden inzwischen erheblich weiterentwickelt und stark verbessert und so für den Einsatz in beliebigen Beteiligungsverfahren optimiert. Es ist unter dem Namen *Beteiligung-Online* bei zahlreichen Verfahren im Einsatz.

3.1 Konzept

Das Konzept von *Beteiligung-Online* vereinigt mehrere innovative Ansätze: Es ist vollständig im Internet realisiert, es ist datenbankgestützt, es erlaubt nicht nur textliche Einwendungen sondern vor allem auch zeichnerische Anmerkungen in den bereitgestellten Planungskarten und als Basissoftware wurden Open-Source Komponenten verwendet. Außerdem sind an die Rechner der Beteiligten außer einem Internetbrowser keine weiteren Hard- oder Softwareanforderungen zu stellen, da die Rechenleistung ausschließlich vom Internet-Server erbracht wird.

3.1.1 Internet

Alle drei Verfahrensphasen laufen ausschließlich im Internet ab. Es gibt daher keinen Wechsel zwischen Online- und Offline-Phasen, keine redundante Datenhaltung und keine Medienbrüche. Die Prozesskette wird dadurch stark verkürzt.

3.1.2 Datenbank

Um die beschriebenen Nachteile der E-Mail-Kommunikation zu umgehen, wurde als zentrale Komponente eine Datenbankanwendung entwickelt, die sich auf einem Internet-Server befindet. Alle Einwendungen werden direkt und ohne Umweg über das Internetprotokoll (also z.B. E-Mail) in die Datenbank geschrieben. Zusätzlich werden sensible Daten (z.B. Passworte) verschlüsselt übertragen (SSL).

Im Zentrum des Verfahrens steht daher die sogenannten Beteiligungsdatenbank. Diese enthält zwei strikt von einander getrennte und passwortgeschützte Bereiche: Den Auswertungsbereich des Vorhabenträgers und die persönlichen Arbeitsbereiche der Beteiligten. Für jede Person oder Institution, die sich beteiligt, wird ein solcher persönlicher Arbeitsbereich angelegt, der außschließlich dem jeweiligen Beteiligten zugänglich ist. Hier werden alle Anmerkungen, Einwendungen und Bedenken erstellt, bearbeitet, gesammelt und nach ihrer Fertigstellung an den Vorhabenträger „verschickt". Bei diesem „Versand" werden die Daten aus dem persönlichen Arbeitsbereich der Datenbank den Auswertungsbereich des Vorhabenträgers verschoben. Danach verbleibt im persönlichen Arbeitsbereich ein unveränderbares Belegexemplar jeder Einwendung, welches natürlich auch ausgedruckt oder lokal abgespeichert weren kann. Durch die Nutzung des Original-Datenmaterials (Texte und Karten) wird bei jedem Einwand der entsprechende Bezug mit abgespeichert.

Durch den Einsatz eines hochperformaten Datenbankmanagementsystems stehen sowohl den Beteiligten als auch dem Vorhabenträger leistungsfähige Werkzeuge zur Verfügung. Auf Seiten des Vorhabenträgers dient die Beteiligungs-Datenbank zur Analyse, Bearbeitung, Abwägung und Druckausgabe der Einwendungen. Mit Hilfe eines Abfrage-Editors kann die Datenbank nach beliebigen Kriterien durchsucht oder sortiert werden. Durch die Authentifizierung des Beteiligten mittels Benutzername und Passwort sind alle Einwendungen eindeutig einem Einwender bzw. einer Institution zugeordnet. Auch der direkte Ausdruck der synoptischen Darstellung der Einwendungen und die integrierte, datenbankgestützte Prozessdokumentation unterstützen den Abwägungsprozess maßgeblich.

Damit die noch analog eingehenden Einwendungen auch datenbankgestützt bearbeitet und abgewogen werden können, erlaubt ein Eingabemodul diese komfortabel in die Beteiligungsdatenbank zu integrieren. Dadurch können alle Einwendungen unabhängig von ihrer Eingangsart in einem System verwaltet werden.

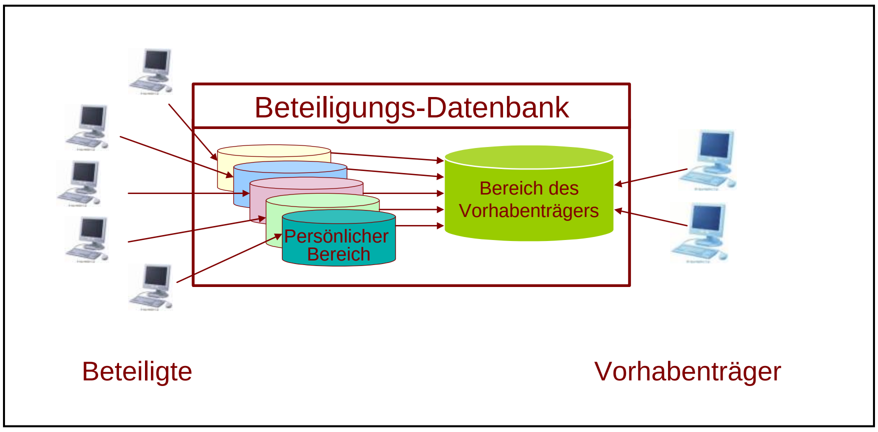

Abb. 1: Beteiligungsdatenbank

3.1.3 Zeichnerische Einwendungen

Im Unterschied zu anderen Verfahren können nicht nur textliche Einwendungen auf Grundlage der Originaltexte erstellt werden, sondern auch zeichnerische Einwendungen direkt in die Originalkarten eingezeichnet werden. Dies erfolgt mit Hilfe eines Java-Applets, welches dem Nutzer über das Internet zur Verfügug gestellt wird. Damit haben zeichnerische Anmerkungen immer einen exakten Raumbezug, sind hervorragend lesbar und machen ungenaue ungenaue Örtlichkeits-Beschreibungen ("rechts neben der Autobahn" oder "hinter dem Wald") überflüssig. Durch die Georeferenz können sie außerdem als Digitalisiergrundlage in Geo-Informationssystemen verwendet werden, um die entsprechenden Geofachdaten zu editieren.

3.1.4 Open-Source Software

Zur Realsierung der Funktionen von Beteiligung-Online sind zahlreiche leistungsfähige Software-Komponenten erforderlich. Insbesondere im Rahmen des oben erwähnten Forschungsvorhabens wurde besonderer Wert darauf gelegt, dass durch die Verwendung von lizenzkostenfreien Open-Source-Produkten als Basiskomponenten die Anschaffung dieser Programme keine unüberwindlichen Investitionshürden darstellen.

3.2 Bausteine von *Beteiligung-Online*

Aus dem oben Gesagten ergibt sich, dass *Beteiligung-Online* keine Produkt „out-of-the-box“ ist, sondern aus einem komplexen Zusammenspiel von vielen verschiedenen Einzel-Bausteinen entsteht. Als wesentliche Elemente sind hier die folgenden Programme zu nennen: Zur kartografischen Visualiserung wird der UMN-Mapserver eingesetzt, die Oberfläche hierfür wurde auf Basis des MapBenders realisiert. Für die Beteiligungsdatenbank und alle anderen datenbankbasierten Funktionen wird das DBMS MySQL verwendet. An Stelle von MySQL können natürlich auch andere Datenbanksysteme wie z.B. PostgreSQL eingesetzt werden. Als Skriptsprache kommt PHP zum Einsatz und als Servlet-Engine wird Tomcat verwendet.

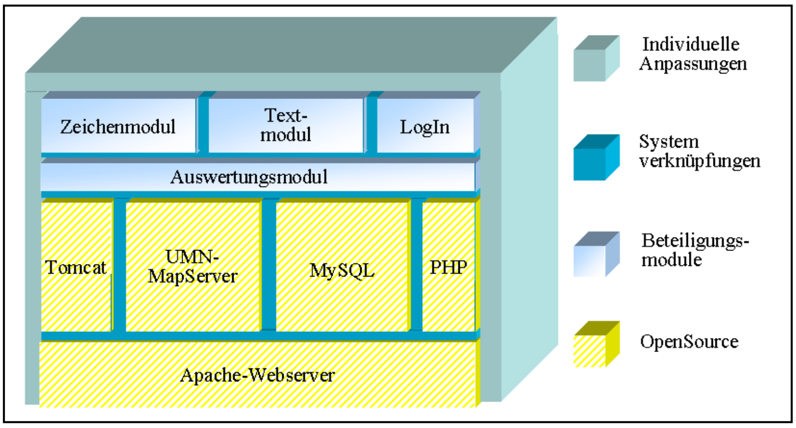

Abb. 2: Bausteine von *Beteiligung-Online*

Als Neuentwicklungen stellen die sogenannten Beteiligungsmodule die eigentlichen Funktionen für die Online-Beteiligung bereit. Dabei greifen auch die Beteiligungsmodule teilweise wieder auf Open-Source-Komponenten zurück. Alle Komponenten werden durch Systemverknüpfungen mit einander verbunden und durch individuelle Anpassungen für die jeweiligen Beteiligungsverfahren maßgeschneidert. Durch den Zugriff auf den Programmcode aller verwendeten Komponenten ergibt sich ein extrem hohes Maß an Flexibilität.

3.3 Nutzung

Grundsätzlich kann *Beteiligung-Online* auf einem beliebigen Internetserver installiert und eingerichtet werden. Auf Grund der Vielzahl von einzurichtenden Komponenten ist jedoch in der Regel die Verwendung eines zentralen Internetservers für zahlreiche Verfahren sinnvoll. Die Dienste dieses Servers mit der vollständigen und bei Bedarf individuell angepassten Software werden vom Vorhabenträger nur für die Dauer des jeweiligen Beteiligungsverfahrens in Form von Application Service Providing (ASP) gemietet. Das macht den Einsatz eines eigenen Servers mit der damit verbundenen Konfiguration, Software-Installation, Pflege, Wartung, Sicherung etc. überflüssig, was sich in einer sehr deutlichen Kostenersparnis bemerkbar macht.

4 ERFAHRUNGEN

Neben dem erwähnten Forschungsvorhaben wurden bzw. werden inzwischen zahlreiche Beteiligungen zu sehr unterschiedlichen Fachplanungen mit Hilfe von *Beteiligung-Online* durchgeführt. Hierdurch konnten wertvolle Erfahrungen gesammelt und in die Anwendung integriert werden. *Beteiligung-Online* wird in der Regional- und Landschaftsrahmenplanung eingesetzt, aber auch bei der Beteiligung zum Landesraumordnungsprogramm Niedersachsen, beim Internetportal und dem Beteiligungsverfahen zur A22 (Küstenautobahn) und zukünftig bei allen Verfahren der Landesplanung in Nordrhein-Westfalen.

4.1 Ressourcen-Einsparung

Vor dem Hintergrund steigender personeller und finanzieller Kürzungen der öffentlichen Hand ist die Einsparung von Ressourcen durch den Einsatz von Technik ein wichtiges Argument für den Einsatz von Online-Beteiligungsverfahren. Vor dem Hintergrund der zunehmenden Notwendigkeit von Bürgerbeteiligungen werden rein papiergebundene, analoge Beteiligungsverfahren in absehbarer Zeit nicht mehr finanzierbar und durchführbar sein. Insbesondere bei Beteiligungsverfahren mit großer Öffentlichkeitswirksamkeit, stellt die datenbankgestützte Online-Beteiligung ein wichtiges Instrument dar, um solche Verfahren möglichst schnell und effizient und damit kostengünstig durchzuführen. Anfänglich wird es als Aufwertung und zum teilweisen Ersatz konventioneller Verfahrens eingesetzt werden. Mittelfristiges Ziel muss jedoch ein medienbruchfreies Verfahren sein, welches dann nur noch online durchgeführt wird.

Mit Hilfe von *Beteiligung-Online* können in erheblichem Umfang finanzielle und personelle Ressourcen eingespart werden.

Druck und Versand von Verfahrensunterlagen kann erheblich vermindert oder sogar ganz eingespart werden, da die Unterlagen in guter visueller Qualität im Internet zur Verfügung stehen. Da die Bereitstellung von Kartenmaterial im Internet erheblich kostengünstiger ist als der Druck vergleichbarer Papierexemplare, können zur Verbesserung des Verständnisses der Planungsaussagen diese auf mehrere Karten verteilt werden. Dies erhöht die Transparenz der Planung und verbessert damit die Akzeptanz bei den Beteiligten. Es besteht also nicht mehr der Zwang, aus Kostenersparnisgründen möglichst viele planerische Inhalte in möglichst wenige Karten zu komprimieren.

Die integrierte Volltextsuchmaschine vereinfacht für den Einwender das Durchsuchen der Textdokumente nach relevanten Textstellen und das Zeichenmodul erleichtert das Erstellen von exakten kartografischen Hinweisen. Damit werden insbesondere umfangreiche Planungsunterlagen viel leichter handhabbar.

Durch die eingesetzte Technik wird für alle Einwendungen immer einen Bezug zur Textstelle (Kapitel, Ziel, Begründung etc.) bzw. zum kritisierten Teil einer Karte sichergestellt. Die Einwendungen werden direkt vom Einwender selbst in die Datenbank eingegeben. Damit entfallen alle weiteren Erfassungsarbeiten. Alle Einwendungen (internetbasiert und analog eingegangene) werden in der gleichen Datenbank verwaltet, die von jedem Rechner mit Interanschluss aus passwortgeschützt zugänglich ist. Dadurch können die Einwendungen dezentral von zahlreichen Sachbearbeitern parallel bearbeitet werden. Zudem stehen alle Einwendungen jederzeit für beliebige Auswertungen zur Verfügung. Dies ist etwa bei internen Beratungen oder öffentlichen Veranstaltungen (z.B. Anhörungsterminen) außerordentlich hilfreich, da hier stets hochaktuell sämtliche Originalunterlagen und alle Einwendungen sowie deren Abwägungen verfügbar sind, ohne dass Berge von Aktenordnern und großformatigen Karten transportiert werden müssen.

Die beschriebenen Datenbankwerkzeuge (Suchen, Filtern, Drucken, synoptische Darstellung etc.) vereinfachen die Arbeit mit den Einwendungen und das Erarbeiten der Abwägungen ganz entscheidend. Diese Werkzeuge sind insbesondere bei Verfahren mit tausenden von Einwendungen unverzichtbar, um diese vor dem Hintergrund immer knapper werdender Personalressourcen überhaupt abarbeiten zu können.

Schließlich kann nach Abwägung und Beschlussfassung das Abwägungsergebnis wieder als synoptische Darstellung im Internet für alle Beteiligten bereit gestellt werden. Durch die verfügbaren Datenbankfunktionen wird das Arbeiten mit diesem umfangreichen Datensatz erheblich ereleichtert.

Die beschriebenen Einsparung sind je nach Verfahren unterschiedlich groß und daher nicht direkt monetarisierbar. Gleichwohl ist offenkundig deutlich, dass die Einsparungen um so weitreichender sind, je stärker die Online-Beteiligung eingesetzt und von den zu Beteiligenden genutzt wird.

4.2 Akzeptanz

Ein zentraler Aspekt beim Einsatz von Online-Beteiligung ist die Akzeptanz bei den zu Beteiligenden. Die bereits mit der oben beschriebenen Technik durchgeführten Internet-Beteiligungsverfahren in unterschiedlichen Planungsfeldern haben gezeigt, dass die Akzeptanz und damit die Beteiligung von verschiedenen Faktoren abhängen.

Die wichtigsten Punkte hierbei sind die Bekanntheit des Online-Verfahrens und dessen Positionierung durch den Planungsträger. Durch Auftakt- und Informationsveranstaltungen sowie begleitende Berichterstattung und Informationen in den Medien muss von Anfang an für einen möglichst hohen Bekanntheitsgrad des Verfahrens gesorgt werden. Gleichzeitig erhält die Online-Beteiligung auf diesem Wege eine größere Bedeutung. Es muss deutlich gemacht werden, dass die Beteiligung im Internet der Regelfall ist und analoge Unterlagen bzw. Einwendungen die Ausnahme darstellen. Es ist so mit einer deutlich höheren Nutzung der Internet-Beteiligung zu rechnen, als wenn die Online-Beteiligung nur als fakultatives Ergänzungsangebot zum konventionellen Verfahren betrachtet wird.

Da zur Zeit Online-Verfahren im Rahmen von Bürgerbeteiligungen noch vergleichsweise wenig durchgeführt werden, ist diese Technik bei den Bürgern noch relativ unbekannt. Insbesondere bei den eher abstrakten und langfristigen Planungen der Regional- und Landesplanung ist außerdem eine Beteiligung der Bürger nur dann zu erwarten, wenn eine direkte Betroffenheit (z.B. beim Thema Windenergie) vorliegt. Um hier das Interesse der Bürger stärker zu wecken, empfiehlt es sich, mit Hilfe von nicht planungsrelevanten Zusatzangeboten (z.B. digitale Luftbilder, Adresssuche) erhöhte Aufmersamkeit für die Onlineseiten des Beteiligungsverfahren zu erzielen.

Anders verhält es sich mit der Beteiligung der Träger öffentlicher Belange. Diese haben deutlich häufiger mit Beteiligungsverfahren zu tun und können daher die Vorteile der internetgestützten Arbeitsweise besser für sich einschätzen.
Bei der Online-Beteiligung zum Freiraumkonzept des Zweckverbandes Großraum Braunschweig sind rund 26% (253) aller Einwendungen (961) digital eingegangen (Stand 22.12.2004). Von einigen wenigen Ausnahmen abgesehen, stammen die digitalen Einwendungen von Trägern öffentlicher Belange. Bedingt durch die eingesetzte Technik zeigte sich bei diesen Einwendungen durchweg eine höhere inhaltliche Qualität und ein konkreterer Sachbezug als bei den analogen Einwendungen.

4.3 Gesamtstrategie

Häufig vernachlässigt wird die Tatsache, dass Online-Beteiligungen ein zentrales und wichtiges Element von e-Demokratie darstellen. Schließlich wird durch solche Verfahren den Bürgern deutlich vor Augen geführt, dass sie im Rahmen der Beteiligung direkt Einfluss auf politisch-planerische Entscheidungen nehmen können. Nur wenn den Beteiligten offen gezeigt wird, dass und wie ihre Einwendungen, Anregungen und Bedenken im Rahmen des Abwägungsprozesses in das Vorhaben eingeflossen sind, haben Online-Beteiligungsverfahren langfristig eine Chance. Durch die datenbankgestützte, automatisierte Erzeugung von personalisierten Bestätigungs-, Dankes-, Antwort-, Abwägungs- und Hinweisschreiben zu verschiedenen Zeitpunkten des Verfahrens wird dem Vorhabenträger sehr einfach gemacht, den beteiligten Bürgern zu zeigen, dass sie Ernst genommen werden.

Um die Beteiligung an Planungsvorhaben nicht zu singulären Demokratie-Ereignissen wie beispielsweise der Stimm-„abgabe“ bei den Wahlen werden zu lassen, müssen sie in eine e-Demokratie-Gesamtstrategie eingebunden werden. Diese Gesamtstrategie muss offen und transparent kommuniziert werden, sie muss veränderbar und bürgernah sein. So lässt sich möglicherweise die zunehmende Politikverdrossenheit durch eine neue Kultur der Beteiligung (Mitterhuber, 2004) an Planungsvorhaben kompensieren.

5 FAZIT

Die (Bürger-)Beteiligungen zu Planungsvorhaben werden zukünftig massiv zunehmen. In Zeiten immer knapper werdender öffentlicher Haushalte erschließen innovative, internetgestütze Beteiligungsverfahren wie *Beteiligung-Online* erhebliche Einsparpotenziale. Mittelfristiges Ziel muss es daher sein, Online-Beteiligung als Standardform zu etablieren. Dies wird jedoch nur gelingen, wenn sie in eine breiter angelegte e-Demokratie-Strategie eingebettet sind.

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STÄRKEN UND SCHWÄCHEN VON PUBLIC PARTICIPATORY GIS

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ABSTRACT

Dieser Beitrag gibt zuerst eine kurze Einführung in die Thematik Public Participatory Geographic Information Systems (PP GIS), legt die wichtigsten Komponenten eines PP GIS dar und konzentriert sich dann auf online GIS unterstützte Beteiligungsprozesse in der räumlichen Planung. Nach der Erklärung der Methode SWOT werden in einer tabellarischen Übersicht Stärken, Schwächen, Chancen und Risiken von PP GIS analysiert. Anschließend konzentrieren wir uns auf die Motivation der Bürger und auf die Usability einer PP GIS Applikation. Diese zwei identifizierten Schwächen analysieren wir am Beispiel eines Projektes für die Stadt Salzburg, das derzeit in der Entwicklung ist. Wir schließen das Paper mit einem Ausblick in die Zukunft ab.

1 EINFÜHRUNG

Public Participatory Geographic Information Systems (PP GIS) ist ein Forschungsfeld, das sich mit der Partizipation der Öffentlichkeit an Planungsprozessen unter Nutzung von Geographischen Informationssystemen (GIS) beschäftigt. Das Internet als Kommunikationsplattform bietet sich hierbei in besonderer Weise an, diese neue Form der Bürgerbeteiligung in räumlichen Planungsprozessen zu unterstützen. Die Kommunikation bildet jedoch nicht nur ein zentrales Merkmal des Internets, sondern stellt eine der Hauptaufgaben der Planung an sich dar. Nach Selle *(1999)* erfordert die Gestaltung des Vermittlungsprozesses zwischen den beteiligten Akteuren die gleiche Menge an Energie wie die Beschäftigung mit Sach- und Fachfragen. Je mehr Akteure beteiligt sind, desto schwieriger wird die Durchführung des gesamten Kommunikationsprozesses. Durch die Anwendung von online PP GIS in einem räumlichen Entscheidungsprozess bieten sich Möglichkeiten einer Verbesserung und Aufwertung und zwar besonders im Bereich der demokratischen Mitbestimmung *(Habekost, 2002).* Denn vor allem in Planungsfragen ist das Verlangen nach interaktiven Systemen, welche eine Integration der Expertinnen und Experten, Betroffenen und Interessenvertretungen ermöglichen, stark ausgeprägt. Durch die Anwendung von online PP GIS entstehen neue Möglichkeiten, die Qualität der traditionellen Beteiligungsmethoden zu verbessern. Online PP GIS zielen vor allem darauf ab, jene Nutzergruppen zu erreichen, die den herkömmlichen Beteiligungsformen nichts abgewinnen können.

Online PP GIS bringen jedoch nicht nur Vorteile mit sich, sondern weisen auch Schwächen und Probleme auf. Fragen, die bei der Applikationsentwicklung möglicherweise auftreten, sind folgende: Wie geht man mit den unterschiedlichen abgegebenen Meinungen um? Wie erfolgt die Einbindung jener Bürger in den Beteiligungsprozess, die noch über keinen Internetzugang verfügen? Führt der Einsatz von PP GIS erst wieder zu einer Stärkung des Einflusses von Elitegruppen in der Bevölkerung? Wie viele Bürger werden sich wirklich an der Entscheidungsfindung beteiligen? Wie kann die Öffentlichkeit motiviert werden sich an Planungsentscheidungen zu beteiligen? Dies ist nur eine Auswahl an Fragestellungen, die bei der Entwicklung bzw. Anwendung von online PP GIS in räumlichen Planungsprozessen auftreten können.

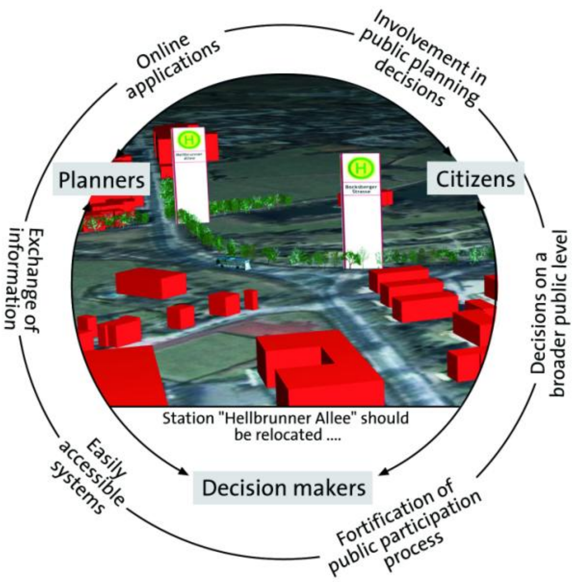

Abb.1: Was ist PPGIS?

Abbildung 1 beschreibt die wesentlichsten Komponenten eines derartigen Systems. Als solche können folgende identifiziert werden: Planer, Entscheidungsträger und Bürger. Diese drei Gruppen wirken am Partizipationsprozess einer räumlichen Planung mit. In nebenstehendem Beispiel geht es um das Finden eines Standorts für eine neue Bushaltestelle. Die Bürger sind aufgerufen, ihre Stimme zu dem geplanten Vorhaben abzugeben. Die Entscheidung wird zwar von der Politik in Abstimmung mit den Experten getroffen, jedoch bilden die abgegebenen Stimmen der Bevölkerung eine wichtige Basis für die Entscheidungsfindung.

Der äußere Ring der Graphik umschreibt Teilbereiche von PP GIS, welches das Zentralthema dieser Graphik bildet. Die Graphik spricht folgende Teilbereiche an: Online Applikationen, Einbeziehung der Bürger in öffentliche Planungsprozesse, Informationsaustausch, leicht zugängliche Systeme, Stärkung der Bürgerbeteiligungsprozesse und Entscheidungen, die auf einer breiteren öffentlichen Basis getroffen werden.

2 STÄRKEN, SCHWÄCHEN, CHANCEN, UND RISIKEN

Die Analyse der Stärken (strenghts), Schwächen (weaknesses), Chancen (opportunities) und Risiken (threats) wird als SWOT Analyse bezeichnet. Diese aus den USA stammende Methode ist auch als Potenzialanalyse bekannt und stellt eine der verbreitesten Analysemethoden im Marketing und Strategiemanagement dar. In wirtschaftlichen Bereichen wird die SWOT Analyse dahingehend genutzt, dass die unternehmensinterne und die unternehmensexterne Perspektive zusammengeführt werden. Sie integriert damit die Stärken-Schwächen-Analyse und die Chancen-Risikenanalyse, um die Grundlage für die fundierte Ableitung von Strategien zu schaffen und so Wettbewerbsvorteile gegenüber der Konkurrenz ausnutzen zu können *(Simon H., 2000; Balamuralikrishna R. and J.C. Dugger, 1995)*. Die SWOT Analyse ist eine deskriptive Methode, formulierte Kriterien werden also keiner metrischen Messung unterzogen. Besteht das Vorhaben eine PP GIS Applikation zu entwickeln, so ist es in der Anfangsphase von besonderer Wichtigkeit, die Stärken, Schwächen, Chancen und Risiken von bereits existierenden Applikationen zu identifizieren und daraus dann Strategien für die Umsetzung einer konkreten PP GIS Applikation, welche die Bürgerbeteiligung in der Raumplanung unterstützt, abzuleiten. Die gewonnenen Erkenntnisse sollen also zu einer zielgerichteten und an die Bedürfnisse der Nutzer angepassten Projektumsetzung beitragen.

Die Logik der SWOT Analyse kann folgendermaßen charakterisiert werden:

Stärken, die es zu stabilisieren gilt

Schwächen, die es abzubauen gilt

Potenziale, die es zu nutzen gilt

Risiken, die es abzuwehren gilt

Steve Carver *(2001)* hat sich als einer unter vielen Forschern intensiv mit der Thematik Partizipation und geographische Information auseinandergesetzt. Er hat die Rolle, welche geographische Information in räumlichen Planungsprozessen spielt, untersucht und eine umfassende SWOT Analyse zu diesem Themengebiet vorgenommen. Wir haben im ersten Schritt seine Analyse in tabellarischer Form aufbereitet. Im zweiten Schritt haben wir die Analyse Carvers durch Stärken, Schwächen, Chancen und Risiken von online PP GIS erweitert.

STÄRKEN	**SCHWÄCHEN**
GIS als beste Methode zur Analyse räumlicher Daten	Kein Internetzugang für die gesamte Bevölkerung
Einbezug lokalen Wissens in die Entscheidungsfindung	Marginalisierung bestimmter sozialer Gruppen der Bevölkerung
Bestmögliche Organisation von räumlichen Daten in Form einer Karte	Mangelnde Problemlösungskompetenz und meist zu starke Vereinfachung von Problemen durch die Bevölkerung
Erhöhter Zugang der Bürger zu Information	Mangelnde Akzeptanz neuer Technologien seitens der Verwaltungen
Möglichkeit der Beteiligung zu jeder beliebigen Zeit	Einschränkung sozialer Kontakte durch die Verwendung des Internets
Ortsungebundenheit	Bestehende Vorbehalte der Bürger gegenüber digitalen Angeboten
Weniger durch andere Personen beeinflusste Abgabe der eigenen Stellungnahme	Verfälschung der Ergebnisse durch mehrfache Systemeintragungen
Abschwächung räumlicher Hierarchieebenen durch den Einsatz von online PP GIS	
Einsatz virtueller Umgebungen, gute Visualisierungsmöglichkeiten wie beispielsweise 3D Visualisierungen	
Durchführung kartenbasierter Diskussionen im Internet	
Erhalt personalisierter räumlicher Information	

CHANCEN	**RISIKEN**
Ergänzung traditioneller Methoden in der Bürgerbeteiligung	Missbrauch des Vertrauens der Bevölkerung
Erhöhte Entscheidungsbefugnis für die Bevölkerung	Problem der Differenzierung seriöser und nicht seriöser Stellungnahmen
Einbezug der gesamten Gesellschaft in räumliche Planungsprozesse	Niedrigere Bereitschaft der Bevölkerung sich zu beteiligen
Entwicklung leicht bedienbarer und verständlicher Benutzerschnittstellen	Divergenz zwischen technischer und gesellschaftlicher Entwicklung
Erhöhte Transparenz in räumlichen Planungsprozessen	

Nachfolgend werden wir uns mit zwei konkreten Schwächen, die aus dieser SWOT Analyse abgeleitet werden können, beschäftigen. Aus unserer Sicht sind für das Gelingen eines GIS unterstützten Beteiligungsprozesses die Motivation der Bürger sowie die Usability der Applikation von besonderer Wichtigkeit. Fragen, die hierbei auftreten, sind folgende: Mit welchen unterstützenden Mitteln können die Bürger motiviert werden, sich an Planungsprozessen zu beteiligen? Wie sieht eine für die Gesamtbevölkerung leicht bedienbare und leicht nutzbare Applikation aus? Beide Fragestellungen konzentrieren sich auf den Kommunikationsaspekt von GIS unterstützten Beteiligungsprozessen in der Planung.

3 MOTIVATION DER BÜRGER

Erläuterungen zu bereits existierenden online PP GIS Applikationen weisen vielfach auf die Thematik der oft geringen Beteiligung durch die Bevölkerung hin. Welche Bedingungen müssen für die Bürger erfüllt sein, damit sie sich beispielsweise für die Entwicklung ihres Stadtteils interessieren? Während die Bürger eine verstärkte Einbindung in lokale Entwicklungsprozesse anstreben, erhoffen sich die Entscheidungsträger ein aktuelles Meinungsbild aus der Bevölkerung. Dieses Bild entsteht aus Anregungen, Ideen und Stellungnahmen aus der Bevölkerung *(Strastil von Straßenheim A., 2000)*. Wenn ein Planungsvorhaben keine direkten Auswirkungen auf den Bürger hat, ist es oft schwierig, die Bürger für eine aktive Beteiligung zu gewinnen. Weiters besteht vielfach die Annahme, dass der einzelnen Stimme eines Bürgers bei einer Planungsentscheidung ohnehin kein Gewicht beigemessen wird. Die Bevölkerung hat vielfach auch kein Vertrauen in den Umgang der Planungsverantwortlichen mit den abgegebenen

Stimmen. Die Bürger sind also oft der Meinung, dass die Kosten einer Beteiligung den tatsächlichen Nutzen übersteigen und ignorieren daher die Möglichkeit der Beteiligung. Dieses Phänomen, das als rationale Ignoranz bezeichnet wird, wird in der „Public Choice Theory“ behandelt (*Buchanan, J. and T. Gordon, 1962, Gunning, 2002*). Um die Beteiligung der Bürger an räumlichen Planungsentscheidungen zu erhöhen, ist es besonders wichtig, ihre Aufmerksamkeit für das konkrete Projekt zu erregen. Unterschiedliche Aktivitäten sollen die Bürger für eine aktive Beteiligung im Projekt motivieren. Franck (1996) beschäftigt sich mit der steigenden gesellschaftlichen Bedeutung der Aufmerksamkeit im Informationszeitalter. Die gesamte Werbewirtschaft beispielsweise lebt von der Aufmerksamkeit der Menschen. Menschen müssen sich permanent entscheiden, wem beziehungsweise welchen Dingen sie ihre Aufmerksamkeit widmen wollen. Um die Bürger für die Teilnahme an einem online PP GIS zu motivieren, können beispielsweise folgende Aktivitäten durchgeführt werden:

3.1 Werbung in Printmedien und im lokalen Fernsehen

Durch ein regelmäßiges Bewerben der Internetseite kann die Bevölkerung über die Existenz einer derartigen Applikation informiert werden. Zeitungsartikel über das Projekt, kurze Fernsehschaltungen und das Verteilen von Flugzetteln sollen zu einer Erhöhung der Beteiligungszahlen führen.

3.2 Durchführung von Einführungsveranstaltungen

In öffentlichen Veranstaltungen können die Bürger mit dem Projekt vertraut gemacht werden und die Vorteile von GIS unterstützter Bürgerbeteiligung vermittelt werden. Bei diesen Veranstaltungen erhalten die Bürger die Gelegenheit, die Experten direkt mit ad hoc Fragestellungen zur Plattform zu konfrontieren. Diese Veranstaltungen sollen auch dem Vertrauensaufbau der Bevölkerung mit den Entscheidungsträgern dienen.

3.3 Durchführung eines *online Gewinnspiels*

Die Gestaltung eines online Gewinnspiels, das im Vorfeld mit der Unterstützung unterschiedlicher Medien beworben wird, könnte die Bürger ebenfalls zu einer aktiven Beteiligung motivieren.

3.4 Aufstellen von *Touchscreens*

Die Nutzung weiterer zusätzlicher Medien wie beispielsweise Touchscreens, die an stark frequentierten Orten aufgestellt werden, können ebenfalls zu einer breiteren Beteiligung der Bevölkerung beitragen. Auch Experten und Entscheidungsträger sollen diese Punkte zu festgelegten Zeiten aufsuchen. Dies fördert die direkte Kommunikation der angesprochenen Gruppen und unterstützt den gegenseitigen Lernprozess.

Die Motivation der Bürger für die Teilnahme an derartigen Applikationen wurde bisher in der Literatur stark vernachlässigt. Ein Grund dafür ist die starke Fokussierung auf technische Aspekte bei der Systementwicklung. Die obige Zusammenstellung ist nur eine Auswahl an Möglichkeiten, um die Motivation der Bevölkerung sich an Planungsentscheidungen im Internet zu beteiligen, zu erhöhen. Die genannten Beispiele können nur den Anreiz schaffen an räumlichen Planungsprozessen zu partizipieren.

4 USABILITY DER PP GIS APPLIKATION

Ein wesentlicher Aspekt, der unmittelbar mit der Erhöhung der Beteiligung an Partizipationsprozessen zusammenhängt, ist die ansprechende und leicht verständliche Gestaltung der Benutzeroberfläche. Jokob Nielsen *(1993)* behauptet in seinem Buch mit dem Titel „Usability engineering“, dass Webseiten erst benutzerfreundlich in ihrer Anwendung werden, wenn der Aufbau der Webseite unter zu Hilfenahme von Usability Methoden erfolgt ist. Web Usability engineering beschäftigt sich mit Methoden für die Entwicklung und Realisierung von benutzerorientierten Webseiten. Die Hauptidee von Usability berührt also darauf, dass der Nutzer in das Zentrum des Interesses gerückt wird. Gute Usability einer Webseite kann zu verbesserter Glaubhaftigkeit der Webseite und ihres Inhaltes führen. Ist dies gewährleistet, so sind die Nutzer eher bereit sich zu registrieren, an Umfragen teilzunehmen, inhaltliche Beiträge zu leisten und die Seite auch weiterhin aufzusuchen. Dazu sind die Nutzer allerdings weniger bereit, wenn sie der Webseite kein Vertrauen schenken *(Fogg et al, 2002*). Der Begriff universelle Usability beschreibt ein für den Durchschnittsbürger gestaltetes System. Ein Hindernis von universeller Usability sind technische und soziale Faktoren wie zum Beispiel Sprachbarrieren und etwaige Behinderungen der Nutzer. Unterschiedlichen Nutzergruppen muss gleichermaßen die Möglichkeit einer aktiven Beteiligung am räumlichen Planungsprozess eingeräumt werden, was soviel bedeutet wie gleicher Systemzugang für alle potentiellen Nutzer.

Das User Interface (Benutzerschnittstelle) stellt einen der wichtigsten Aspekte von GIS Usability dar. Dies ist jener Bestandteil, mit dem der Nutzer interagiert. Es ist also wichtig, dass die Benutzerschnittstelle dem Nutzer eine schnelle Zielerreichung garantiert. Die Schnittstelle zum Benutzer muss die konkrete Durchführung einer konkreten Aufgabe erleichtern *(Medyckyj, 1992)*. Freundschuh *(1997)* stellt in seiner Arbeit fest, dass die Kenntnis der unterschiedlichen Bilder, die Menschen vom Raum besitzen, für das Design der Benutzerschnittstellen besonders wichtig ist, da ein besserer Umgang mit dieser Tatsache zu leichter benutzbaren Informationssystemen führen kann. Die Existenz von verschiedenen Raumtypen impliziert unterschiedliche theoretische und methodologische Fragen, welche das Design und den Nutzer von geographischen Informationssystemen betreffen.

Im Rahmen einer Studie über 12, im Web befindliche PP GIS Applikationen, haben wir eine Expertenbefragung unter anderem auch zum Thema Usability durchgeführt *(Steinmann et al, 2004)*. Die Experten hatten die Aufgabe, die Usability einer online Applikation anhand 6 unterschiedlicher Kriterien zu evaluieren. Das Ergebnis dieser Studie besagt unter anderem, dass ein Großteil der derzeit online befindlichen Applikationen noch Schwächen aufweist. Vor allem die Verfügbarkeit von Metadaten und die Möglichkeit eine personalisierte Sicht der Daten zu erstellen sind nur mangelhaft. Vor Beginn der Entwicklung einer GIS unterstützten Bürgerbeteiligungsplattform, sind folgende Analysen zu machen:

Bei der Anforderungsanalyse wird entschieden, welche Informationen dem Bürger präsentiert werden sollen und zu welchem Zweck.

Die Benutzeranalyse identifiziert den zukünftigen Benutzer.

Die Taskanalyse beschäftigt sich mit den Zielen, die der User bei der Benutzung der Plattform verfolgt.

Aufbauend auf diesen Analysen kann das erste Design der online PP GIS Applikation und die anschließende Erstellung des Prototyps erfolgen. Anschließend wird der Prototyp verschiedenen Usability Tests unterzogen. Die Ergebnisse dieser Tests werden für das Redesign des Prototyps genutzt. Nach der Veröffentlichung der Plattform soll den Benutzern die Möglichkeit eingeräumt werden, Feedback zum Design der Applikation zu geben.

5 FALLBEISPIEL PROJEKT STADT SALZBURG

In Zusammenarbeit mit der Stadt Salzburg werden wir eine online PP GIS Applikation entwickeln. Die Maßnahmen für die Motivation der Bürger und die Usability Faktoren werden wir im Rahmen dieses Projektes testen und analysieren. Das Projekt verfolgt das Ziel, eine nachhaltige Stadtentwicklung zu fördern, indem die Bevölkerung in die Planung konkreter Vorhaben eingebunden wird. Die Bürger sollen dabei über Projekte nicht nur informiert werden, sondern sind aufgerufen, aktiv ihre Meinung kundzutun. Traditionelle Methoden der Bürgerbeteiligung wie beispielsweise Bürgerversammlungen werden ebenfalls zur Anwendung kommen, denn nur die Verbindung unterschiedlicher Kommunikationskanäle kann einen langfristigen Erfolg des Projektes sicherstellen.

5.1 SWOT Analyse

Vor Beginn der Entwicklung der online Applikation werden wir eine SWOT Analyse zum ausgewählten Projektgebiet in Hinblick auf den Einsatz von online PP GIS duchführen. Die Vorgangsweise wird dabei folgende sein:

Identifikation einer konkreten Situation, in der Bürgerbeteiligung notwendig ist

Entwicklung eines Usability- und Motivationsmodells

Analyse der Stärken, Schwächen, Chancen und Risiken

Entwicklung der WebGIS basierten Applikation

Die SWOT Analyse wird sich vor allem damit beschäftigen, die Chancen und Probleme zu identifizieren, die bei der Anwendung von online PP GIS für den ausgewählten Stadtteil auftreten könnten. Das darauf aufbauende Projekt wird versuchen, die Stärken bestmöglich in die Tat umzusetzen, die Chancen zu erkennen und die Schwächen durch entsprechende Gegenmaßnahmen zu mindern.

5.2 Erhöhte Motivation der Bürger

Begleitende Maßnahmen sind notwendig, um möglichst zahlreiche Bürger für die Beteiligung an diesem Projekt in der Stadt Salzburg zu motivieren. Folgende Visionen existieren für die Umsetzung einer neuen Form der Bürgerbeteiligung für Planungsvorhaben in der Stadt Salzburg:

Ansprechende Visualisierungen sollen den Bürgern unterschiedlichste Projektinhalte näher bringen und ihnen das Hineindenken in Planungsvorhaben erleichtern. Virtuelle Landschaften könnten derzeitige Gegebenheiten und geplante Vorhaben anschaulich darstellen.

Kartenbasierte Diskussionen sollen ermöglicht werden, bei denen die Bürger sowohl untereinander als auch mit den Planungsverantwortlichen diskutieren können. Die Kommentare anderer Systemnutzer sollen also auf der Karte einsehbar sein.

Das Medium interaktives Fernsehen kann zu Abstimmungen über bereits bestehende konkrete Projektvorschläge herangezogen werden. Das Abstimmungsergebnis trägt dann zur Entscheidungsfindung bei.

Die Stadtteilentwicklung kann durch eine spielerische Herangehensweise unter Zuhilfenahme des Mediums Internet völlig neuartig gestaltet werden. Mit der Verwendung von Simulationsmodellen können die Bürger beispielsweise ihre Vorstellungen, wie die Stadt ihrer Zukunft aussehen könnte, in spielerischer Art und Weise erarbeiten.

Ein wichtiges Anliegen im Rahmen dieses Bürgerbeteiligungsprozesses im Bereich der Stadtentwicklung wird die Bewusstseinsschaffung für die Thematik der Nachhaltigkeit in der Bevölkerung sein. Denn nur wenn Entscheidungen auf einer breiten Basis getroffen werden, kann die Nachhaltigkeit einer Planung gewährleistet werden.

Zukünftig werden auch mobile Applikationen in der Unterstützung der Bürgerbeteiligung in räumlichen Planungsprozessen eingesetzt.

Teile der oben angeführten Visionen werden in der Applikation für die Stadt Salzburg im Laufe des Jahres 2005 umgesetzt werden. Die entstehende Plattform wird sehr stark abhängig sein vom konkret herangezogenen Beispiel, den verfügbaren Daten, dem Stadium, in dem sich die Planung gerade befindet sowie den vorab definierten Zielgruppen. Bereits im Internet existierende Applikationen kämpfen sehr oft mit der Tatsache, dass sich meist nur wenige Bürger zu einer aktiven Teilnahme bewegen lassen. Der Motivationsaspekt wird in der Entwicklung der Applikation für die Stadt Salzburg besondere Beachtung finden und im Anschluss auch ausführlich diskutiert werden. Ein starker Fokus soll auf die Gestaltung der Benutzeroberfläche bzw. auf die leichte Verständlichkeit und Bedienbarkeit des Systems gelegt werden. Dadurch soll gewährleistet werden, dass unterschiedliche soziale Gruppen partizipieren können. Der Designprozess der Applikation wird mit der Identifizierung der potentiellen Nutzergruppen starten. Dann wird ein Set von Indikatoren entwickelt, die eine benutzerfreundliche Applikation erfüllen muss. Schließlich wird die entwickelte kartenbasierte online Beteiligungsapplikation gemäß der ausgewählten Usability Indikatoren getestet.

6 AUSBLICK

Durch den vermehrten Einsatz von online PP GIS in der räumlichen Planung könnten Planungsentscheidungen auf eine breitere Basis in der Bevölkerung gestellt werden. Online PP GIS sind also eine weitere Methode, die dazu beitragen soll, die Bürgerbeteiligung in räumlichen Planungsprozessen transparenter zu gestalten und zu verbessern. Es entstehen damit neue Möglichkeiten traditionelle Beteiligungsmethoden zu ergänzen.

Kritische Stimmen wie jene von Andrea Strastil von Straßenheim *(2000)* behaupten, dass der Einsatz des Medium Internet für die Zwecke der Bürgerbeteiligung in Planungsprozessen noch zu keiner Demokratisierung beiträgt. Gründe dafür sind, keine gleichberechtigten Voraussetzungen für den Zugang zum Internet, starker Anstieg der Zahl der Internetzugänge in den letzten Jahren, wobei jedoch viele der Adressaten bis jetzt noch über keinen Zugang verfügen. Weiters haben viele der Nutzerinnen und Nutzer noch nicht die Medienkompetenz, die vorhandenen Angebote auszuschöpfen. Sie sehen darin auch vielfach nicht den Bedarf. Diesen Kritikpunkten ist jedoch auch viel Positives entgegenzusetzen. Es ist anzunehmen, dass die Zahl der Internetnutzer in den nächsten Jahren weiter steigen wird und dadurch immer mehr Menschen mit diesem Medium vertraut werden und zwar nicht nur vorwiegend Jugendliche, sondern auch ältere Menschen. Gelingt es, die Bürger vermehrt für die Teilnahme an PP GIS zu motivieren, so bestehen gute Aussichten für die Zukunft, Planungsprozesse stärker zu demokratisieren. Gerade dieser Aspekt ist uns bei der Entwicklung der Applikation für die Stadt Salzburg besonders wichtig. Ein vordergründiges Ziel bei der Applikationsentwicklung ist auch, den potenziellen Nutzern die bestmögliche Usability zu gewährleisten. Diese garantiert unter anderem, dass sich Nutzer, die bisher online Beteiliungsmethoden nichts abgewinnen konnten, vermehrt angesprochen fühlen beziehungsweise dass die Nutzer wiederholt zu einer Webseite zurückkehren und sich weiterhin am Planungsprozess beteiligen. Vor dem Start der Applikationsentwicklung werden wir noch eine SWOT Analyse des ausgewählten Projektgebietes in Relation zur Thematik PP GIS durchführen. Diese soll uns geeignete Strategien hinsichtlich der Projektentwicklung liefern.

Generell sollte bei online GIS unterstützten Beteiligungsprozessen neben der technischen Realisierbarkeit, vielmehr der Mehrwert für die Bürgerbeteiligung an sich im Vordergrund stehen. Die eigentliche Qualität eines GIS unterstützten Beteiligungsprozesses in der räumlichen Planung liegt darin, ob es gelingt zur breiten Meinungsbildung und –äußerung und damit zu einem von der breiten Masse akzeptiertem Entscheidungsprozess beizutragen. Es werden letztendlich aber die potentiellen Nutzerinnen und Nutzer entscheiden, ob der Einsatz von Online-GIS-unterstützter Bürgerbeteiligung ein Trend bleibt, ein Instrument nur für spezifische Gruppen, oder ob dieses neue Mittel in Zukunft zu einem selbstverständlichen Bestandteil in Bürgerbeteiligungsprozessen wird.

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Planung & Engineering Plattform (PEP) der ÖBB

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„Vom professionellen Umgang mit dem Unvorhergesehenen und dem Unberechenbaren“, das war wohl der Leitspruch während der gesamten Umstrukturierung der ÖBB! Doch nicht nur während der Umstrukturierung ist Professionalität angesagt. Professionalität und Innovation zeigte auch der ÖBB Infrastruktur Geschäftsbereich `Planung & Engineering` (kurz ÖBB-PE) bei der Entwicklung und Umsetzung der Planung & Engineering-Plattform (kurz PEP).

Planung & Engineering ist jener Geschäftsbereich der ÖBB, in dem Projekte zum Bau von Eisenbahninfrastrukturanlagen „unter dem rollenden Rad“ koordiniert und in Zusammenarbeit mit anderen ÖBB Geschäftsbereichen sowie zahlreichen Auftragnehmern abgewickelt werden.

1 DAS UMFELD UND HERAUSFORDERUNGEN FÜR DIE IMPLEMENTIERUNG VON PEP

Experten und Expertinnen von Planung & Engineering haben in einem mehrmonatigen Prozess in der Zusammenarbeit mit einer externen Firma die Planung & Engineering Plattform (PEP) zur Unterstützung der Projektabwicklung der Planungs- und Bauprojekte entwickelt.

Das Tool sollte jedes Projektgruppenmitglied unterstützen, den Überblick über die Vielzahl seiner Projekte zu wahren, um termingerecht eigene Aufgaben im Projekt vorbereiten und abwickeln zu können. Die Komplexität der Abwicklung ist durch die Vielzahl und durch die Größe der Projekte sowohl in technischer, finanzieller und personeller Sicht sowie hinsichtlich der Projektdauer enorm. Durch diese Vielzahl und Größe entstehen gegenüber Kleinprojekten zusätzliche Herausforderungen wie zB insgesamt häufigerer Wechsel von Projektgruppenmitgliedern, fast ausschließlich dislozierte Projektteilnehmer, unterschiedliche Methodiken in Abwicklung, große Informationsmengen, schnelle Nachvollziehbarkeit der Projekt-Historie auf über einen längeren Zeitraum.

2 WAS IST PEP?

PEP ist ein vollelektronisches, speziell auf die Bedürfnisse der Projektabwicklung im Planungs- und Baubereich angepasstes Tool. Standort- und zeitunabhängig können die Projektgruppenmitglieder auf die für sie relevanten und aktuellen Projektinformationen zugreifen und untereinander austauschen sowie Arbeitsprozesse damit unterstützen. ÖBB Planung & Engineering nutzt diese Plattform als gemeinsames Projektmanagement- und Kommunikationswerkzeug.

PEP ist eine internetbasierend Plattform. Einzige Voraussetzung, um PEP zu nutzen, ist die Verfügbarkeit eines Internetzugangs, eines PC mit einem gängigen Internetbrowser sowie von Usernamen und Passwort. Diese Minimalvoraussetzungen erlauben einen raschen Einstieg für jedes firmenin- oder –externe Projektgruppenmitglied ohne aufwendige Softwareinstallationen auf den lokalen PC’s.

3 DER NUTZEN

3.1 Aufbau – Funktionen - Nutzen

Der Zugriff auf die Inhalte der Plattform ist durch ein Berichtigungskonzept geregelt. Jedes einzelne Projektgruppenmitglied wurde dabei wie in der realen Projektorganisation einer Rolle auf der Plattform zugeordnet. Jede Rollen ist dabei mit projektübergreifenden, einheitlichen Zugriffsberechtigungen auf alle Plattform-Informationen ausgestattet. Dieses Konzept der Zugriffsverteilung soll vermeiden, dass das Projektgruppenmitglied nicht mit für ihn irrrelevanten Projektinformationen überflutet wird, sondern die für seinen Beitrag im Projekt relevanten Informationen einfach und rasch findet.

Das Zurechtfinden auf der Plattform wird neben einer einfachen Symbolik und nachfolgenden Features durch ein „3-Welten-Konzept“ gefördert. Das 3-Welten-Konzept beschreibt die Sichtweisen eines Projektgruppenmitglieds bei Einstieg auf die Plattform. Jedes Projektgruppenmitglied findet sich durch die Einteilung in „MyWorld, ProjectWorld und BusinessWorld“ auf der Plattform zurecht. Der Unterschied dieser drei Sichtweisen besteht in der unterschiedlichen Darstellung der Projektinformationen:

Die *MyWorld-Ansicht* zeigt alle aggregierten Informationen sämtlicher Projekte für einen User (sämtliche Besprechungstermine, sämtliche ihm zugeordnete Aufgaben).

Im Gegensatz zur MyWorld zeigt die *ProjectWorld-Ansicht* alle aggregierten Informationen eines Projektes.

Die *BusinessWorld* zeigt projektübergreifende Informationen (zB Unternehmens-News, Eingliederung des Projektes in die Unternehmensorganisation).

Informationen werden durch das Zugriffskonzept und die „3-Welten-Darstellung“ individuell gefiltert und übersichtlich für jedes Projektgruppenmitglied aufbereitet dargestellt.

Inhaltlich enthält die Plattform sämtliche Informationen zum Projekt an sich wie auch sämtliche aus dem Projekt resultierende Informationen und (Teil-)Ergebnisse.

3.2 Aktuelle Informationen zum Projekt für alle Projektgruppenmitglieder

Die Planung & Engineering-Plattform enthält sämtliche Informationen zum Projekt an sich (zB Eingliederung in die Unternehmensorganisation, Projektstart, -ende, Kontakte der Projektgruppenmitglieder, Projekt-News, Projektfortschritt, Termin- und Meilensteinpläne, Besprechungstermine, To Do´s für einzelne Projektgruppenmitglieder).

3.3 Dokumente managen

Neben Detailinformationen zum Projekt an sich, werden in der Plattform eine Vielzahl von projektrelevanten Dokumenten verwaltet.

Die Projektleitungen von Planung & Engineering haben sich zu diesem Zweck auf eine gemeinsame Ordnerstruktur über alle Projekte geeinigt. Diese Ordnerstruktur wird in allen Projekten gleich verwendet.

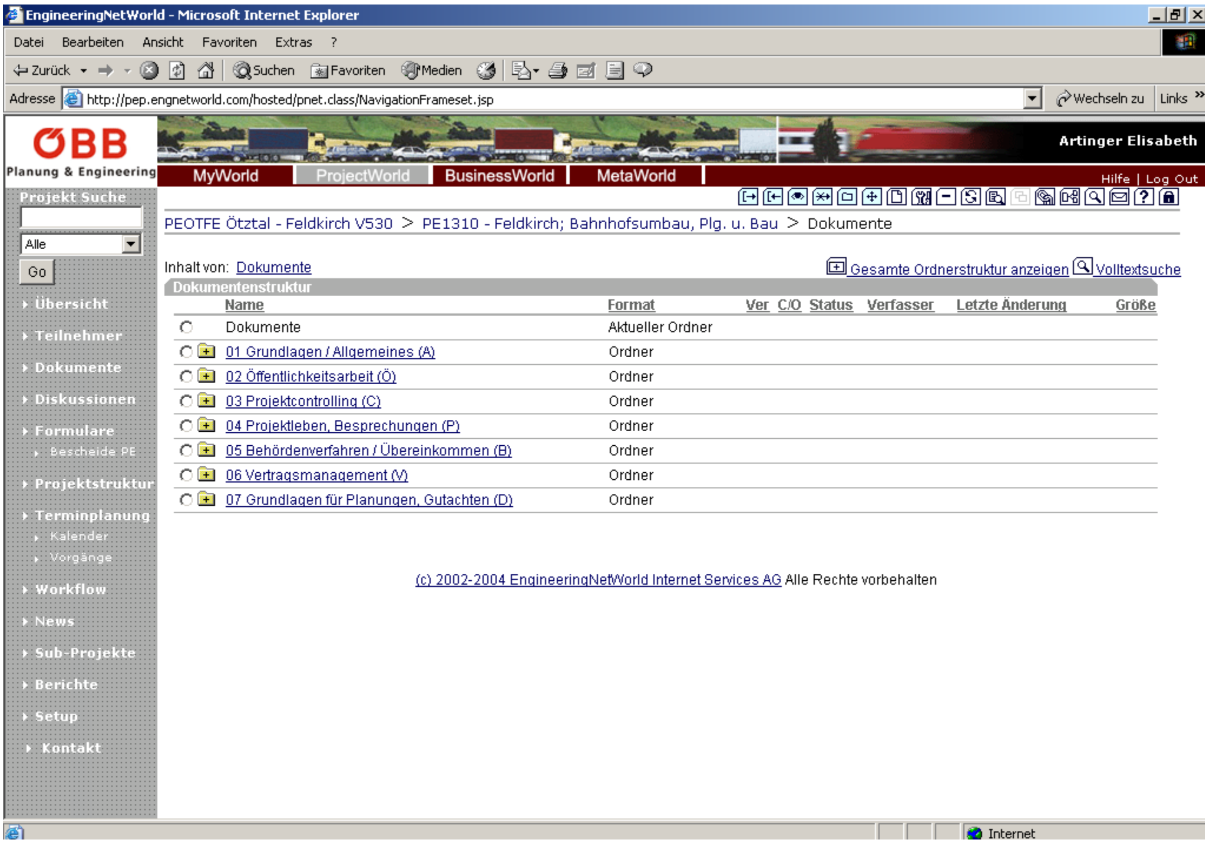

Abb.1: Ordnerstruktur in der Planung & Engineering Plattform (PEP)

Statt Dokumente und Informationen ausschließlich via email zu verteilen, lädt jedes Projektmitglied die Dokumente auf die Internetplattform. Die Plattform ermöglicht den Beteiligten eine strukturierte Ablage und Verwaltung beliebiger Formate. Eine einheitliche Ablagestruktur für alle Projekte und ein automatisches Dokumentenkennzeichnungssystem schaffen dabei eine vorgegebene Ordnung. Jedem Teammitglied werden so Projektinformationen zentral und projektspezifisch zur Verfügung gestellt.

Zur Bearbeitung durch einen Benutzer wird das betreffende Dokument für andere Anwender gesperrt (Check- Out), sodass diese nur noch Lesezugriff haben, aber keine Änderungen vornehmen können. Nach der Bearbeitung wird das Dokument wieder für alle Benutzer freigegeben (Check- In).

Möchte ein Teammitglied über die Änderung, Löschung oder Neuerstellung eines Dokuments informiert werden, so kann es sich über email eine automatisierte Benachrichtigung vom System zusenden lassen.

Durch diese Vorgangsweise reduzieren sich Bearbeitungs-, Such- und Ablageaufwand deutlich.

Durch Mechanismen wie Historisierung und Versionierung entsteht ein transparenter und gesicherter Nachweis, wer wann, welche Dokumente gelesen oder bearbeitet hat. Missverständnisse durch unterschiedliche Dokumentenversionen entfallen.

Umfangreiche auch projektübergreifende Suchmöglichkeiten (Volltext, Attribute) schaffen eine weitere Unterstützung.

3.4 Verteilung von Aufgaben

Neben dem gemeinsamen Zugriff auf relevante Daten ist es für jeden Beteiligten wichtig, über den Projektfortschritt und die persönlichen Aufgaben Bescheid zu wissen.

Die Plattform ermöglicht es, Projekte in Phasen, Phasenübergänge (Abnahmen), Liefergegenstände (zu liefernde Ergebnisse), Meilensteine und Vorgänge zu gliedern und die jeweiligen Aufgaben oder Arbeitspakete den einzelnen Teilnehmern und Teilnehmerinnen zuzuteilen. Jedem Projektgruppenmitglied ist dadurch möglich, zu wissen, in welchem Stadium sich das Projekt befindet, und welche Aufgaben durch ihn (noch) zu erledigen sind.

Leitende Mitarbeiter und Mitarbeiterinnen haben immer den Überblick über den aktuellen Projektstatus und die Ressourcenverteilung.

3.5 Kommunikation

Über die PEP werden die projekt- und unternehmensübergreifenden Kommunikationskanäle gefördert. Kommunikationswerkzeuge in Form von Diskussionsforen, Kalendermodulen, gemeinsame Terminverwaltung und News-Bereiche unterstützen in der Planung von Terminen, Erstellen von Agenden u. v. m.. Der Nutzen liegt hier im projekt- und unternehmensübergreifenden Austausch von Erfahrungen und Projektwissen.

Zusätzlich können durch vielfältige Verknüpfungsmöglichkeiten von zusammengehörigen Informationen (zB Diskussionsbeiträge, Aufgaben, Dokumente, Formulare, Termine, etc.) Problemfelder rasch behandelt werden, was nicht nur Transparenz für alle Beteiligte bringt, sondern auch eine erheblich Zeiteinsparung.

3.6 Formulare, Vorlagen, Berichte

Mittels eines \`Formular – Designers\` ist die einfache Erstellung von Datenbankformularen wie Bescheidüberwachungspunkte, Baustellen- oder Montageberichten, Checklisten, etc. möglich. Projekt- und Unternehmensstandards können damit einheitlich gestaltet und eingesetzt werden.

Auswertungen (zB Welche Punkte sind aus behördlichen Bescheiden erfüllt oder offen? Welche Probleme gibt es bei einzelnen Punkten?) können aus den vorhandenen Formularen durch automatisierte Filter- und Sortiervorgänge einfach erstellt werden.

Ein weiterer Vorteil der Plattform liegt in der Möglichkeit, über Vorlagen Projektstrukturen wieder zu verwenden. Es können sowohl einzelne Projektbereiche, wie zB die Dokumentenstruktur oder Formulare, aber auch komplette Projekte als Vorlage übernommen werden. Hat sich eine Projektstruktur einmal bewährt, kann sie bei zukünftigen Projekten erneut eingesetzt werden - ohne das Rad neu erfinden zu müssen. Durch die Verwendung von Vorlagen ist auch ein schnellerer Start für Projekte auf der Plattform sichergestellt.

Vorgefertigte Berichte (zB verspätete Vorgänge, fällige Vorgänge, Ressourcenauslastung, neue Projektteilnehmer und -teilnehmerinnen) geben eine strukturierte Übersicht über Zeit, Ziel und Kosten der Projekte und stellen für das Management und Projektleiter ein Planungs- und Steuerungswerkzeug dar. Diese können zu jeder Zeit selbst entscheiden, wann welche Informationen abgerufen werden.

3.7 Projektabschluss

Rasche Entscheidungs- und Umsetzungswege sowie Übersichtlichkeit, Nachvollziehbarkeit werden durch den Einsatz der Plattform gefördert. Auf der Plattform dokumentierte Informationen zu abgeschlossenen Projekten können für zukünftige Projektplanungen herangezogen werden. Eine Projektarchivierungs- und Exportfunktion verbessert die Schnittstelle zum „Erhalter“ durch die Übergabe von Daten die auch ohne die Plattform gelesen werden können.

4 AKTUELLER STAND DER IMPLEMENTIERUNG UND AUSBLICK

Die Plattform wurde in sechs Pilotprojekten aus dem Geschäftsbereich Planung & Engineering getestet. Für rund 220 User bot diese Plattform (derzeitiger Stand) bereits hervorragende Projektabwicklungsunterstützung. Das Ergebnis einer im Herbst 2004 durchgeführten, umfassenden Evaluierung von PEP unterstrich, dass die Akzeptanz überdurchschnittlich hoch ist und der Nutzen von den Usern eindeutig erkannt wird.

Derzeit befindet sich die ÖBB im Umstrukturierungsprozess.

Mit dem Bundesbahnstrukturgesetz 2003 wurde die Umwandlung des Unternehmens ÖBB in eigenständige Aktiengesellschaften und GmbHs unter dem gemeinsamen Dach einer Holding AG beschlossen. Per 31. Dezember 2004 werden jene Unternehmensbereiche der ÖBB abgespalten, für welche eigenständige Gesellschaften gegründet wurden (ÖBB-Personenverkehr-AG, Rail Cargo Austria AG, ÖBB-Traktion GmbH, ÖBB-Technische Services-GmbH, ÖBB-Dienstleistungs GmbH und ÖBB-Infrastruktur Betrieb AG). Der "Rest" der ÖBB (Planung & Engineering/Teilbereich Projekte, Kraftwerke, Schieneninfrastruktur samt Anlagen und Einrichtungen, Telekom und Facility Management) wird in die ÖBB-Infrastruktur Bau AG umgewandelt. Die HL-AG sowie die Schieneninfrastrukturfinanzierungs-Gesellschaft werden mit der ÖBB-Infrastruktur Bau AG verschmolzen. Die ÖBB-Immobilien sowie die Brenner Eisenbahn GmbH (BEG) werden der ÖBB-Infrastruktur Bau AG als Tochtergesellschaften angegliedert.

Mit der Umstrukturierung werden die Anzahl der Planungs- und Bauprojekte in der ÖBB-Infrastruktur Bau AG beachtlich steigen. Damit ist auch mit einer zunehmenden Komplexität in der Projektabwicklung für das einzelne Projektgruppenmitglied zu rechnen, wo durch PEP Unterstützung geboten werden kann.

Am roll-out dieses Tools auf sämtliche Bau AG-Projekte wird gearbeitet. Eine Verbesserung in der Nutzung bestehender Features sowie die Etablierung neuer Features (z. B. im Bereich des Berichtswesens) ist geplant.

Open Source GIS als Alternative im Desktop-Bereich - Evaluation freier Software im Bereich Geoinformation

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1 EINLEITUNG

Open Source Software hat sich in den letzten Jahren zu einer ernst zunehmenden Alternative zu kommerzieller proprietärer Software am Desktop entwickelt. Immer mehr Firmen und auch große Bereiche der öffentlichen Verwaltung wagen den Umstieg auf Open Source, Tendenz steigend. Im Serverbereich erfreuen sich Linux und andere Unix-Derivate wegen ihrer hohen Systemstabilität schon seit längerem großer Beliebtheit, auf dem Desktop behielt Microsoft Windows bislang die Oberhand. Bekannte Beispiele für den Umstieg auf Open Source Desktops im Bereich der öffentlichen Verwaltung sind München und Wien. Die Stadt München hat sich im Mai 2003 für eine Migration von Windows NT auf Linux als Client-Betriebssystem entschieden.

Neben dem Betriebssystem müssen aber auch viele Anwendungsprogramme ausgewechselt werden. Dies gilt auch für die Software zur Erfassung, Speicherung, Manipulation, Analyse und Visualisierung von Geodaten. Da Open Source Software auch im GIS Bereich immer größeren Stellenwert bei Systementscheidungen erfährt, wird das Thema in der Branche stark diskutiert. Ein Beweis dafür ist die Tatsache, dass der Runde Tisch GIS e.V. im Jahr 2004 eine Expertenrunde dem Thema Open Source Software und Geoinformationssysteme widmete. Rund 170 Teilnehmer aus Verwaltung, Wirtschaft und Wissenschaft nutzten diese Veranstaltung zum Informationsaustausch. [Huber, Jaenicke , 2004]

In weiterer Folge soll nun geklärt werden, wieweit freie GIS Produkte im Desktop-Bereich proprietäre Software ersetzen können. In diesem Beitrag stehen nicht die serverseitigen Lösungen wie Datenmanagementsysteme oder Webapplikationen mit GIS Basisfunktionen, sondern komplexe GIS Analysen sowie der Einsatz der Software am Desktop im Vordergrund. Neben einer Übersicht gängiger freier GIS Desktop-Software werden ausgewählte Produkte eingehend besprochen. Beispielhaft seien hier QGIS und GRASS erwähnt.

Die Stärken und Schwächen dieser beiden Open Source GIS Programme im Einsatz am Desktop werden herausgearbeitet und mit jenen der proprietären Software verglichen. QGIS soll dabei primär als Pendant zum weitverbreiteten Produkt ArcView der Firma ESRI gesehen werden. Exemplarisch werden die Einsatz- und Erweiterungsmöglichkeiten der Software aufgezeigt. Für komplexere Analysen ist der Einsatz von GRASS vorgesehen. Ursprünglich von der U.S.-amerikanischer Regierungsbehörde mit einem Aufwand von mehreren Millionen Dollar entwickelt, arbeitet heute ein international tätiges Entwicklerteam an der stetigen Verbesserung und Erweiterung des Produkts. GRASS kann in der aktuellen Version einen Funktionsumfang aufweisen, der proprietären Produkten kaum nachsteht. Kann es aufgrund dieser Tatsache bereits als seriöse Alternative zu den in Gebrauch stehenden Systemen angesehen werden?

2 OPEN SOURCE SOFTWARE

Freie Software und Open Source bezeichnen nicht spezielle Entwicklungsmodelle, sondern Lizenzmodelle. Der Ausdruck Open Source steht für quelloffen, einerseits in dem Sinne, dass der Quelltext eines Programms frei erhältlich ist, andererseits für 'offene Quelle', also dass ein Werk frei zur Verfügung steht. Software gilt als Open Source, wenn sie bestimmte Kriterien erfüllt, die in ihrer Open-Source-Lizenz geregelt sind. [http://www.wikipedia.org, GISWiki]

Die 1985 gegründete Free Software Foundation verschrieb sich der Verbreitung und Förderung freier Software. Folgende vier Freiheiten des Nutzers beschreiben die Hauptmerkmale freier Software:

- Die Freiheit, das Programm für jeden Zweck zu benutzen.
- Die Freiheit zu verstehen, wie das Programm funktioniert und wie man es für seine Ansprüche anpassen kann.
- Die Freiheit, Kopien weiterzuverbreiten.
- Die Freiheit, das Programm zu verbessern und die Verbesserungen der Öffentlichkeit zur Verfügung zu stellen, damit die ganze Gemeinschaft davon profitieren kann. [Free Software Foundation]

Ein wesentlicher Unterschied von Open Source Software im Vergleich zu kommerzieller proprietärer Software ist, dass der Programmcode in einer für den Menschen lesbaren Form vorliegt. In der Regel handelt es sich bei dieser Form um die Quelltexte in einer höheren Programmiersprache. Vor dem eigentlichen Programm(ab)lauf ist es normalerweise notwendig, diesen Text durch einen so genannten Compiler in eine binäre Form zu bringen, damit das Computerprogramm vom Rechner ausgeführt werden kann. Durch den offenen Quellcode ist es für andere möglich den Aufbau des Programms zu verstehen und Verbesserungen anzubringen, die wiederum allen Benutzern zugute kommen. So können neue Softwareprojekte auf bestehende aufbauen und müssen mit ihrer Arbeit nicht immer wieder von Vorne beginnen. Die meisten Open Source Lizenzen verlangen aber im Gegenzug dafür, dass Folgeprodukte welche auf Open Source aufbauen, wiederum der Öffentlichkeit zur Verfügung gestellt werden.

3 OPEN SOURCE GIS SOFTWARE

Open Source GIS Software hat heute eine schwer überschaubare Fülle erreicht, für jeden Bereich der Geoinformation gibt es ein OpenGIS Werkzeug oder eine OpenGIS Bibliothek. Die existierenden Produkte sind heute in einem Stadium, wo die Software sowohl die gewünschten Funktionen als auch eine hohe Stabilität bietet. Die Weiterentwicklung kann sich somit auf Verbesserungen und Feinheiten der Programme konzentrieren. In den meisten Systemumgebungen kann Open Source GIS Software den kompletten Funktionsumfang von proprietärer Software ersetzen. Eine Liste von Software, die diesen Ansprüchen genügt, sowie eine

Kurzbeschreibung und einen Link zum Download findet man auf den Internetseiten von Freegis.org und OpenSourceGIS.org. Abbildung 1 soll anhand ausgewählter freier GIS Software, unterschiedlicher Datenformate und Kommunikationswege eine grobe Vorstellung über das Zusammenspiel von Open Source in der Geoinformationsverarbeitung geben.

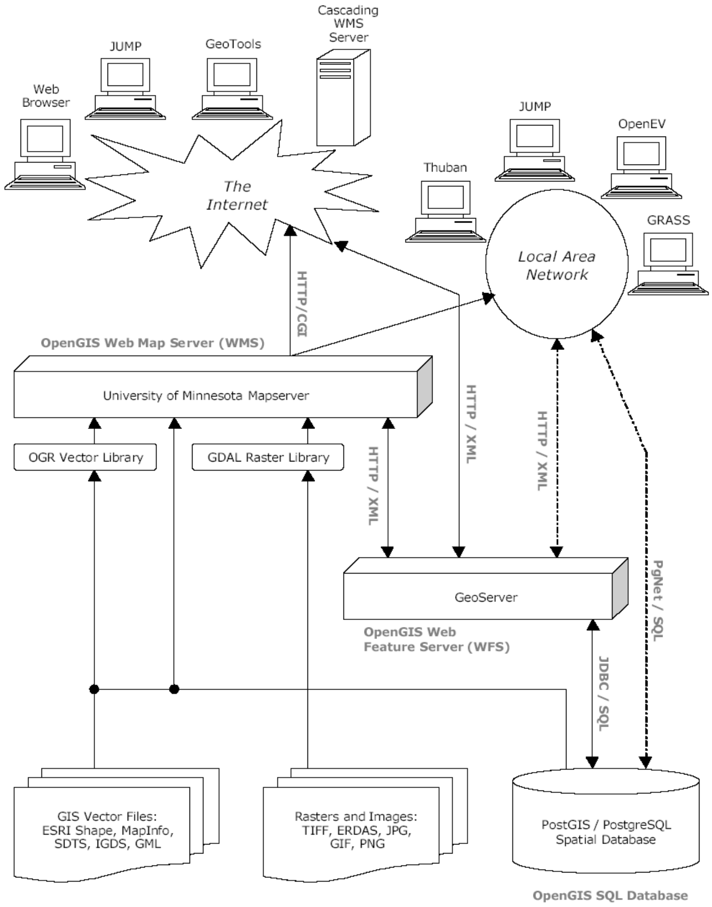

Abb.1: Überblick Open Source GIS [Ramsey, 2004]

3.1 Unterteilung von Open Source GIS Software

Open Source GIS lässt sich nach Einsatzzweck, unterstützer Datenformate und die, für die Implementierung verwendete Programmiersprache unterscheiden. Nach der verwendeten Programmiersprache ergeben sich zwei voneinander unabhängige Entwicklungszweige:

- Die C-Richtung besteht aus Entwicklern, die an Softwareprojekten wie UMN Mapserver, GRASS, GDAL/OGR, OSSIM, Proj4, GEOS, PostGIS und OpenEV arbeiten.
- Die Java-Richtung besteht aus Entwicklern, die an Softwareprojekten wie GeoServer, GeoTools, JTS, JUMP/JCS, und DeeGree arbeiten.

An beiden Zweigen arbeiten internationale Entwicklergruppen, meist an mehreren Softwareprojekten gleichzeitig, was eine hohe Kompatiblilität der einzelnen Programme garantiert. Eine Ausnahmestellung bei der Einteilung nach der Programmiersprache bildet die Datenbankmanagementsoftware PostgreSQL und ihre Erweiterung für die Bearbeitung räumlicher Daten PostGIS. PostGIS ist zwar in C geschrieben und damit eigentlich ein Mitglied des C-Zweiges, wird aber in beiden Zweigen verwendet. [Ramsey, 2004]

Da sich bei der genaueren Betrachtung von internationanlen Projekten im Bereich der Kartographie und Geoinformation zeigte, dass sich die Mehrheit der Projekte für den Einsatz von Software aus dem C-Zweig entschieden hat, wird dieser nun noch genauer betrachtet. Beispiele für kartographische Applikationen, die fast ausschließlich auf Open Source Software zurückgreifen, befinden sich im Virtual Map Forum (http://www.gis.univie.ac.at/vmf/) des Institutes für Geographie und Regionalforschung, Kartographie und Geoinformation der Universität Wien.

3.2 Freie GIS Software in der Programmiersprache C

Open Source GIS Software in der Programmiersprache C kann im Vergleich zu Java-Software auf eine längere Entwicklungsgeschichte und eine größere Fangemeinde zurückblicken. Durch den regen Erfahrungsaustausch in diversen Mailinglisten und Newsgroups zwischen Entwicklern und Benutzern hat sich eine ausgereifte Sammlung an GIS Applikationen und Bibliotheken zusammengefunden. Der Kern der C-Projekte besteht aus gemeinsam genutzten Bibliotheken. Sie stellen wichtige Ressourcen, wie die Unterstützung von Datenformaten und Projektionsregeln für alle Applikationen zur Verfügung. Zu den Bibliotheken zählen:

- GDAL/OGR: GDAL ist eine Übersetzungsbibliothek für räumliche Raster-Daten. Als Bibliothek bietet es den aufrufenden Anwendungen ein einheitliches, abstrahiertes Datenmodell für alle unterstützten Formate und ermöglicht somit das Lesen und Schreiben von unterschiedlichen Rasterdatenformaten. OGR ist das Pendant von GDAL für Vektorformate.

- Proj4: Proj4 enthält eine Bibliothek für die Transformation und kartographische Projektion von Daten. Hierfür wird eine umfangreiche Zahl von Projektionen angeboten.

- GEOS: GEOS ist ein C++ Port der Java Topologie Suite (JTS). Das Ziel ist es, die komplette Funktionalität von JTS in C++ zu implementieren. Dies beinhaltet alle Funktionen und räumlichen Operatoren der OpenGIS "Simple Feature for SQL" Spezifikation ebenso wie einige spezielle topologische Funktionen der JTS.

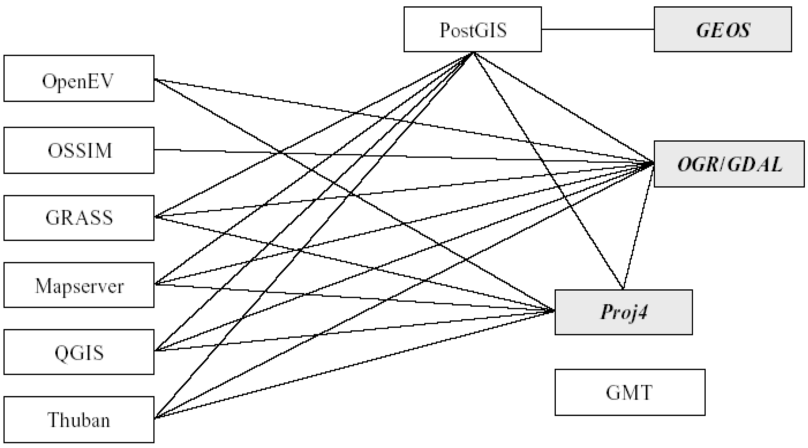

Abb.2: Vertreter der C-Projekte (Quelle: Ramsey, 2004)

Bei den in C geschriebenen Open Source GIS Applikationen handelt es sich aus einer Mixtur von server- und clientseitigen Applikationen, Analysewerkzeugen und Werkzeugen für die reine Datenbetrachtung. Hier eine Auswahl der verfügbaren Programme:

- UMN Mapserver: Der Mapserver der Universität von Minnesota ist ein Internet Mapserver. Ausgewählte Geodaten werden serverseitig gerendert und kartographisch visualisiert.

- GRASS: Das freie Geographische Informationssystem für die Bearbeitung von Rasterdaten, topologischen Vektordaten und Bilddaten.

- PostGIS: PostGIS ist eine Erweiterung von PostgreSQL um geographische Objekte. Damit wird PostgreSQL in die Lage versetzt, als Datenserver für GIS zu dienen.

- OpenEV: Bibliothek und Referenzanwendung zum Anzeigen und Analysieren von Raster- und Vektordaten. OpenEV wird plattformunabhängig in C und Python entwickelt und bietet 2D und 3D Visualisierung.

- QGIS: Quantum GIS soll ein umfangreiches GIS für GNU/Linux und Unix allgemein werden. QGIS bietet Support für Vektor- und Rasterdaten. Derzeit unterstützt QGIS viele übliche Vektor- und Rasterformate sowie PostreSQL/PostGIS-Ebenen.

- Thuban: Thuban ist ein interaktiver Betrachter für Geodaten. Hauptmerkmale sind die Cross-Plattform-Fähigkeit, leichte Erweiterbarkeit, sowie Konfigurierbarkeit zur Erstellung individueller GIS-Anwendungen. [Freegis.org, 2004]

4 OPEN SOURCE GIS SOFTWARE AM DESKTOP

Betrachtet man noch einmal die oben genannten in C geschriebenen Open Source GIS Applikationen, so werden nicht alle am Desktop landen. Je nach dem ob nur ein „Viewer“ für die Betrachtung von vorhandenen Geodaten benötigt wird, oder ob es sich um ein GIS mit umfangreichen Funktionen zur Datenmanipulation und Visualisierung handeln soll, muss eines der Produkte angewendet werden.

Für die Betrachtung von Geodaten sind im C-Zweig Softwareprodukte wie Thuban, OpenEV oder QGIS vorgesehen. Es handelt sich um Programme, die aufgrund ihrer, im Vergleich zu GRASS kurzen Entwicklungszeit nur wenig Funktionen für die Datenmanipulation und Analyse mitbringen. Am weitesten fortgeschritten ist momentan QGIS, aber bei der raschen Entwicklung von Open Source Software kann sich das in Zukunft noch ändern. QGIS wird in weiterer Folge als freies Pendant zur proprietären Software ArcView von ESRI gesehen.

GRASS kann noch immer als das Open Source GIS bezeichnet werden. Es ist das älteste der freien GIS Produkte und wurde ursprünglich als geschlossenes Projekt der US Army entwickelt, um Funktionen bereitzustellen die in kommerzieller GIS Software nicht enthalten waren. Für komplexere GIS-Analysen, wie sie etwa mit ArcGIS durchgeführt werden können, ist GRASS noch immer die einzige freie Aternative. QGIS und GRASS werden im Folgenden genauer erläutert.

4.1 QGIS

Quantum GIS ist ein Geoinformationssystem, das ursprünglich für GNU/Linux und Unix entwickelt wurde, aber mittlerweile auch in einer Windows Version erhältlich ist. Es baut auf die herkömmlichen Open Source Bibliotheken auf und unterstützt daher viele der üblichen Vektor- und Rasterformate sowie PostreSQL/PostGIS-Ebenen:

- Vektor Formate: PostGIS, Shapefiles, MapInfo, Formate die von der OGR-Bibliothek unterstützt werden, GRASS Vektor, GPSeXchange

- Raster Formate: GeoTiff, Tiff mit Worldfile, USGS DEM, ArcInfo ASCII Grid, ERDAS Imagine, SDTS Raster, DTED Elevation Raster, GRASS Raster

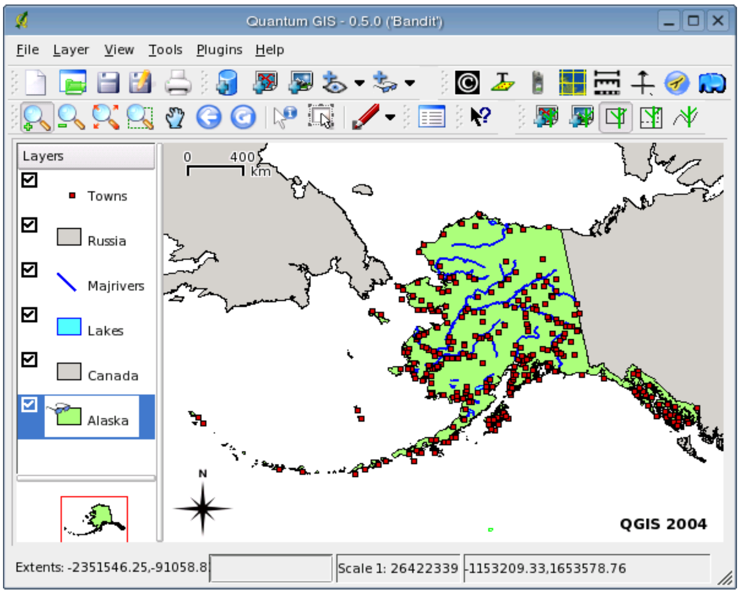

Abb.3: PostGIS-Ebenen in QGIS [Quelle: http://qgis.org, 2004]

QGIS wurde auf einem Rechner mit SuSe Linux 9.1 ohne Probleme installiert. Voraussetzung für eine reibungslose Installation ist, dass zuvor QT (bei gängigen Linux-Distributionen bereits enthalten), GDAL/OGR, PostgresSQL/PostGIS und GRASS bereits installiert sind. Sind diese Voraussetzungen gegeben und QGIS installiert, können Shapefiles, PostGIS-Layer und die meisten Rasterformate sofort angezeigt werden. Um GRASS-Daten anzuzeigen wird QGIS am besten direkt aus einer GRASS-Shell aufgerufen. Um GRASS Vektor zu digitalisieren muss allerdings eine GRASS Version ab 5.7 verwendet werden.

4.2 GRASS

Das "Geographic Resources Analysis Support System", allgemein als GRASS bezeichnet, ist eines der derzeit weltweit größten Open-Source GIS Projekte. Es handelt sich dabei um ein kombiniertes Raster-/Vektor-GIS mit einem integrierten Bildverarbeitungs- und Visualisierungssystem. Die 300 Module für die Bearbeitung von Raster-, Vektor- und Punktdaten und die Bearbeitung der Ergebnisse, können sowohl über eine fensterorientierte Benutzeroberfläche als auch von der Kommandozeile aus bedient werden.

GRASS ist sicherlich das kompletteste Open Source GIS, es hatte aber in den vergangenen Versionen Defizite in der Vektordatenverarbeitung und es mangelte an der Benutzerfreundlichkeit. Für beide Probleme wurde unter den Entwicklern nach einer raschen Lösung gesucht. Momentan wird GRASS in mehreren Versionsserien entwickelt. Die Serie 5.0 ist im auslaufen und wurde nur mehr mit einer stabilen Nummer abgerundet, da sie nur eingeschränkte Vektorfunktionen enthält. Zwischen Version 5.0 und 5.7, die mit einer neuen Vektorengine und einem neuen GUI ein neues Zeitalter in der GRASS-Ära einläutet, wurde noch 5.3 eingeschoben.

<table>
<tr><th>GRASS 5.0</th><th>GRASS 5.3</th><th>GRASS 5.7</th></tr>
<tr><td colspan="3">Raster- und Bildanalyse</td></tr>
<tr><td colspan="3">2D und 3D Visualisierung</td></tr>
<tr><td colspan="2">d.dm /tcltkgrass</td><td>d.m / Modul GUIs</td></tr>
<tr><td colspan="2">Punktdaten (sites) Support</td><td>Punkte (sites) als Vektoren</td></tr>
<tr><td colspan="2">2D Vektor Support (old vect)</td><td>2D/3D Vektor Support</td></tr>
<tr><td></td><td colspan="2">Datum Transformation</td></tr>
<tr><td></td><td></td><td>Vektor Netzwerkanalyse</td></tr>
<tr><td></td><td></td><td>DBMS Support</td></tr>
<tr><td></td><td></td><td>Spatial Index</td></tr>
</table>

Abb.4: Neuerungen in den einzelnen GRASS GIS [http://grass.itc.it, 2004]

Bei GRASS 5.7 handelt es sich um eine Entwicklerversion die noch starken Veränderungen unterliegt. Schon jetzt zeigt sich, dass das neue GUI mit der Möglichkeit der Ebenengliederung die Benutzerfreundlichkeit stark erhöht. Eine weitere zusätzliche Funktion ist die Vektor Netzwerkanalyse. Diese Neuerung macht GRASS erstmals auch im Einsatzbereich der kommunalen Planung zu einer möglichen Alternative.

Auch wenn GRASS 5.7 noch im Entwicklungsstadium ist, so bietet es bereits einen Funktionsumfang, der ArcGIS ebenbürtig ist. Für viele Anwender ist aber die eingeschränkte Bedienmöglichkeit der Software über das GUI und die damit noch immer notwendige

Arbeit des Eingebens von Befehlen über die Kommandozeile, ein großer Rückschritt gegenüber der Verwendung von kommerziellen GIS.

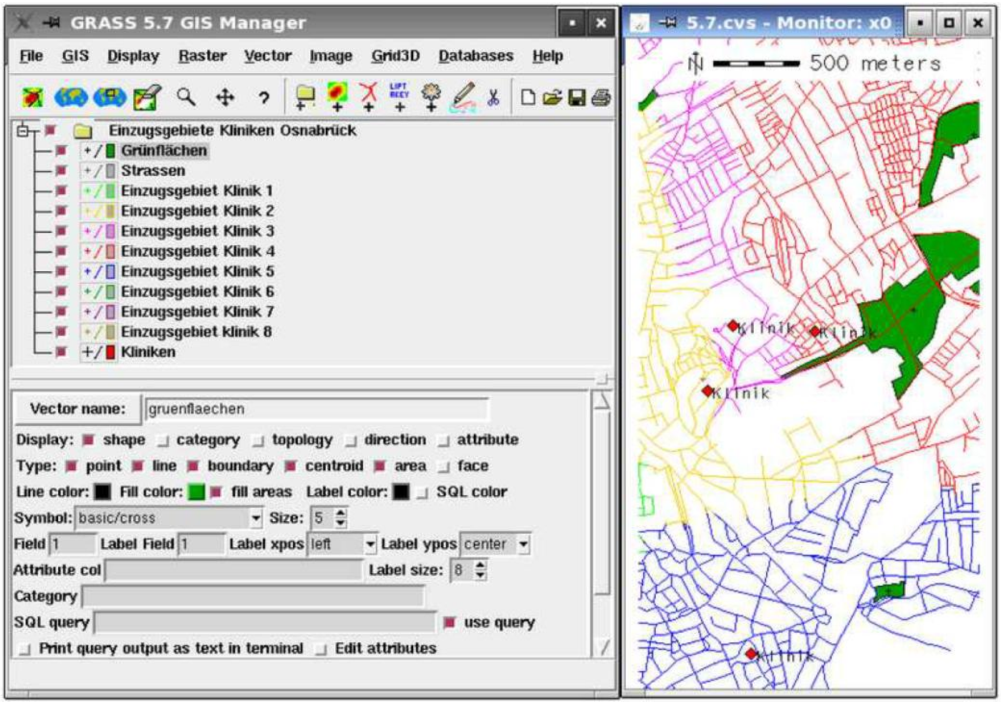

Abb.5: d.m – GIS Manager von GRASS 5.7 mit FRIDA Daten [http://grass.itc.it, 2004]

5 AUSBLICK

Open Source GIS ist ein dynamischer, sich rasch weiterentwickelnder Bereich der Softwareentwicklung. Es gibt nicht das „All-in one-Paket“, aber mit mehreren kleineren Programmen und GRASS lassen sich fast alle Aufgabenbereiche der geographischen Datenverarbeitung erfüllen. Man sollte die Entwicklung der Open Source GIS Software auf keinen Fall aus den Augen verlieren, da bestimmte heute nicht implementierte Funktion, morgen schon bereit stehen könnten.

6 LITERATUR UND LINKS

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GRASS GIS: http://grass.itc.it
Free Software Foundation: http://www.fsf.org/
Wikipedia: http://www.wikipedia.org
GISWiki: http://webgis.dyndns.org:8080/giswiki/Wiki.jsp?page=Startseite

Generalisierung von Mehrzweckkarte und 3d Modell der Stadt Wien

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KURZFASSUNG

Die Mehrzweckkarte (MZK) – die digitale Stadtkarte von Wien – bietet eine Fülle an Informationen und ist entsprechend komplex strukturiert. Für viele Aufgaben und Fragestellungen ist dieser Detailreichtum für den Benutzer jedoch ein Zuviel an Information. Um daher die Kunden mit einem, für sie, optimalen Produkt versorgen zu können, ist ein schlanker, ausgedünnter Datenbestand notwendig. Darüber hinaus gibt es noch andere wirtschaftliche Faktoren, welche die Entwicklung einer Anwendung rechtfertigen, die einen Datensatz derartig verändern kann, dass mit einem Minimum an verspeicherten Daten ein Maximum an benötigter Information transportiert wird. Eine solche Anwendung soll die MZK unter Berücksichtigung ihrer speziellen Eigenheiten generalisieren.

1 EINLEITUNG

In etlichen Bereichen ist der Mensch mit seinen perzeptiven Fähigkeiten an seine Grenzen gestoßen. Das Auge kann nur bis zu einem gewissen Grad optische Reize unterscheiden und zuordnen. Oft kommen allerdings Daten zum Einsatz, die mit Details so überladen sind, dass dem Benutzer der Informationsgewinn aus den Daten unnötig erschwert wird.

Viele Anwender müssen mit Daten arbeiten, die nicht primär für diesen Verwendungszweck geschaffen wurden. Es liegt hier ein großes Optimierungspotenzial vor. Diese Arbeit könnte effizienter geschehen, wenn die Anwender Daten zur Verfügung hätten, welche optimal auf den jeweiligen Verwendungszweck abgestimmt wären. Doch nicht nur im Bereich der Ressourcenoptimierung, sondern auch auf der distributiven Seite eines Unternehmens macht es einen großen Unterschied, wie skalierbar ein Datensatz ist. So kann der Unternehmer seine Produktpalette dynamisch erweitern um den Anforderungen des Kunden jederzeit gerecht zu werden.

Die Stadtvermessung der Stadt Wien (Magistratsabteilung 41) ist unter anderem für die Erstellung und Wartung von digitalen Kartengrundlagen für Wien verantwortlich. Eine solche Grundlage ist die Mehrzweckkarte (MZK) (Belada 1994). Die Datenerfassung erfolgt im unmittelbaren Straßenbereich durch terrestrische Vermessung, im übrigen Stadtgebiet durch photogrammetrische Stereoauswertung. Der Aktualisierungszyklus beträgt drei Jahre. In diesem Zeitraum wird das gesamte Stadtgebiet kontrolliert und aktualisiert. Dieser hohe Genauigkeitsgrad macht die MZK zur idealen Grundlage für eine ganze Reihe von Anwendungen (z.B. Straßenbau, Leitungsbetreiber, etc.).

Trotzdem gibt es aber auch Situationen, in denen ein nicht ganz so hoher Detaillierungsgrad notwendig ist. Ein grob strukturierter Datensatz ist die Realnutzungskartierung. Dieser Datensatz basiert auf einer Blockstruktur, welche sich aus den Straßenachsen ergibt. Die Klassifizierung in 42 verschiedene Klassen erfolgt vorwiegend durch Luftbildinterpretation. Viele Klassifizierungen können auch durch Zusammenarbeit mit anderen Dienstellen des Magistrats durchgeführt werden. Die Realnutzungskartierung ist ein Werkzeug zur Dokumentation der Stadtentwicklung. Sie wird alle drei Jahre aktualisiert. Darüber hinaus wird der Datensatz für überregionale Planungsvorhaben verwendet.

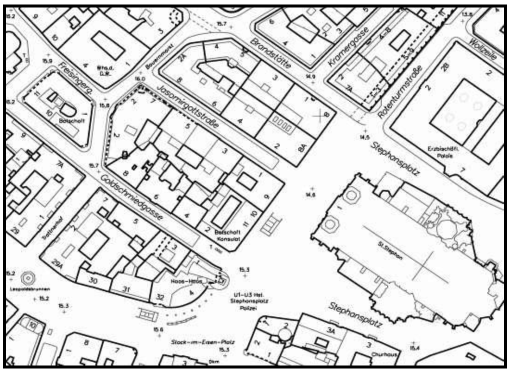

Abb.1: MZK, Ausschnitt

Abb.2: Realnutzungskartierung, Ausschnitt

Es ist also deutlich ein Bedürfnis nach einem Produkt vorhanden, welches den Bereich zwischen einer sehr genauen MZK und einer sehr groben Realnutzungskartierung abdeckt. Das Ergebnis einer Machbarkeitsstudie zeigte, dass eine MZK, welche bis zu einem gewissen Grad generalisiert ist, diesen Bereich optimal abdecken könnte.

Dieser Artikel befasst sich nun mit der Frage, inwieweit es möglich ist, einen Datensatz, in diesem Fall die MZK, weitestgehend automatisiert zu verändern, sodass mit einem Minimum an verspeicherten Daten ein Maximum an benötigter Information transportiert wird. Das Resultat soll primär als Grundlage zur weiteren EDV-technischen Bearbeitung dienen und muss somit nicht sämtlichen kartographischen Ansprüchen genügen. Aus diesem Grund werden gewisse kartographische Bearbeitungen, wie zum Beispiel Verdrängung, vergrößerte Darstellung und dergleichen, nicht berücksichtigt. Zur weiteren Bearbeitung am Bildschirm werden Maßstäbe ab 1:2000 angestrebt.

2 PROBLEMSTELLUNG

Im Rahmen der Erstellung der MZK werden die einzelnen Geometrien kodiert erfasst und verspeichert. Eine Reihe von Kodes ermöglicht die Zuordnung jeder Geometrie zu einer Feature–Klasse. Ein Folgeprodukt der Mehrzweckkarte ist die Flächenmehrzweckkarte (FMZK). Diese Karte besteht aus Flächen, welche durch teilautomatisierte Bearbeitung der Daten der MZK gewonnen werden. Dabei werden aus den Linien der MZK klassifizierte Flächen generiert, welche das gesamte Stadtgebiet lückenlos und topologisch korrekt abdecken. Die Aktualität der FMZK entspricht dabei der Aktualität der zugrunde liegenden MZK. Das Baukörpermodell (BKM) (Dorffner und Zöchling 2003) setzt wiederum auf der FMZK auf. Unter einem Baukörper versteht man in diesem Zusammenhang ein Prisma, welches als Grundfläche eine einzelne Gebäudeteilfläche aus der FMZK hat. Die Höhe des Prismas ist photogrammetrisch erfasst.

Abb.3: FMZK, Ausschnitt

MZK, FMZK und 3d Modell liegen flächendeckend für ganz Wien vor. Der Datenbestand besteht aus kodierten Linien und Flächen mit einer Reihe von topologischen Beziehungen zueinander. Es gibt eine Vielzahl von Layern, welche jeweils eine Informationsebene darstellen. Gerade aufgrund dieser Layerstruktur hat sich der Einsatz von herkömmlichen Generalisierungsalgorithmen als nicht zufrieden stellend erwiesen, da ein reines geometrisches Generalisieren jedes einzelnen Layers die komplexen räumlichen Zusammenhänge zerstört. Weiters besteht die Notwendigkeit gewisse Feature–Klassen mit einer höheren Priorität in Bezug auf die maximale Verschiebung der Geometrien auszustatten. Nicht zuletzt soll die zu erzielende Reduktion der Datenmenge Vorteile im Speicherplatzbedarf und ein performantes Handling der Daten bringen.

Unter Generalisierung versteht man „… eine Auswahl des Wichtigsten, Wesentlichen und dessen zielgerichtete Verallgemeinerung, bei der es darauf ankommt, auf der Karte die Wirklichkeit in ihren wichtigsten, typischen Zügen und charakteristischen Besonderheiten entsprechend der Zweckbestimmung, der Thematik und dem Maßstab der Karte abzubilden“ (A. Hettner, 1910).

Es gibt bereits viele Ansätze Geodaten automatisiert zu generalisieren (ESRI 1996; Weibel 1997; Meng 2002; Ware *et al.* 2003). Douglas und Peucker (Douglas und Peucker 1973) entwickelten als eine der ersten einen Algorithmus zur Vereinfachung von Geometrien. Obwohl dieser Algorithmus sehr viele Anwendungsmöglichkeiten fand, zeigte Weibel (Weibel 1995), dass der Algorithmus zwar zur Generalisierung einzelner Geometrien, nicht aber zur Generalisierung eines ganzen (konzeptionellen) Modells geeignet war. Harrie (Harrie 2004) entwickelte ein Verfahren, welches auf Bedingungen gestützte Optimierungstechniken verwendet, um Geodaten in Echtzeit zu generalisieren. Aber auch dieser Ansatz bearbeitet nur einzelne Geometrien. Steiniger und Meier (Steiniger und Meier 2004) entwickelten eine Methode, die gut geeignet ist Linien zu generalisieren, allerdings nicht auf die MZK angewendet werden kann, da zum einen das Aufrechterhalten der topologischen Beziehungen einen hohen Aufwand bedeuten würde, zum anderen würde die charakteristische Struktur der MZK verloren gehen. Gerade in den letzten Jahren sind viele neue Methoden entwickelt worden, welche versuchen Geodaten mit den verschiedensten Datenstrukturen zu generalisieren. Gold (Gold *et al.* 2001) beispielsweise arbeitet mit Durchschnittsachsentransformation (engl: Medial Axis Transform) um ein Polygon auf das entsprechende Skelett zu reduzieren. Das Skelett eines Polygons besteht dabei aus den Kreismittelpunkten aller maximalen Kreise, welche in das Polygon projiziert werden können. Bei dieser Art der Generalisierung werden topologische Zusammenhänge bewahrt. Gold’s Ziel war es unter anderem eine Methode zu entwickeln, die keine (oder so wenige wie möglich) Parameter enthält, über die sich die Generalisierung steuern lässt (Weibel 1995). Dieser Umstand wirkt sich in einem System zur Generalisierung der MZK eher nachteilig aus, da es aufgrund variierender Zielmaßstäbe und der Vielfalt an unterschiedlichen Feature–Klassen durchaus erwünscht ist die einzelnen Vorgänge gezielt zu beeinflussen. Harrie und Sarjakoski (Harrie und Sarjakoski 2002) entwickelten ein System, welches gut geeignet zu sein scheint, die Daten der MZK zu bearbeiten. Es basiert auf Bedingungen und der Schwerpunkt liegt auf der graphischen Generalisierung. Allerdings soll in einer generalisierten MZK keine Verdrängung oder Vegrößerung von Objekten stattfinden.

Keine dieser Ideen ist daher direkt auf die MZK anwendbar. Eine Reihe von Experimenten und analytischen Betrachtungen zeigte, dass sich die oben diskutierten Generalisierungsalgorithmen nicht gut eignen, um zusammenhängende Strukturen, wie bei der MZK, zu generalisieren. Um zu gewährleisten, dass die charakteristischen Eigenschaften der MZK bestehen bleiben, muss der hier benötigte Algorithmus Rücksicht auf die Zusammenhänge in der Layerstruktur der MZK nehmen.

3 LÖSUNGSANSATZ

Um die verschiedenen Eigenheiten der MZK optimal auszunutzen, werden im realisierten Lösungsansatz die 240 geometrisch relevanten Feature–Klassen der MZK in mehreren Schritten bearbeitet.

Im ersten Schritt soll die Datendichte reduziert werden, indem gewisse Elemente gelöscht werden. Ein Entscheidungsfindungsprozess gab vor, welche Feature–Klassen im Zielmaßstab nicht mehr von Relevanz sind. Beispielsweise können Kanalgitter ab einem Maßstab von 1:2000 vernachlässigt werden. Insgesamt können 30 Feature–Klassen auf diesem Weg entfernt werden. Nach dem Löschen der betroffenen Geometrien muss jedes mal sichergestellt werden, dass die gesamte Topologie konsistent bleibt.

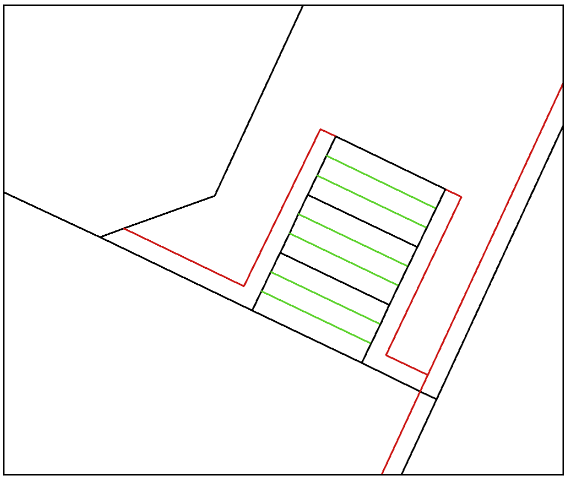

Abb.4a: Stiege, MZK Ausschnitt

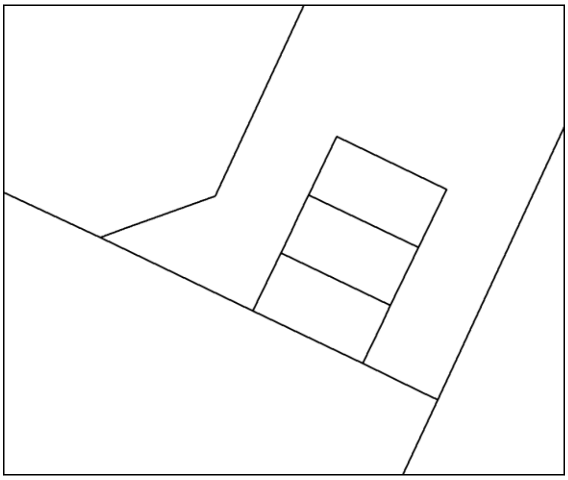

Abb.4b: Stiege generalisiert, MZK Ausschnitt

Abbildung 4a zeigt eine Stiege wie sie in der MZK sehr häufig vorkommt. Die einzelnen Stufen haben zwei verschiedene Kodes. Der Grund dafür ist, dass man bereits auf Auszeichnungen im Maßstab 1:2000 auf diese Stufen verzichten wollte und daher dazu überging Stufen schon bei der Erfassung zwei verschiedene Kodes zuzuweisen. Somit können diese Stufen gezielt selektiert und gelöscht werden. Weiters sieht man in Abbildung 4a mehrere Mauern. Eine Mauer besteht prinzipiell aus zwei parallel zueinander verlaufenden Linien. Eine Mauerlinie wird terrestrisch vermessen, die andere Linie wird per Algorithmus generiert. Auch diese beiden Linien haben unterschiedliche Kodes, was wiederum ein schnelles Selektieren und Entfernen der generierten Mauerlinien ermöglicht. Abbildung 4b zeigt die Situation nach dem Entfernen bestimmter Feature–Klassen.

Der zweite Schritt behandelt Flächen, welche einen so kleinen Flächeninhalt aufweisen, dass sie im Zielmaßstab nicht mehr relevant sind. Nach einer Reihe von Experimenten hat sich ein Flächeninhalt von 7 m² als gut geeigneter Schwellwert herausgestellt. Für jede dieser Flächen bis 7 m² wird die längste Kante bestimmt, die Teil der Umfahrung dieser kleinen Fläche ist. Danach wird der Nachbar ermittelt, der an dieser Kante angrenzt. Die so bestimmte Kante wird aufgelöst und die kleine Fläche wird mit dem Nachbarn vereinigt, wobei die Attribute der kleinen Fläche aus dem Datenbestand verschwinden.

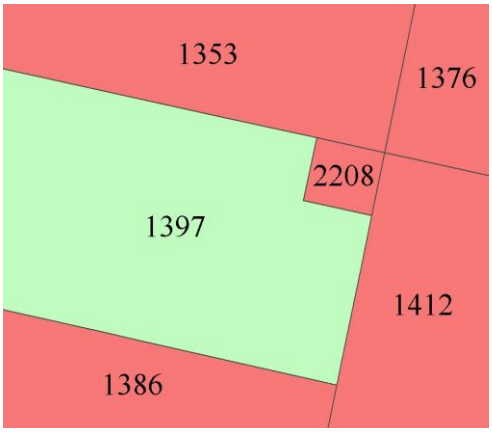

Abb.5a: Innenhof

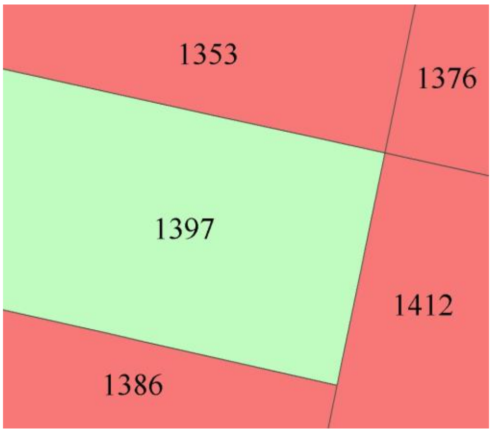

Abb.5b: Innenhof generalisiert

Abbildung 5a zeigt fünf Gebäudeflächen (rot) und eine Innenhoffläche (grün). Angenommen der Flächeninhalt der Fläche mit der ID 2208 liegt unter dem Schwellwert von 7m², so ist diese Fläche für die weitere Bearbeitung in diesem Schritt qualifiziert. Die Fläche mit der ID 2208 besitzt drei Kanten, eine als Grenze zur Fläche 1353, die zweite als Grenze zur Fläche 1412 und die dritte Kante trennt sie von der Fläche mit der ID 1397. Als erstes wird die längste dieser drei Kanten bestimmt. In diesem Fall ist es die Kante zum Nachbarn mit der ID 1397. Die Flächen 1397 und 2208 werden in weiterer Folge vereinigt. Dabei werden sowohl die Attribute der kleineren Fläche, als auch die Kante zwischen den beiden Polygonen aus der Datenbank entfernt. Abbildung 5b zeigt die Situation nach erfolgter Generalisierung.

Der Detailreichtum der Mehrzweckkarte spiegelt sich auch in einer sehr fein abgestuften Klassifizierung wider, welche in einer Fülle an Feature–Klassen resultiert. Auch hier soll der Grundgedanke der Generalisierung angewendet werden. So werden im nächsten Schritt die Kodes jener Linien zusammengefasst, welche im Zielmaßstab ähnliches darstellen. Beispielsweise werden sämtliche Einfahrten und Eingänge, welche in der Mehrzweckkarte mit eigenen Kodes versehen sind, entsprechend ihrer Umgebung umkodiert und dem übergeordneten Feature zugeordnet. Der Kode „Eingang zu Hauslinie“ wird daher auf den Kode „Hauslinie“ umkodiert. Die ehemalige Eingangslinie wird mit den angrenzenden Hauslinien zu einem einzelnen Feature zusammengefasst und als solches in der Datenbank verspeichert. Insgesamt werden 85 Feature–Klassen zu 4 Feature–Klassen aggregiert. Zusätzlich werden mehrere Features als einzelnes Feature verspeichert. Dadurch reduziert sich auch die Anzahl der Datensätze mitunter beträchtlich, was sich ebenfalls positiv auf den notwendigen Speicherbedarf auswirkt.

Im vierten Schritt erfolgt die kontrollierte, geometrische Vereinfachung der Linienfeatures, mit dem Ziel, das unruhige Kartenbild zu „glätten“. Dies soll erreicht werden, indem gezielt nach bestimmten Mustern gesucht wird, durch welche das Kartenbild überladen wirkt. Dabei handelt es sich um Mauervorsprünge, Stufen und anderen Vorbauten. Jedes Feature wird einzeln analysiert. Dabei werden die einzelnen Segmente eines jeden Features mit einer Reihe von vordefinierten Mustern verglichen. Beispielsweise können auf diesem Weg U-förmige Features erkannt werden. Nach Erkennung eines Musters wird getestet, ob die entsprechenden Segmente gewisse vordefinierte Kriterien hinsichtlich Länge und Richtung (Orientierung) erfüllen. Eine einzelne Stufe vor dem Eingang eines Hauses beispielsweise stellt so ein U-förmiges Muster dar. Nach erfolgter Erkennung wird nun diese U-Form hinsichtlich der Länge und Ausrichtung (Orientierung) der einzelnen Segmente untersucht. Sind alle Werte innerhalb eines definierten Bereichs, so wird dieses Segment einer bestimmten Bearbeitung unterzogen und somit vereinfacht. Für jedes Muster, welches erkannt werden kann, gibt es bestimmte Verabeitungsschritte, die auf das Feature wirken, wenn die entsprechenden Kriterien erfüllt sind. Eine weitere Möglichkeit diesen Prozess zu steuern ist es, unterschiedliche Kriterien bei der Verarbeitung eines Features anzusetzen, in Abhängigkeit vom Datentyp des Features.

Ein Feature kann aus beliebig vielen Segmenten bestehen. Um sicherzustellen, dass auch alle Kombinationen von Mustern innerhalb eines Features gesucht werden, wird jedes Feature von Anfang bis zum Ende durchlaufen. Dabei wird eine Art Fenster über das Feature geschoben. Jene Segmente im Fenster werden mit den vordefinierten Mustern verglichen. Beginnend mit dem Muster mit der größten Länge wird der Inhalt rekursiv durchlaufen. Die Fenstergröße ist variabel und richtet sich nach der Anzahl der Segmente des Features. Die aktuelle Implementierung analysiert und erkennt Muster mit einer Länge von bis zu fünf Segmenten. Findet eine Vereinfachung statt, ändert sich der Inhalt des Fensters und der Vergleich beginnt erneut. Findet keine Vereinfachung statt, wird das Fenster weitergeschoben. Die Bearbeitung eines Features endet, wenn das Fenster am Ende des Features angelangt ist.

Abb.6a: Situation vor Durchführung von Schritt 4

Abb.6b: Situation nach Durchführung von Schritt 4

Abbildung 6a zeigt eine Situation mit Gebäudeflächen (rot) und eingeschlossenen Innenhofflächen (grün, hellgrau) wie sie nach den ersten drei Bearbeitungsschritten aussieht. Es sind deutlich die Vorsprünge zu sehen, die in den Innenhof ragen. Sie lassen das Bild kantig und unruhig wirken. Nach Durchführung von Schritt 4 erhalten wir das Bild in Abbildung 6b. Die Vorsprünge wurden entfernt, was das Kartenbild merklich ruhiger macht.

Zusätzlich wird nach erfolgreicher Durchführung eines jeden der vier Bearbeitungsschritte eine Prüfung durchgeführt, welche die Konsistenz der Daten, insbesondere der Topologie, gewährleistet. Zuletzt müssen entstandene Fehler, wie zum Beispiel overshoots (überstehende Liniensegmente) oder undershoots (zu kurz geratene Liniensegmente) bereinigt werden. Dies kann zum Teil durch automatisches Snapping gemacht werden, das heisst die fehlerhafte Linie wird beispielsweise automatisch verkürzt, wenn der Überstand kleiner als ein Sollwert ist. Fehler, welche sich nicht mit einem automatischen Snapping bereinigen lassen, werden markiert und dem Bearbeiter zur genaueren Ansicht angezeigt.

Sämtliche Folgeprodukte der MZK profitieren ebenfalls von dieser Vereinfachung. So kann beispielsweise aus den generalisierten MZK Daten ad hoc auch ein generalisiertes Baukörpermodell erstellt werden.

Die Umsetzung erfolgte mittels ESRI ArcGIS 9 und VisualBasic for Applications (VBA). Die Wahl fiel auf VBA, weil damit ein schnelles Testen kleinerer Programmteile möglich ist und keine eigene Entwicklungsumgebung notwendig ist. Zusätzlich ist es sehr einfach den Sourcecode nach Abschluss der Programmierarbeit auf VisualBasic .NET zu portieren, um eine vollwertige Extension für ArcGIS zu erzeugen.

Die einzelnen Programmteile wurden als Funktionen implementiert, da somit größtmögliche Modularität und Wiederverwendbarkeit gewährleistet ist. Ein Frontend, welches Eingaben vom Benutzer entgegen nimmt, steuert diese Funktionen. Der Ablauf des Programms sieht vor, dass die oben genannten Schritte der Reihe nach abgearbeitet werden. Die Reihenfolge ist dabei entscheidend, da eine Funktion jeweils die Ergebnisse der vorherigen Berechnung ausnutzt.

4 ERGEBNISSE UND AUSBLICK

Eine erste Implementierung dieses Prozesses lieferte viel versprechende Ergebnisse. Die generalisierten Daten entsprechen bereits in hohem Maß den Erwartungen. Eine starke Reduktion von Punkten und Linien und das Zusammenfassen einzelner Features bringen eine erhebliche Ersparnis im Speicherbedarf der Daten. In innerstädtischen Gebieten werden ungefähr ein Drittel aller Punkte eingespart und circa zwei Drittel aller Linien. Dabei kann man von einer Ersparnis im Speicherbedarf von circa 60 – 70 % ausgehen. Aber auch das optische Erscheinungsbild der Daten für Maßstäbe ab 1:2000 wird signifikant verbessert. Das Kartenbild wirkt ruhiger und nicht mehr überladen und eignet sich somit hervorragend für die rasche Bearbeitung größerer Gebiete und die Beantwortung räumlich ausgedehnter Fragestellungen.

Der weitere Verlauf des Projektes sieht eine Justierung der einzelnen Parameter vor. Auch ist eine Erweiterung der Liste von vordefinierten Mustern denkbar. Ausserdem wurde angedacht die Höheninformation des Blockmodells einer seperaten Generalisierung zu unterziehen, um auf diesem Weg auch das dreidimensionale Erscheinungsbild des Modells neuen Verwendungszwecken zuzuführen. Momentan liegt der Fokus der Analyse der einzelnen Features auf den Baublöcken. In einer nächsten Erweiterung soll auch der Straßenraum detailliert untersucht werden.

Es bleibt abzuwarten, welche Auswirkungen diese neuen Möglichkeiten auf die Produktpalette und die Dienstleistungen der MA41 haben. Die Vielseitigkeit von derart veränderten Daten liegt auf der Hand. So kann beispielsweise ein generalisierter Datensatz von ganz Wien, welcher zur Evidenthaltung in den Aktualisierungszyklus eingebunden wurde, für eine Fülle von Anwendungen verwendet werden. Insbesondere die Webapplikationen des Magistrats, wie zum Beispiel die Basisdaten für die Stadtplansuche, können in hohem Ausmaß von diesem optimierten Datensatz profitieren.

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3D-Stadtmodell- Generierung aus kommunalen Geodaten und benutzerspezifische Echtzeitvisualierung mithilfe von Game- Engine- Techniken

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ABSTRACT / ZUSAMMENFASSUNG

In den, dem Paper zugrunde liegenden Projekten, werden neben den Standardtechniken zur Erstellung von 3D-Stadtmodellen erstmals Ansätze aus der Unterhaltungsbranche aufgegriffen - insbesondere aus der Computerspieleindustrie unter Unterstützung der DirectX- Fähigkeiten - moderner Grafikkarten - die eine bis dato nicht gekannte Darstellungsqualität mit den Möglichkeiten einer selbstständigen Navigation und Interaktion in Echtzeit kombinieren. Der virtuelle Spaziergang durch ein 3D-Stadtmodell wird somit auch vom heimischen PC zum Erlebnis.

Eine der wichtigsten Fragen im Rahmen der Erstellung eines 3D-Stadtmodells lautet: Wofür kann ein 3D-Stadtmodell nützlich sein? Die Erwartungen sind je nach Anwender, Auftraggeber und „Modellbauer“ sehr verschieden. Wesentlich erscheint, dass ein 3D-Stadtmodell nicht nur nach dem „l´art pour l´art“- Prinzip erstellt wird, sondern universell in verschiedenen Bereichen der Kommune eingesetzt werden kann, zur Unterstützung der Diskussion verschiedener Planungsszenarien. Weiterhin kann für Kommunen der externe Gebrauch von 3D-Stadtmodellen interessant sein. Durch die Weitergabe bzw. durch die Verwertung der Nutzungsrechte des Modells z.B. zu Marketingzwecken oder im Immobilienentwicklungsbereich könnten hierbei Mehrwert-Effekte erzielt werden. Über die Koordinierung verschiedener Anwendungsbereiche und unter Hinweis auf Synergie- Effekte, kann vor allem in den Kommunen die Zurückhaltung bezüglich dieser neuen Art der Planungsgrundlage wohl zumindest verringert werden. Offensichtlich werden zurzeit die günstigen Potenziale für die tägliche Praxis (noch) verkannt.

Die in der Praxis erprobten Einsatzfelder wie Beleuchtungssimulationen, Integration von Architekturentwürfen, Hochwasser- und Stoffausbreitungssimulationen sowie die generelle Integration der Stadtmodelle in einen Echtzeit- Viewer werden in diesem Paper ausführlich diskutiert und die daraus gewonnenen Erkenntnisse abschließend beurteilt.

1 WORKFLOW 3D-STADTMODELL GENERIERUNG

In den Kommunen Deutschlands schlummert weitestgehend ungenutzt ein großer Schatz: GEODATEN! Denn fast 80% aller kommunalen Daten weisen einen Raumbezug auf.

Vor diesem Hintergrund entstand die Idee, 3D- Stadtmodell aus kommunalen Geodaten zu generieren, Datenbestände zusammenzufassen, zu aggregieren und im gesamtstädtischen Kontext zu einem Workflow- Modell zu entwickeln.

Besonders in dem kleinmaßstäblichen Architekturbereich, der Darstellung gesamtstädtischer Situationen gewinnt das Thema 3D-Stadtmodelle zunehmend an Bedeutung. Experten gehen davon aus, dass es zukünftig als unumgänglich erachtet werden kann, universell einsetzbare Stadtmodelle für die unterschiedlichsten Anwendungsfelder (Sicherheit, Katastrophenschutz, Tourismus, Infrastruktur etc.) vorzuhalten. Neben den vielfältigen Möglichkeiten im Planungsprozess selbst, werden vor allem Potenziale in der Darstellung räumlicher Zusammenhänge städtebaulicher Strukturen gesehen, die in planaren 2D- Darstellung oftmals nicht wahrgenommen werden. Die ästhetische Attraktivität sowie der hohe Detaillierungsgrad lässt überdies virtuelle Welten entstehen, die Dynamik und auch Spaß bei Auseinandersetzung mit dem Thema Stadt mit sich bringen.

Neue Ansätze zum Umgang mit großen Zeichnungen kommen zurzeit aus der Unterhaltungsbranche, da besonders im Bereich der Computerspiele große Mengen an dreidimensionalen Daten anfallen und in Echtzeit verarbeitet werden müssen. Es ist nahe liegend diese Entwicklungen mit den Aufgaben der Verarbeitung von Stadtstrukturen zu verbinden und von der Geschwindigkeit und den maximalen Datenmengen dieser Game- Engines zu profitieren.

Dabei sind folgende Aspekte zu beachten:

- Integration vorhandener kommunaler Geodaten
- Ergänzung um aktuelle Messdaten (Laserscans etc.)
- Modifizierbarkeit / Aktualisierbarkeit in einem gesicherten Workflow
- Lage- und Höhengenauigkeit der zu erzeugenden Modelle
- Offene Datenschnittstellen / Datenformate (Datenbankanbindungen etc.)
- Kompatibilität zu gängigen Softwareapplikationen (DXF, 3DS, Direct X)
- Integration der Stadtmodelldaten in kommunale Anwendungen
- Weiterbearbeitbarkeit der neu erzeugten Geodaten (intern)
- Sicherheit durch Verschlüsselung der Stadtmodelldaten (extern)
- Einfache Handhabung und Navigation - auch für Laien
- Finanzierbarkeit durch Nutzung von Bestandsdaten
- Refinanzierbarkeit (Tourismus, Automobilindustrie, Versorger, Sicherheit etc.)

Das hieraus entwickelte, idealtypische Workflow- Modell erfüllt die Anforderungen an Genauigkeit, einfache Erstellung, rasche Aktualisierung und Modifizierbarkeit, offene Datenschnittstellen und kostengünstiges Arbeiten im vollen Umfang erfüllen. Mithilfe einer eigens entwickelten Software „Architecural Space" ist es möglich, vergleichsweise einfach ein Level- of- Detail 1 (LOD)- Modell zu erstellen. Hierzu benötigt man lediglich Grundriss- (ALK-) Polygone der Gebäude (2D-Polygone) und ein digitales Höhenmodell. Für das Level- of- Detail 2 bis 3- Modell werden zusätzlich stereoskopisch ausgewertete Dachstrukturen benötigt, sowie Fassadenmappings, die mit einer Digitalkamera aufgenommen werden können. Ebenfalls sind Laserscandaten integrierbar.

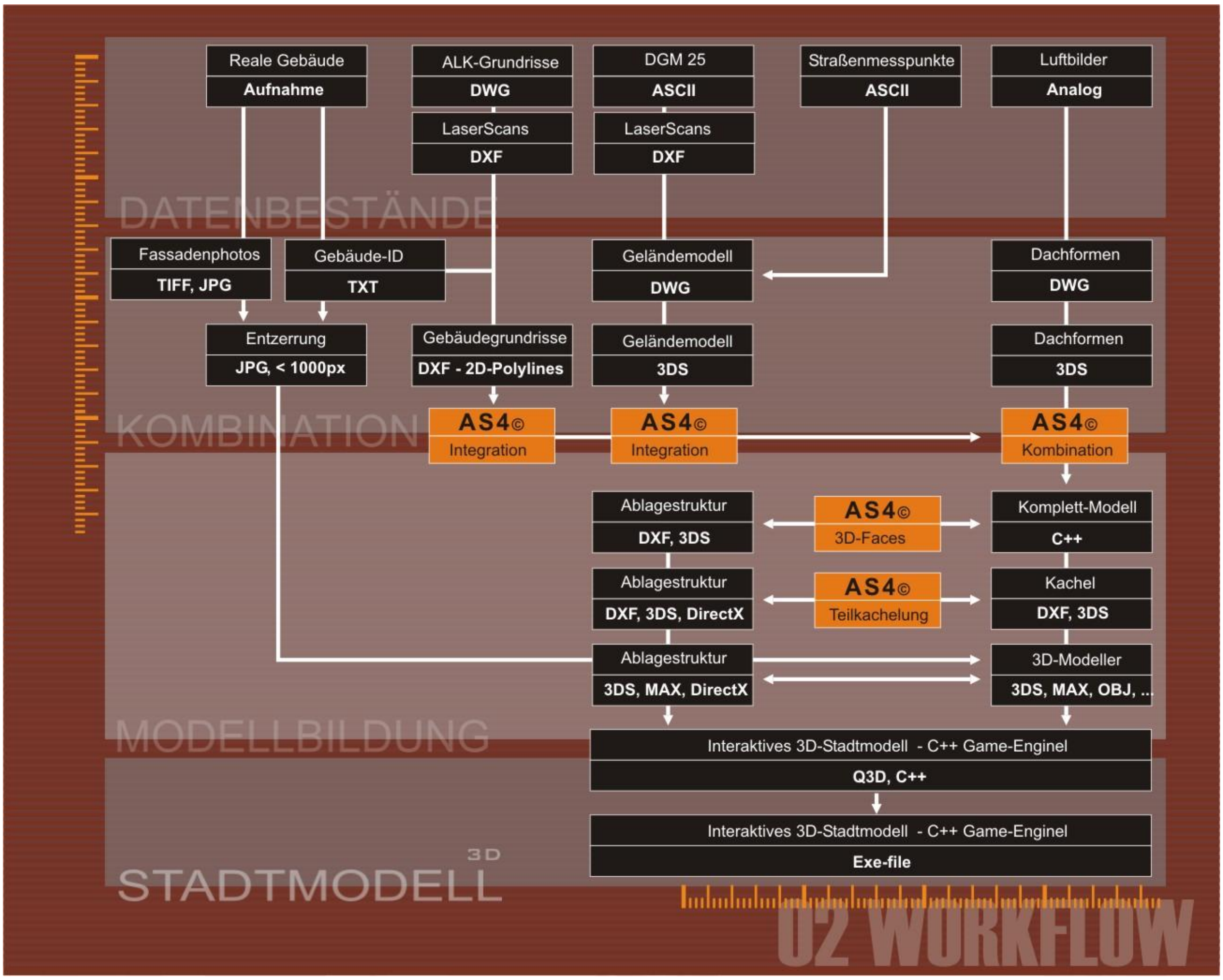

Abbildung: Workflow zur Erstellung eines 3D-Stadtmodells aus kommunalen Geodaten [eigene Darstellung]

2 EXTRAPOLATION UND EXPORT DURCH ARCHITECTURAL SPACE AS4©

AS4© ArchitectualSpace stellt eine Softwarelösung dar, die eine bestehende Lücke zwischen 2D-CAD-Zeichnung und 3D- Face-Modellen schließt und dies insbesondere im Bereich kleinmaßstäblicher, gesamtstädtischer Planungen.

Aufgabe der Software ist es, drei Datensätze (DGM, 2D-Stadtgrundkarte, Dachflächen) zu verknüpfen und in einer gemeinsamen Darstellung zu vereinen. Das Ziel ist es eine Zeichnung zu erhalten, in der dreidimensionale Gebäude auf dem Geländemodell dargestellt sind.

Die Inspiration bei der Entwicklung dieser Stadtmodellgenerierungssoftware und dem Umgang mit großen Zeichnungen kommt aus der Unterhaltungsbranche, da besonders im Bereich der Computerspiele große Mengen an dreidimensionalen Daten anfallen und in Echtzeit verarbeitet werden müssen. Diese Technologien gilt es nun, zur Erzeugung von dreidimensionalen Architektur- und Stadtmodellen, nutzbar zu machen. Wesentliche Ansätze lagen hierbei in der Handhabung der Grafik, nämlich von DirectX bzw. OpenGL. Mithilfe von Schnittflächenberechnungen durch Kollisionserkennung, Delauny- Triangulation der entstehenden Flächen sowie Tesselation der Dachflächen durch OpenGL-CallBack-Funktion entstehen relativ große Stadtmodell- Datensätze [Wettels 2004].

Um dennoch mit diesen großen Dateien arbeiten zu können und keine Informationen beim Speichervorgang zu verlieren, kann das entstandene Modell in einer beliebig wählbaren Größe gerastert werden. Hierbei beziehen sich alle Rasterteile auf denselben, modellinternen Nullpunkt. Die einzelnen Dateien werden nach ihren Entfernungen von dem Nullpunkt benannt und in automatisch erzeugte Verzeichnisse exportiert. Diese Speicherung hat den Vorteil einer einfachen Systematisierung und bietet zudem die Möglichkeit, Informationen zu dem jeweiligen Raster in diesen Ordnern abzulegen. Im Grunde handelt es sich um eine einfache Datenbank, in der eine Verästelung der Unterverzeichnisse ein schnelles Wiederfinden der Daten ermöglicht und in der außerdem noch für jedes Raster Angaben zum Mapping, den jeweiligen Objekten oder der Bearbeitung abgespeichert werden können.

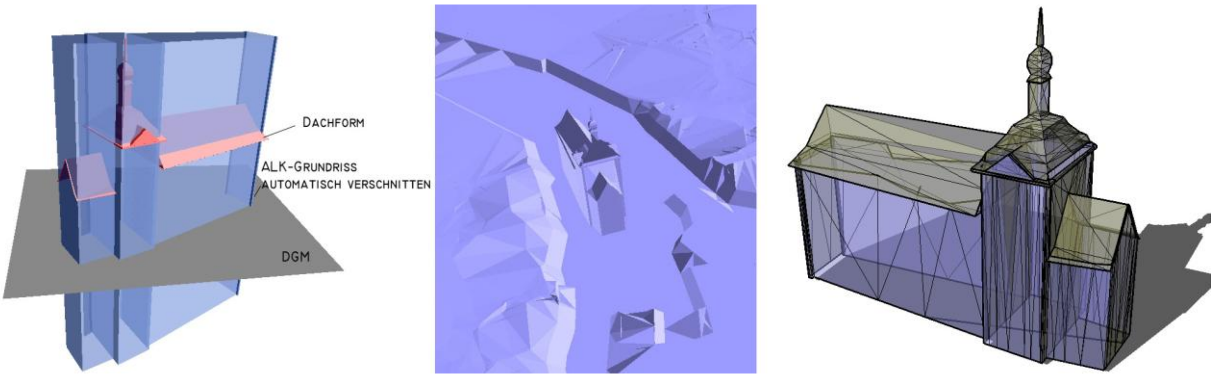

Abbildung: Modellbildung LOD2 mit AS4 [eigene Darstellung]

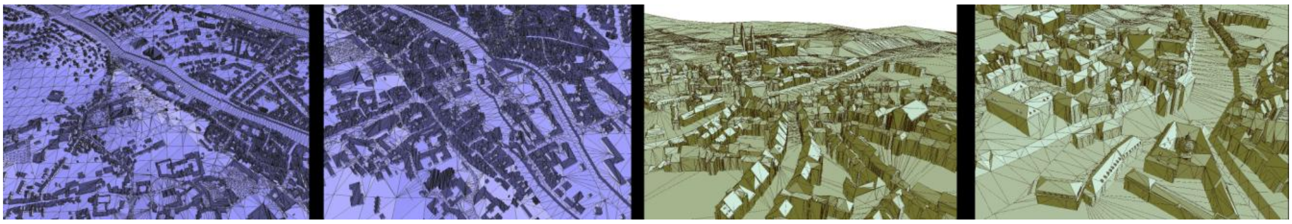

Abbildung: LOD1 und LOD2 Generierung [eigene Darstellung]

3 ANWENDUNGSFELDER

Öffentlich ausgeschriebene Wettbewerbe sind wesentliche Bestandteile der Baukultur und nehmen einen immer bedeutenderen Platz bei der Vergabe von Bauprojekten ein. Sie dienen dem Auslober als Instrument der Entscheidungsfindung, um hochwertige Architekturentwürfe und Realisierungskonzepte für bestimmte, im öffentlichen Raum bestehende Situationen zu diskutieren, und diese baulich neu zu ordnen [Petschek & Lange 2004]. Die Wettbewerbsbeiträge sollen zum einen durch qualitativ hochwertige Architektur bestechen, zum anderen müssen sie auch auf bestehende Baustrukturen reagieren und sich in den Stadtkörper einfügen. Im Zuge der Chancengleichheit, der Kostenreduzierung, der besseren Vergleichsmöglichkeiten sowie einer objektiveren Bewertbarkeit von Architektur – die sich im Übrigen in ihrer Qualität nur schwerlich messen lässt – sind 3D- Stadtmodelle bestens geeignet, um eine ansatzweise wertneutrale Beurteilung zu ermöglichen. Insbesondere im Wertbewerbswesen leistet ein, für alle Teilnehmer gleichwertiges 3D-Stadtmodell, das, von darstellungstechnischen Unterschieden des umgebenen Stadtkörpers befreit, eine vielleicht objektivere Bewertung des eigentlichen Wettbewerbsbeitrages.

Abbildung: triggerbasierter Echtzeit- Vergleich von Planungsalternativen [eigene Darstellung]

Planung allgemein setzt sich aus den einzelnen Verfahrensschritten der Informationsgewinnung, der Ziel- und Problemstrukturierung, der Prognosenformulierung, der Planentwicklung und der dazu gehörigen Alternativenfindung, der Planbewertung und Entscheidung sowie der nachfolgenden Planverwirklichung und Erfolgskontrolle zusammen. Der zielgerichtete Einsatz von 3D-Stadtmodellen zur Wissensvermittlung und Kommunikation kann in den jeweiligen Planungsstufen die Transparenz der Entscheidung maßgeblich erhöhen. Anhand dieser Modelle ist es möglich, Varianten, Planungen und Veränderungen im Stadtgefüge zum Einen zeitlich und räumlich zu analysieren und zu bewerten, und zum Anderen eine Diskussionsgrundlage zu erstellen, um verschiedene Planungsvarianten und – Versionen zu diskutieren [Achleitner, Schmidinger, Voigt 2003].

Wichtig in allen Planungsphasen ist zum einen die verständliche Darstellung des Planungsinhaltes als auch die interaktive Veränderbarkeit im direkten Vergleich von einzelnen Planungsalternativen [Schildwächter, Poesch, Wettels, Zeile 2004]. Als Planungsgrundlage in den Entwurfsphasen ist das “Experimentieren mit Stadträumen“ ein wichtiger entwurfsprozessbegleitender Bestandteil, der durch das Zurückgreifen auf eine Grunddatenmenge für den gesamten Planungs-, Entscheidungs- und Kommunikationsprozess in städtebaulichen Fragen sehr gut geeignet ist. Der implementierte Detailreichtum und die Validierung von Simulationstechniken sollten hierbei allerdings mit weiteren Untersuchungen unter Einbeziehung der Umwelt- und Wahrnehmungspsychologie verknüpft werden [Voigt 2001].

Je nach Planungsanlass wird zu entscheiden sein, ob es, vor allem aus Kostengründen, sinnvoll erscheint, die Planung dreidimensional zu visualisieren. Hinsichtlich der Nachvollziehbarkeit und der Transparenz der Entscheidungsfindung sind diese neuen Einsatzmöglichkeiten jedoch ein probates Mittel, um jedem am Planungsprozess beteiligten Akteur auch ohne Kenntnis der jeweiligen fachspezifischen Plandarstellung und des damit verbundenen Fachvokabulars bestmöglichst zu informieren.

Die Ausbreitung von Immissionen kann im virtuellen Modell unter zu Hilfenahme der Klassifizierung der Stoffeigenschaften bzw. durch Bennnenung der Stoffe selbst, mittels Software in Echtzeit durchgeführt werden. Angefangen von Simulationen über Starkregenereignissen oder Kanalbrüchen bis hin zu Szenarien des Katastrophenschutzes bei Unfällen mit Chemikalien können so detaillierte und dezidierte Aussagen zur Ausbreitung dieser Stoffe, auch über einen längeren Zeitraum hinweg, getroffen werden.

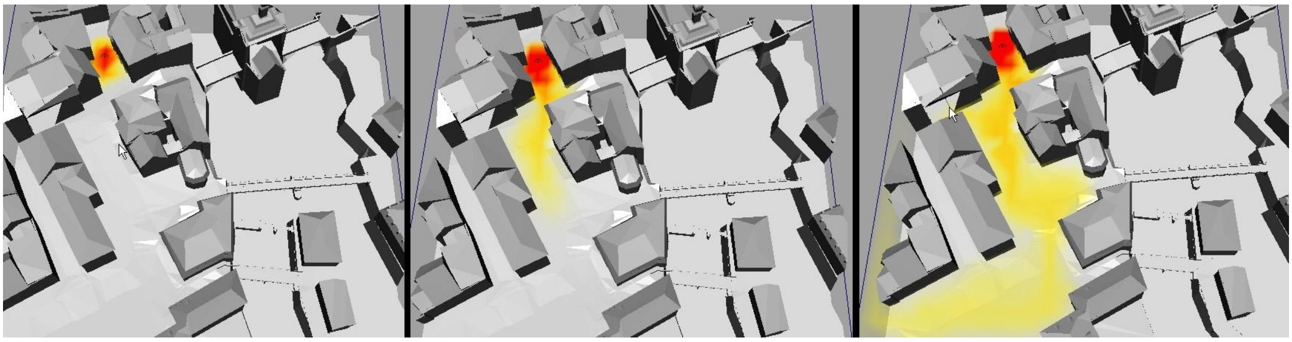

Abbildung: Stoffausbreitungssimulation [eigene Darstellung]

Bei baulichen Veränderungen an Wasserwegen wie Brückenbauten, Durchlässe und Uferbebauungen von Fließgewässern verändern sich die Fließbedingungen und damit das hydraulische Leistungsvermögen des Gewässers. Dennoch muss für die Gefahrenabwehr die schadlose Ableitung eines Jahrhunderthochwasserabflusses gewährleistet sein. Durch Versiegelung geht natürliches Retentionsvolumen verloren, dieses muss an anderer Stelle wieder ausgeglichen werden.

Für diese erforderlichen Untersuchungen wird ein digitales Geländemodell benötigt. Nur auf dessen Datengrundlage können Nachweise sinnvoll und wirtschaftlich erbracht werden, das heißt über ein DGM, Abflussmengen und Volumina von Retentionsräumen sowie von Stauzielen einfach und kurzfristig berechnet werden, wobei Wasserspiegelveränderungen im Zentimeterbereich ermittelbar sind [Endres 2003].

Idealerweise sollte ein DGM aber auch noch Zusatzinformationen über die bauliche Situation vor Ort enthalten. So kann das Abflussverhalten des Wassers exakter simuliert werden, insbesondere wenn sich durch bauliche Kubaturen die Fließrichtungen ändern.

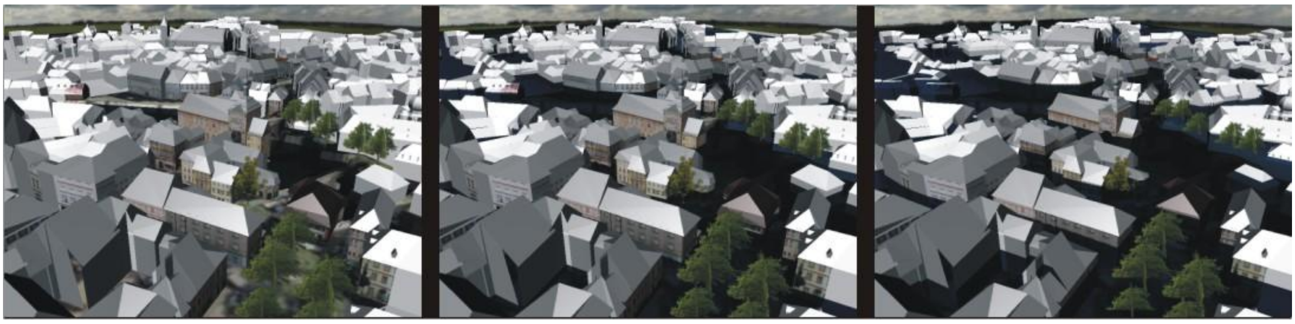

Abbildung: Hochwassersimulation [eigene Darstellung]

Für Lärmmodellrechnungen werden schon jetzt bereits abstrahierte 3D-Stadtmodelle eingesetzt. Dabei werden in ein LOD1- Modell Lärmquellen integriert und deren Schallausbreitung im Bestand als Isolinien oder mithilfe von Farbverläufen visualisiert. Hierbei kann man auch die Lärmbelastung über den Tagesverlauf mit sich ändernden Lärmemissionen simulieren. Eine grobe Berechnung der Schallausbreitung gelingt mit dem reinen Volumenmodell. Benötigt man dagegen genauere Messwerte, so müssen den einzelnen Objekten differenzierte Reflexionseigenschaften zugewiesen werden. Kleinere Objekte, die eine geringere Oberfläche als 8-9qm aufweisen, sind für die Berechnungen weitest gehend unerheblich. Grundsätzlich nimmt die Schallenergie mit zunehmender Entfernung vom Emittenten ab.

Wichtig ist die exakte Erfassung der Schallintensität an der Emissionsquelle; je weiter die Emissionsquelle entfernt ist, desto ungenauer darf die Datengrundlage sein. Neben der Reflexion des Schalls muss auch die Schallabschirmung berücksichtigt werden. Durch die Abschirmung verlängert sich der Weg des Schalls vom Emittenten bis zur Immissionsstelle. Jede Verlängerung des Schallweges führt hierbei zu einer allerdings nur geringen Schallreduktion. Die Schallberechnungen werden in der Praxis für die Lärmminderungsplanung eingesetzt. Durch steigende Hardwareleistungskapazitäten sind solche Berechnungen sehr detailliert durchführbar. Sofern schon eine Stadtmodellgrundlage vorliegt, sind die vorhandenen Daten schnell zu modifizieren und die Lärmberechnung kann problemlos durchgeführt werden. Allerdings haben einige Systeme bei komplexen geometrischen Strukturen Probleme mit der Datenverarbeitung. Mit einfachen Volumenmodellen (LOD1) erreicht man dennoch relativ verlässliche Ergebnisse.

Im Katastrophenschutz werden bislang zu Übungszwecken haptische 3D-Modelle aus Kunststoff oder Holz eingesetzt. Diese sind jedoch nicht an eine reale Situation gebunden, sondern stellen immer nur einen Ausschnitt aus einer fiktiven Stadt oder ländlichen Gegend mit den dazugehörigen Infrastrukturen dar. Die Gebäude werden mit aufklappbaren Fensteröffnungen und Türen ausgearbeitet. Mit Zubehör wie Autos, Zügen und Flugzeugen teilen diese oftmals sehr kostenaufwendigen Modelle die Grundlage für die Simulation von Katastrophenszenarien. Nachteilig wirkt sich hierbei der mangelnde Realitätsbezug aus. Dementsprechend erachten es Brandschutzexperten als sinnvoll, die Übungen in realen Strukturen durchzuführen, in denen z.B. auch Fahrtzeiten und Verkehrsaufkommen simuliert werden können [Schildwächter, Zeile, Poesch et al. 2004]. In der Praxis dienen 3D-Daten dem Katastrophenschutz nur unterstützend, da eigenständige 3D- GIS -Systeme noch nicht verfügbar sind. Allerdings werden derzeit schon 2,5D-Modelle (Geländemodelle) für Ausbreitungsberechnungen auf der Oberfläche genutzt, wobei störende Volumina in Form von Gebäuden oder Stützmauern noch nicht berücksichtigt werden. Zur genaueren Berechnung sind zumindest die Gebäudekubaturen ein sinnvolles ergänzendes Detail. Grundsätzlich bedeutet die bislang unbekannte Einbeziehung der dritten Dimension in Analysen nicht nur für den Katastrophenschutz einen enormen Vorteil für die Geodatenstruktur vor Ort. Jeder Benutzer kann die räumliche Situation vielmehr besser erfassen und aufgrund dieser Basis viel intuitiver und schneller Entscheidungen treffen. Auch lassen sich im präventiven Bereich die Trainingsszenarien eindringlicher darstellen.

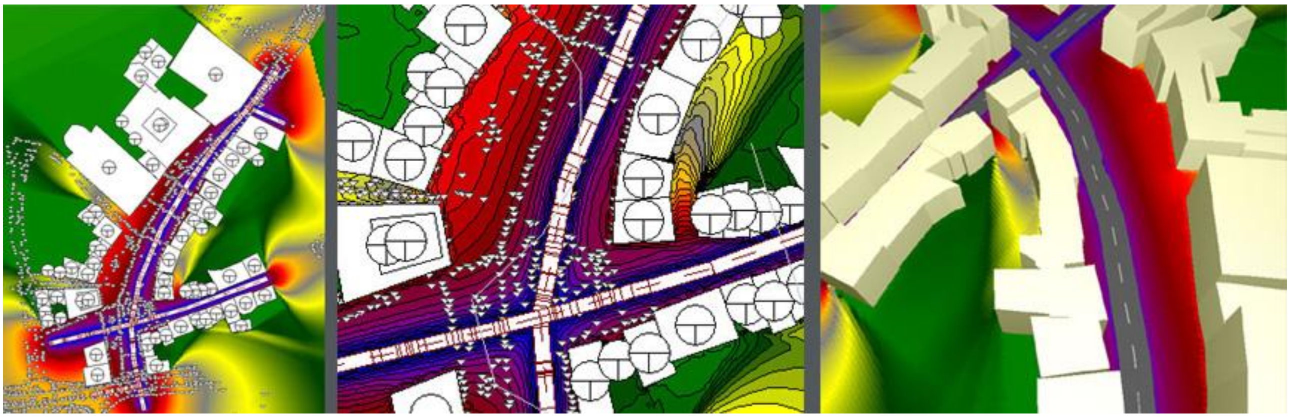

Abbildung: Schallausbreitungssimulation [eigene Darstellung]

Bei der Planung von Funknetzen, etwa für die Aufstellung neuer UMTS- Sendemasten oder auch für die Gestaltung der Netzausbreitung von WLAN, ist es wichtig, ein 3D-Modell der Umgebung zu besitzen, in der die bereits aufgestellten Sender registriert sind. Durch die Stellung von Gebäuden, in engen Straßenschluchten oder durch bewegte Topografie kann es zu sogenannten Funklöchern kommen, die für den Anwender zum Ausfall des Netzes bzw. des Dienstes, auf den er angewiesen ist, führen.

Weiterhin ist es möglich, die CAD- Datengrundlage für die Erstellung von CNC-gefrästen Modellen zu verwenden. Die Potenziale und die damit verbundene Anwendung des computergestützten Modellbaus in der Architektur und Raumplanung haben vor allem Streich und Weisgerber 1996 erstmalig umfassend beleuchtet. Insbesondere die Vision des Modellbaus auf Knopfdruck für Stadtplaner und Architekten wurde hierbei hervorgehoben [Streich, Weisgerber 1996]. Durch den Einsatz von CAD/ CAAD-Systemen können mithilfe geeigneter Schnittstellen und verschiedensten Verfahrensweisen wie 2D-Schneideverfahren, 3D-Fräsverfahren, Stereolithografie, Lasersintering und vieles mehr, großartige physische Modelle hergestellt werden [Streich Weisgerber 1996].

Allerdings stellt sich hier nun die Frage: warum wird überhaupt noch ein haptisches Modell erstellt, wenn schon das virtuelle Modell vorliegt? Zumal die Kosten für die Erstellung immer noch verhältnismäßig hoch sind! Um die Tragweite der Problematik in der Auswahl konkurrierender Modelltypen besser zu verstehen, sei zunächst eine kleine Episode geschildert. Im Laufe des Projekts Bamberg-3D wurde am Lehrgebiet cpe ein erstes kleines Modell von Bamberg gefräst. Bei einer Präsentation wurde zum einen das virtuelle LOD2-Modell präsentiert, zum anderen das gefräste Modell mit den Maßen125x125x80 mm. Das Modell wurde angefasst, gedreht, man diskutierte darüber. Das haptische Erlebnis, das in die Mitte nehmen und begreifen löst kommunikative Prozesse aus. Streich bemerkte schon 1996, dass die reine Substitution eines Modells durch eingesetzte Virtual Reality Verfahren nicht die kommunikative Funktion eines physisch realen Modells ersetzt [Streich Weisgerber 1996]. Demzufolge ist es logisch, dass man versucht, nachdem das virtuelle 3D-Modell nun schon besteht, durch vergleichsweise kostengünstige Verfahren haptische Modelle zu erzeugen.

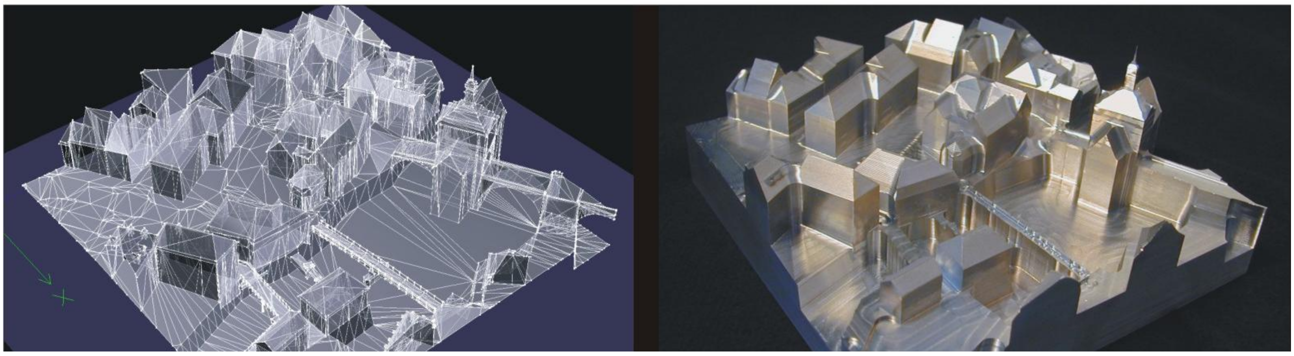

Abbildung: digitales und daraus per Rapid Prototyping erstelltes physisches Modell [eigene Darstellung]

Die Beschäftigung mit Lichtmasterplanungen zur Kostenreduktion in Kommunen sowie die Inszenierung von Plätzen durch den effektvollen Einsatz von Licht ist momentan sehr en vogue. Mithilfe eines dreidimensionalen Stadtmodells und einem geeigneten Rendering- Programm lassen sich im Vorfeld einer sehr aufwendigen und teuren Lichtplanung erste Planungsziele verhältnismäßig einfach und vor allem auch für den Laien verständnisvoll visualisieren. Teure Prototypenerstellung zu Testzwecken in der realen Umgebung lassen sich zwar nicht komplett vermeiden, jedoch lassen sich im Vorfeld zumindest sehr in sich differierende Zielvorstellungen ausschließen. Alle für die Lichtplanung wichtigen Parameter wie die verwendete Lumenzahl, die auf die Oberfläche auftreffenden Candela- Werte, die Farbtemperatur in Kelvin, die Integration von IES- Dateien zur exakten Wiedergabe der Leuchteigenschaften eines im Handel erhältlichen Glühmittels bis hin zur Fotonenreflexion von auf die Oberfläche aufprallender Lichtpartikel sind möglich.Durch den gezielten Einsatz digitaler Simulationsmethoden kann schon im Vorfeld einer Lichtplanung die Kommunikation zwischen Fachleuten und Laien erheblich verbessert und Zielvorstellungen exakt formuliert werden.

Abbildung: Lichtsimulation [eigene Darstellung]

4 AUSBLICK/ IN ENTWICKLUNG BEFINDLICHE FEATURES

Primär gilt es, die fehlenden additiven Informationen bezüglich der einzelnen Gebäude, in das Modell zu integrieren. Ähnlich dem Verfahren auf einer HTML- Seite soll der Benutzer, sofern er Informationen zu einem Objekt benötigt, diese durch Anklicken bekommen. Um diese Daten aktuell zu halten muss eine Datenbankanbindungschnittstelle, sei es über ODBC, MySQL, Oracle Spatial oder ähnliche, geschaffen und nach Bedarf oder tagesaktuell neu eingelesen werden.

Die 3D-Stadtmodell- Datei, eine Exe- Datei von ca. 20 mb ist vom User einmalig herunterzuladen und auf seinem Rechner zu installieren. Alle Daten, die veränderbar sind, wie Öffnungszeiten, oder die Veränderung in der Baustruktur, können als Art Update installiert werden. Der Benutzerkomfort und auch der Komfort für die Content- Anbieter erhöht sich mithilfe dieser Vorgehensweise enorm. Zudem ist eine Web- Streaming – Lösung zur Übermittlung des Modells angedacht; je nach Aufenthalt im Modell werden Gebäude und Inhalte client- server- seitig nachgeladen.

Durch diese Lösung kann das fertige Stadtmodell als Rohfassung auf CD oder per Internet vertrieben und verteilt und gleichzeitig auch aktuell gehalten werden. Da die Distribution als "geschlossene" exe-Datei erfolgt, ist zudem die Datensicherheit der kommunalen Datenbestände im Gegensatz zur Veröffentlichung als VRML- Datei gegeben.

5 FAZIT

Durch die vorgestellten Einsatzfelder und die nachfolgende Integration der Ergebnisse in die Echtzeitpräsentation werden die Potenziale aufgezeigt, die im aktiven Umgang mit einem 3D-Stadtmodell liegen. Die Generierung des 3D-Wireframe-Modells wirft trotz der Integration des Geländemodells keine Probleme auf, einfache LOD 1 Modelle können ohne großen Zeitaufwand erstellt werden. Die mit einem höheren Arbeitsaufwand verbundenen LOD- Stufen 2 und 3 machen eine Stadt am Computer virtuell erlebbar. Insgesamt stecken gerade in der Verbindung von klassischen Modellierungstools für Planung und Architektur mit fachfremden Applikation aus der Virtual Reality und Spiele Szene sowie der Kombination von Open- Source Datenbanken herausragende Potenziale, um Städte, deren Strukturen und die damit verbundenen Geodaten zu erfassen, zu visualisieren, zu analysieren und zu pflegen. Durch die bildhaften, in reale Baustrukturen eingebetteten und traditionellen Sehgewohnheiten entsprechenden Darstellungen von Planungszielen, kann ein neues Bewusstsein für den städtischen Raum, dessen Probleme und den anschließenden Lösungsvarianten erzeugt werden.

Gerade in der jetzigen Zeit des Iconic Turns [Maar, Burda 2004], in der Bilder zunehmend Informationen und Inhalte vermitteln und an Macht gewinnen, müssen die für die gebaute Umwelt verantwortlichen planenden Disziplinen, ihre, den Lebensraum der Natur und des Menschen betreffenden Planungen, allgemein verständlich vermitteln. Tendenzen, menschheits- relevante Planungen vermehrt nur textlich zu artikulieren und zu präsentieren, überfordern den Bürger und zunehmend auch politische Entscheidungsträger. Die interaktiv bewegte, bildhafte Präsentation ist, sofern politisch gewünscht, die beste Möglichkeit der allgemein verständlichen Kommunikation aller am Planungsprozess beteiligten Akteure, weil sie mehr als alle übrigen Medien mit Präsentationscharakter die volle Aufmerksamkeit des Beobachters erzwingt.

3D-Stadtmodelle bieten hierfür die unverzichtbare Planungsgrundlage. Der Stadtraum wird neu erlebbar, transformier- und veränderbar. Bürger können sich ihr eigenes Bild über ihre Stadt, deren Probleme und eventuelle Lösungsmöglichkeiten machen. Als positiven Nebeneffekt sind Daten eines 3D-Stadtmodells - wie bereits oben beschrieben – geeignet, um sie in Bereichen wie dem Katastrophenschutz, dem Denkmalschutz, dem Tourismus etc. zu integrieren.

Touristische Angebote werden multimedial in Echtzeit präsentiert und Städte sowie deren Tourismuseinrichtungen erhalten webgestützte oder offline verfügbare neue Marketinginstrumente.

Durch die Generierung von 3D-Stadtmodellen erlangen die vorhandenen kommunalen Geodatenbestände eine ganz neue Wertigkeit. Denn durch den immer noch brach liegenden Geodatenbestand, der oft auch als kommunaler Schatz bezeichnet wird, kann durch relativ einfache Transformation der Daten neue wesentliche Information für den Bürger, Verwaltung und Wirtschaft erzeugt werden.

3D-Stadtmodelle stellen das planungsunterstützende Element der Zukunft dar und werden das Methodenrepertoire der Stadtplaner nachhaltig beeinflussen.

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Elektronische Planzeichenverordnung –Modellierung, Datenaustausch und Visualisierung von Bauleitplänen mit OGC-Standards

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ABSTRACT

Die Aufstellung von Bauleitplänen wird in Deutschland von einer Vielzahl gesetzlicher Bestimmungen geregelt. Im Rahmen der eGovernment Initiativen „Deutschland Online“ und „Media@Komm-Transfer“ wird im Projekt Elektronische Planzeichenverordnung (EPlanzV) unter der Federführung der Freien und Hansestadt Hamburg (Landesbetrieb Geoinformation und Vermessung) und des Kreises Segeberg in einer Arbeitsgruppe mit Vertretern aus kommunalen und hochschulnahen Institutionen versucht, ein geometrisch/semantisches Datenmodell und ein GML-3 konformes Austauschformat für die Festsetzungen und Regelungen der Bauleitplanung zu entwickeln. Ziel des Projektes ist es, die Interoperabilität der in der Bauleitplanung eingesetzten DV-Systeme zu verbessern, die Visualisierung der Pläne zu standardisieren, und automatisierte Auswerteverfahren für z.B. das Monitoring der Planumsetzung oder die Prüfung von Bauanträgen zu ermöglichen. Langfristig ist auch daran gedacht, den Prozess der Aufstellung, Genehmigung und Änderung von Bauleitplänen (BPlänen) durch entsprechende Datenmodelle zu standardisieren.

Der Beitrag beschreibt den Stand des Projektes, das sich bislang primär auf die Aufstellung von Bebauungsplänen nach dem Bundes-Baugesetzbuch (BauGB) konzentriert hat. Es wird die Objektstruktur des mehr als 40 punkt-, linien- und flächenförmige Einzelobjekte umfassenden Modells skizziert, und exemplarisch die Klasse „Baugebiet“ (Festsetzungen über Art und Maß der baulichen Nutzung) vorgestellt. Weiterhin wird ein Konzept zur internetgestützten Visualisierung von BPlänen vorgestellt.

Hier ist ein flexibles und für einzelne Kommunen auch anpassbares Konzept besonders wichtig. Deshalb wird daran gearbeitet, die in der Planzeichenverordnung (PlanzV) festgelegten Signaturen durch Bitmaps oder SVG-Graphiken zu modellieren, und die Visualisierung eines BPlanes durch ein SLD (Styled Layer Descriptor) Script zu spezifizieren. Eine Untersuchung der Möglichkeiten der Umsetzung der PlanzV mit Hilfe von SLD wird gegenwärtig im Rahmen des EU-Projektes FLOWS durchgeführt und definiert so einen komplementären Aktivitätsstrang zum EPlanzV-Projekt. Diese Vorgehensweise innerhalb der Projekte wird im Beitrag erläutert und mit ersten Ergebnissen illustriert.

1 EINLEITUNG

Eine moderne öffentliche Verwaltung ist Voraussetzung für den wirtschaftlichen Erfolg eines jeden Landes. eGovernment leistet dazu einen entscheidenden Beitrag. Dabei erfordert gutes eGovernment eine umfassende Integration und Optimierung der Verwaltungsprozesse – auf allen Verwaltungsebenen und ebenenübergreifend. In Deutschland steht diesem Ziel die gegenwärtig heterogene IT-Landschaft von Bund, 16 Bundesländern, über 300 Kreisen und weit über 13.000 Kommunen entgegen. Medienbruchfreie elektronische Abläufe zwischen Bund, Ländern und Kommunen sind deshalb derzeit noch die Ausnahme, nicht die Regel. Diese Situation zu verbessern ist das Ziel verschiedener Initiativen von Bund, Ländern und Kommunen wie Deutschland-Online oder Media@Komm-Transfer. Während es bei Deutschland-Online vor allem um die vertikale Integration zwischen Bund, Ländern und Kommunen geht, steht bei Media@Komm-Transfer die horizontale Verbreitung von eGovernment-Lösungen auf kommunaler Ebene im Vordergrund.

Ein in beiden Initiativen bearbeiteter Anwendungsbereich ist die Geodatenverarbeitung im Bereich der kommunalen Bauleitplanung. Die Aufstellung von Flächennutzungsplänen (FNP) und Bebauungsplänen (BPlan) wird in vielen Kommunen schon von IT-Systemen unterstützt. Die Funktionalität der eingesetzten Systeme geht aber selten über die reine Visualisierung hinaus. Obwohl die Art der Visualisierung im Prinzip durch die Planzeichenverordnung (PlanzV) bundesweit geregelt ist, haben viele Kommunen Besonderheiten bei der Darstellung kommunaler Bauleitpläne, was aufwändige Spezialanpassungen der eingesetzten IT-Systeme erfordert. Das Fehlen eines standardisierten Datenmodells und Datenaustausch-Formats verhindert weitgehend den elektronischen Plan-Austausch zwischen den Kommunen und eine effektive IT-Unterstützung beim Aufstellungsverfahren. Anwendungen des rechnergestützten Bauleitplans, die über die reine Visualisierung hinausgehen - z. B. die automatische Erstellung von Flächenbilanzen, oder die Bereitstellung spezifischer Informationen für die Immobilienwirtschaft - sind derzeit kaum möglich.

Im Teilprojekt EPlanzV der Initiativen Deutschland-Online und Media@Komm-Transfer wird deshalb die Standardisierung im Bereich der Bauleitplanung vorangetrieben. Vorrangig werden dabei die folgenden Ziele verfolgt:

Die Entwicklung eines standardisierten, objektorientierten Datenmodells für den BPlan und den FNP;

Die Entwicklung einer standardisierten Visualisierungsvorschrift („Elektronische Planzeichenverordnung“);

Die Gewährleistung des uneingeschränkten Datenaustauschs zwischen unterschiedlichen IT-Systemen (GIS, CAD, Viewer) durch Entwicklung eines standardisierten Austausch-Formats.

Dabei sind existierende gesetzliche Vorgaben wie das Baugesetzbuch (BauGB) oder die Landes-Bauordnungen genauso zu berücksichtigen wie neue Gesetzesinitiativen im nationalen oder EU-weiten Raum. Das langfristige Ziel des Projektes ist es auch, den Prozess der Plan-Aufstellung und der Verfahrensführung durch ein geeignetes Prozessmodell zu standardisieren, das als Grundlage für entsprechende Internet-Applikationen dienen kann. Die Daten-Modellierung soll auf der Basis von UML (Jeckle et al. 2004), d.h. objektorientiert und unabhängig von einer konkreten Programmiersprache erfolgen. Bei den Austauschformaten werden nationale Standards wie ALKIS oder NAS (AdV 2004) genauso berücksichtigt wie internationale Standards von ISO oder OGC.

Der vorliegende Beitrag beschreibt den Stand des Projekts, in dem bisher vor allem die Modellierung von Bebauungsplänen bearbeitet worden ist. Kapitel 2 gibt einen kurzen Überblick über die gesetzlichen Grundlagen und Rahmenbedingungen, die vom Standard zu berücksichtigen sind, und skizziert einige potentielle Anwendungen. Das Objektmodell des BPlans wird im Kap. 3 vorgestellt. Alle nach BauGB möglichen Festsetzungen sind darin als Objektklassen repräsentiert, die punkt-, linien- oder flächenhafte Geometrieelemente referieren. Beispielhaft wird die Objektklasse „Baugebiet" näher vorgestellt. Die Visualisierung von Bebauungsplänen ist Thema von Kap. 4. Es ist vorgesehen, einen Standard für die Visualisierung von BPlänen mit Hilfe der StyledLayerDescriptor (SLD) Technik zu spezifizieren. Erste Ergebnisse aus dem EU-Projekt FLOWS über Möglichkeiten und Grenzen dieser Technologie werden ebenfalls referiert. Im abschließenden Kap. 5 wird noch ein Ausblick auf die nächsten Projektschritte gegeben.

2 RANDBEDINGUNGHEN UND GESETZLICHE GRUNDLAGEN

Bei der Modellierung eines Objektmodells für die Festsetzungen der Bauleitplanung sind die Bestimmungen des Baugesetzbuches (BauGB) sowie des Raumordnungsgesetzes (ROG) maßgebend. § 9a BauGB ermächtigt das Bundesministerium für Verkehrs, Bau- und Wohnungswesen, mit Zustimmung des Bundesrates durch Rechtsverordnung Vorschriften u. a. über die Ausarbeitung der Bauleitpläne einschließlich der dazugehörigen Unterlagen sowie über die Darstellung des Planinhalts, insbesondere über die dabei zu verwendenden Planzeichen und ihre Bedeutung zu erlassen. 1990 ist die aktuell gültige „Verordnung über die Ausarbeitung der Bauleitpläne und die Darstellung des Planinhalts (Planzeichenverordnung 1990 – PlanzV 90)" in Kraft getreten. Die Terminologie der Planzeichenverordnung, d.h. Karten und Planzeichen ist noch mit der analogen, zeichnerisch manuellen Bearbeitung von Bauleitplänen verbunden.

2.1 Planwerke der Bauleitplanung

Die Bauleitplanung hat gemäß § 1 BauGB die Aufgabe, die bauliche und sonstige Nutzung der Grundstücke einer Gemeinde vorzubereiten und zu leiten. Der Flächennutzungsplan (§ 5 BauGB) als vorbereitender Bauleitplan stellt für das gesamte Gemeindegebiet die sich aus der beabsichtigten städtebaulichen Entwicklung ergebende Art der Bodennutzung nach den vorhersehbaren Bedürfnissen der Gemeinde in den Grundzügen dar. Ein Flächennutzungsplan kann in Kooperation mit benachbarten Gemeinden als gemeinsamer Flächennutzungsplan (§ 204 BauGB) aufgestellt werden. In verdichteten Räumen oder bei sonstigen raumstrukturellen Verflechtungen kann ein Plan (§ 9 Abs. 6 ROG) zugleich die Funktion eines Regionalplans und eines gemeinsamen Flächennutzungsplans übernehmen. Prominentes Beispiel für die Aufstellung eines solchen Planwerkes ist aktuell das Verfahren im Planungsverband Ballungsraum Frankfurt / Rhein-Main. Der Bebauungsplan (§ 8 BauGB) enthält die rechtsverbindlichen Festsetzungen für die städtebauliche Ordnung. Die Inhalte eines Bebauungsplanes werden in § 9 Abs. 1 BauGB abschließend aufgezählt. Die Inhalte eines Flächennutzungsplans sind hingegen offener. § 5 Abs. 2 BauGB regelt die Darstellung der Inhalte, die im Besonderen dargestellt werden können. Ebenso offen sind die Festsetzungen eines vorhabenbezogenen Bebauungsplanes (Vorhaben- und Erschließungsplan) gemäß § 12 BauGB. Im Bereich eines Vorhaben- und Erschließungsplans ist die Gemeinde nicht an die Festsetzungen nach § 9 BauGB gebunden. Neben diesen Planwerken kann die Gemeinde auch noch in kommunalen Satzungen die Nutzung von Grundstücken (z.B. § 34 Abs. 4 BauGB) oder z.B. den Erhalt baulicher Anlagen regeln.

2.2 Aktuelle gesetzliche und funktionale Randbedingungen

Als Grundlage für eine Modellierung wurden bereits die neuen Bestimmungen des EAG Bau vom 24.6.2004 beachtet. So wurde u. a. die Möglichkeit gemäß § 9 Abs. 2 BauGB berücksichtigt, festgesetzte bauliche oder sonstige Nutzungen und Anlagen nur für einen bestimmten Zeitraum als zulässig oder bis zum Eintritt bestimmter Umstände als zulässig oder nicht zulässig auszuweisen. Auch die auf erneuerbare Energien ausgerichteten Festsetzungen in Bebauungsplänen wurden in der Modellierung schon berücksichtigt. § 4c BauGB sieht in seiner seit dem 20. Juli 2004 geltenden Fassung vor, dass die Gemeinden die erheblichen Umwelteinwirkungen, die auf Grund der Durchführung der Bauleitpläne auftreten, überwachen (Monitoring). Die Grundlage der Überwachung bildet der Umweltbericht. Der Zweck der Überwachung aller erheblichen Umweltauswirkungen liegt zunächst insbesondere darin, unvorhergesehene nachteilige Auswirkungen frühzeitig zu ermitteln. Untersuchungen raumwirksamer Planungen mit ihren Bewertungen des Beeinträchtigungsrisikos für einzelne Umweltfaktoren lassen sich nur durch die Verknüpfung aller vorhandener Daten realisieren. Die Hauptlast der Informationsbeschaffung und Informationsbewertung liegt bei den Fachbehörden, die in diesem Wege die Gemeinden darüber unterrichten müssen, welche unvorhergesehenen nachteiligen Umweltauswirkungen die Durchführung der Bauleitpläne mit sich bringt. Der (digitale) Austausch von Informationen zwischen Gemeinden und Fachbehörden gewinnt damit wachsende Bedeutung. Dies macht es in Zukunft notwendig, digitale Bauleitpläne in einem einheitlichen Datenformat abzugeben, um den Integrations-Aufwand auf Seiten der Fachbehörden gering zu halten.

Die Etablierung eines Datenaustauschformats im Rahmen der Aufstellung eines Bauleitplanes wird auch vor dem Hintergrund der Bestimmungen der Abschichtungsregelung des § 2 Abs. 4 Satz 5 BauGB wichtig. Die Abschichtungsregelung hat das Ziel, Doppelprüfungen auf den verschiedenen Planungsebenen (Raumordnungs-, Flächennutzungs- oder Bebauungspläne) und bei der Vorhabensgenehmigung im Rahmen der Umweltprüfung zu vermeiden. Ist eine Umweltprüfung auf einer Planungsebene durchgeführt worden, wird die Umweltprüfung und/oder Umweltverträglichkeitsprüfung in einem zeitlich nachfolgenden oder sonst darauf aufbauenden Plan- und Genehmigungsverfahren auf zusätzliche oder andere erhebliche Umweltauswirkungen beschränkt.

Die ergänzenden Bestimmungen bzw. Ausweisungen des sich aktuell in der Diskussion befindlichen Gesetzes zur Verbesserung des vorbeugenden Hochwasserschutzes lassen sich in das Modell einarbeiten.

Das Ziel, ein geometrisch/semantisches Datenmodell und ein GML-3 konformes Austauschformat für die Festsetzungen und Regelungen der Bauleitplanung zu erstellen, lässt sich nur stufenweise erarbeiten, denn es gibt zu viele unterschiedliche Planarten. Die Arbeitsgruppe hat sich zunächst mit der Definition eines Datenmodells für Bebauungspläne beschäftigt (GML Anwendungsschema BPlan). Bebauungspläne sind auch das Tagesgeschäft der Planung, währenddessen vorbereitende Planwerke in längeren Zeitspannen neu aufgestellt werden. Allerdings sind vorbereitende Planwerke auch der zunehmenden gesellschaftlichen und wirtschaftlichen Dynamik unterworfen. Der Gesetzgeber hat darauf reagiert und sieht u. a. vor, dass Flächennutzungspläne spätestens nach 15 Jahren, soweit es erforderlich ist, geändert, ergänzt oder neu aufgestellt werden sollen. Parallel zu dieser Regelung werden Flächennutzungspläne auch aufgrund konkreter Planungsanlässe häufig geändert.

Nachdem die Modellierung der Festsetzungen eines Bebauungsplans abgeschlossen wurde und einer Qualitätssicherung unterworfen wird, beschäftigt sich die Arbeitsgruppe mit der Modellierung weiterer Objektmodelle für Vorhaben und Erschließungspläne, Flächennutzungsplanung, Übernahme von „Altplänen“ oder kommunale Satzungen. Die oben angeführte Möglichkeit der Aufstellung eines regionalen Flächennutzungsplan nach § 9 BauGB, Abs. 6 ROG als Planungsebenen übergreifendes Planwerk lässt den Bedarf an der Übernahme von Objektdaten der Flächennutzungsplanung in eine Systematik von Regionalplänen erkennen. Der Austausch bzw. die Zusammenführung von Regionalplänen ist z.B. auch auf der Bundesebene im Rahmen der Bundesverkehrswegeplanung sinnvoll. Auf der kommunalen Ebene ist die Übernahme bzw. Verarbeitung von Daten der Flächennutzungsplanung zur interkommunalen Abstimmung von Flächennutzungen wichtig. Diese ist vor dem Hintergrund des Wettbewerbs von Regionen im internationalen Wettbewerb sinnvoll.

2.3 Methodische Randbedingungen

Ein Bebauungsplan (sog. verbindlicher Bauleitplan) wird auf der Grundlage von Karten der Vermessungsverwaltung erstellt. Als Kartengrundlage werden in der Regel die digitalen Daten des automatisierten Liegenschaftskatasters (ALK) bzw. Daten digitaler Stadtgrundkarten zugrunde gelegt. Diese Daten werden über diverse Schnittstellenformate wie EDBS, dxf, shp oder dwg in die jeweiligen Zielsysteme (CAD oder GIS) zur Erstellung eines Planwerkes importiert. Die Fachverfahren ALK und das automatisierten Liegenschaftsbuch (ALB) werden aktuell als amtliches Liegenschaftskataster-Informations-System (ALKIS) integriert. Ein Datenaustausch mit ALKIS wird über die normierte Austauschschnittstelle NAS-AAA bereitgestellt. Die NAS basiert auf dem durch das World Wide Web Consortium (W3C) entwickelten XML-Standard, insbesondere XML, XML Namespaces, XML Schema, XLink, XPointer und XPath. Für die Beschreibung der Objektarten in der NAS wird die Geography Markup Language (GML), Version 3.1, des Open Geospatial Consortium (OGC) verwendet. Da Bebauungspläne in Zukunft auf dieser Datengrundlage erstellt werden und sich GML als Standard-Austauschformat zunehmend durchsetzt, hat die Arbeitsgruppe von Anfang an das Ziel formuliert, sich den Standards von ALKIS anzupassen. In wie weit Bebauungspläne in dem Fachverfahren ALKIS integriert geführt werden, muss dagegen noch diskutiert werden.

Eine Standardisierung der Vorgehensweise zur Modellierung von Anwendungen und Produkten mit geographischen Informationen (z.B. Bauleitplanung) erfolgt gemäß der ISO 19100er Normenserie. Im Einklang mit ISO 19109 (Rules for Application Schema) sollen Anwendungen mit der Unified Modelling Language (UML) modelliert werden. Dementsprechend wurde auch das Datenmodell eines Bebauungsplanes mit UML modelliert.

Gemäß dem XML- und dem darauf basierenden GML Standard werden die Objekte und deren Visualisierungvorschriften voneinander getrennt gehalten. Die Übernahme der Darstellung von einem Quellsystem in ein Zielsystem ist bis heute ein Problem. Die Darstellung der Planzeichen ist zwar de facto nach der PlanzV standardisiert, z.B. Flächenfärbung „rot mittel“ für die Ausweisung allgemeiner Wohngebiete, jedoch pflegen viele Kommunen ihre eigenen grafischen Gestaltungsvorstellungen. Auch schon zu Zeiten einer analogen, zeichnerisch manuellen Kolorierung von Plänen wurden die Vorgaben der PlanzV z.B. durch die Nutzung eines Pantone-Farbmodells interpretiert. Bei einer Novellierung der Planzeichenverordnung wäre es angebracht, die Darstellungsvorschriften auf Standard Farbpaletten für z.B. RGB Werte anzupassen.

In der Datenaustauschdatei eines Bebauungsplanes werden in Zukunft lediglich die Objektgeometrien beschrieben. Es obliegt dem jeweiligen Zielsystem, diese zu interpretieren und zu visualisieren. Dabei wird davon ausgegangen, dass die Zielsysteme in der Lage sind, die Visualisierungsvorschriften der Planzeichenverordnung umzusetzen und zu ergänzen. Die Möglichkeiten und Grenzen, diese Visualisierungsvorschriften gemäß offener Standards zu beschreiben, werden in Kap. 4 diskutiert. Im Rahmen einer interkommunalen Zusammenarbeit ist damit zukünftig die Übernahme eines Planes einer Nachbarkommune und seine Visualisierung gemäß einer eigenen Interpretation der Vorgaben der PlanzV kein Problem. Die Festsetzungen eines Bebauungsplans erfolgen bislang durch Zeichnung, Farbe, Schrift und Text. In Zukunft können alle diese Festsetzungen durch eine GML Datei beschrieben werden. Bei einem Datenaustausch werden dann Objektmodelle anstelle von Zeichnungen ausgetauscht. Da es sich bei Bauleitplänen um Rechtsdokumente handelt, müssen diese natürlich im Rahmen eines Datenaustausches vor Veränderungen geschützt werden.

3 OBJEKTMODELL BEBAUUNGSPLAN

Das Objektmodell des Bebauungsplans basiert auf dem Baugesetzbuch. Im §9 dieses Regelwerkes ist festgelegt, welche Festsetzungen überhaupt in einem Bebauungsplan getroffen werden können. Im Regelfall beziehen sich diese Festsetzungen auf genau festgelegte Teile des Planungsgebietes mit flächenförmiger, linienförmiger, oder punktförmiger Geometrie. Festlegungen, die sich auf das Planungsgebiet als Ganzes beziehen, werden im Modell nur als Text-Attribut modelliert, das dem Rahmenobjekt „BPlan“ (s. Abb. 1) zugeordnet ist.

3.1 Klassenhierarchie

Die Basisklasse für alle Einzelobjekte des BPlan-Modells ist die Klasse *BPlanObjekt*. Sie ist als abstrakte Klasse definiert, die nicht direkt instanziiert werden kann. *BPlanObjekt* ist Basisklasse dreier abgeleiteter Klassen:

BPlanGeoObjekt: Dies ist eine ebenfalls abstrakte Basisklasse, von der alle Objektklassen abgeleitet sind, die Festsetzungen mit konkretem Raumbezug modellieren.

BPlanRasterObjekt: Über diese Objektklasse kann eine georeferenzierte Rasterkarte in das Modell integriert werden. Damit können auch eingescannte Altpläne erfasst werden, deren vollständige Neu-Modellierung häufig technisch und wirtschaftlich nicht möglich ist.

BPlanSignaturObjekt: Die (abstrakte) Basisklasse für alle Signaturobjekte, die nur zur Visualisierung des Bebauungsplans benötigt werden. Im Regelfall soll die Visualisierung der Objekte direkt aus der Objektklasse und den zugeordneten Attributen abgeleitet werden, s. Kap. 4. Nur wo dies nicht möglich ist, weil z.B. ein Planzeichensymbol an einer definierten Position dargestellt werden soll, können Signatur-Objekte verwendet werden, die aber noch nicht abschließend spezifiziert sind.

Alle Festsetzungen mit spezifischem geographischem Bezug werden über Objektklassen definiert, die von *BPlanGeoObjekt* abgeleitet sind. Die nähere Spezifikation einer Festsetzung geschieht dann über Attribute der Basisklasse und der abgeleiteten Klassen. Die Basisklasse verwaltet dabei die Attribute, die für alle Festsetzungen eines BPlans von Bedeutung sind (s. Tabelle 1). Alle diese Attribute sind optional, d.h. in einer Objekt-Instanz kann der Attributwert angegeben sein, muss es aber nicht.

Attribut	**Typ**	**Bedeutung**
text	CharacterString	Textliche Festsetzung, die einer Objekt-Instanz zugeordnet werden kann
nachrichtlUebernahme	Boolean	Nachrichtliche Übernahme einer Festsetzung
aufnahmeAlsFestsetzung	Boolean	Übernahme von landesrechtlichen Regelungen als Festsetzung
bedingungStart	CharacterString	Notwendige Bedingung für die Wirksamkeit einer Festsetzung
bedingungEnde	CharacterString	Notwendige Bedingung für das Ende der Wirksamkeit einer Festsetzung
startDatum	Date	Start-Datum der Wirksamkeit einer Festsetzung
endDatum	Date	End-Datum der Wirksamkeit einer Festsetzung
bundesland	CharacterString	Bundesland

Tabelle 1: Attribute der Basisklasse

Die Attributierung der Objektklassen ist so gestaltet, dass eine definierte Erweiterungsmöglichkeit für neue Festsetzungen besteht. So enthalten z.B. fast alle Aufzählungstypen von Zweckbestimmungen den Wert „Sonstiges“, der über ein optionales Textattribut „SonstigeZweckbestimmung“ näher spezifiziert werden kann.

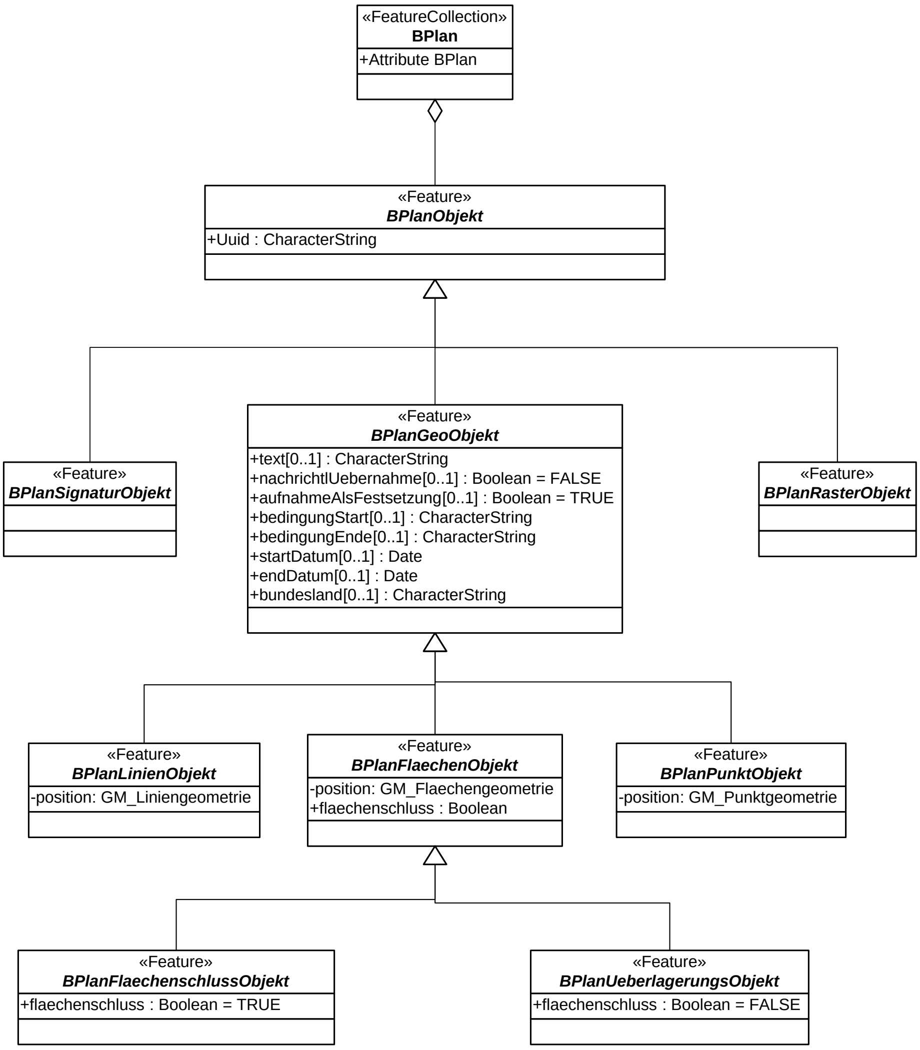

Abb. 1: Klassenhierarchie des Objektmodells

Die Festsetzungen eines BPlans können sich auf Teilflächen, Linien, oder einzelne Punkt-Positionen beziehen. Bei den flächenhaften Festsetzungen ist zu beachten, dass für jeden Teilbereich des Planungsgebietes (mindestens) eine Festsetzung getroffen werden muss, und dass sich bestimmte Festsetzungen gegenseitig ausschließen. So kann z.B. ein bestimmter Bereich nicht gleichzeitig als Gemeinbedarf-Fläche und als landwirtschaftlich genutzte Fläche ausgewiesen werden. Es gibt aber auch flächenhafte Ausweisungen, die andere Festsetzungen überlagern können oder müssen. So kann z.B. eine Fläche für die Ablagerung von Aufschüttungen und Abgrabungen (§9 Abs. 1 Nr. 17 BauGB) entweder unabhängig festgesetzt, oder innerhalb einer Gewerbegebiets-Fläche (§9 Abs. 1 Nr. 1 BauGB) ausgewiesen werden. Dagegen werden Flächen, in denen bestimmte luftverunreinigende Stoffe nicht oder nur eingeschränkt verwendet werden dürfen (§9 Abs. 1 Nr. 23 BauGB) immer im Zusammenhang mit einer Basis-Festsetzung (z.B. als Baugebiet, Gemeinbedarf-Fläche o. Ä.) getroffen werden.

Die flächenhaften Festsetzungen eines BPlans kann man damit in 2 Gruppen separieren. Eine Gruppe besteht aus den Teilflächen, die einen eindeutigen Flächenschluss bilden (Flächenschluss-Objekte), und eine zweite Gruppe (Überlagerungs-Objekte) aus den restlichen Teilflächen, die Flächenschluss-Objekte überlagern. Geometrisches Merkmal der Flächenschluss-Objekte ist, dass sich je zwei Flächen nur am gemeinsamen Rand berühren, aber nicht überlappen können, und dass die Vereinigung aller Flächenschluss-Objekte das gesamte Planungsgebiet überdeckt.

Für die Strukturierung der Objektklassen mit flächenhafter Geometrie gibt es dementsprechend drei Basisklassen (s. Abb. 1):

BPlanFlaechenObjekt: Basisklasse für Objekte, die kontextabhängig als Flächenschluss-Objekte oder als Überlagerungs-Objekte ausgewiesen werden können. Hierunter fallen u. a. Flächen mit besonderem Nutzungszweck (§9 Abs. 1 Nr. 9 BauGB), Ver- und Entsorgungsflächen (§9 Abs. 1 Nr. 12 u. 14 BauGB), Wasserrechtliche Flächen und Flächen für Wasserwirtschaft und Hochwasserschutz (§9 Abs. 1 Nr. 16 BauGB), und Flächen für Aufschüttungen, Abgrabungen, und die Gewinnung von Bodenschätzen (§9 Abs. 1 Nr. 17 BauGB).

BPlanFlaechenschlussObjekt: Basisklasse für Objekte, die immer als Flächenschluss-Objekte ausgewiesen werden. Dies umfasst Baugebiets-Flächenteile (s. Kap. 3.2), Gemeinbedarf-Flächen (§9 Abs. 1 Nr. 5 BauGB), Spiel- und Sportanlagen (§9 Abs. 1 Nr. 5 BauGB), Verkehrsflächen und Verkehrsflächen besonderer Zweckbestimmung (§9 Abs. 1 Nr. 11 BauGB), Wasserflächen (§9 Abs. 1 Nr. 16 BauGB), Flächen für Landwirtschaft und Wald (§9 Abs. 1 Nr. 18 BauGB), sowie Grünflächen (§9 Abs. 1 Nr. 15 BauGB).

BPlanUeberlagerungsObjekt: Basisklasse für Objekte, die immer als Überlagerungs-Objekte ausgewiesen werden. Hierunter fallen u. A. die Grenze des räumlichen Geltungsbereichs des Bebauungsplans (§9 Abs. 7 BauGB), Flächen mit besonderen Auflagen in Bezug auf Luftreinhaltung oder Immissionsschutz (§9 Abs. 1 Nr. 23 BauGB), oder Flächen, die mit einem Geh-, Fahr- und Leitungsrecht zu belasten sind (§9 Abs. 1 Nr. 21 BauGB).

Neben flächenhaften Festsetzungen gibt es Festsetzungen, die sich auf Linien (z.B. Einfahrtsbereich, Baulinien, Baugrenzen) oder Einzelpositionen (z.B. Anpflanzungen, Denkmalschutz-Anlagen) beziehen. Die zugehörigen Objekte sind immer als „Überlagerungs-Objekte" anzusehen und werden von den Basisklassen *BPlanLinienObjekt* bzw. *BPlanPunktObjekt* abgeleitet.

3.2 Objektklasse Baugebiet

Abb. 2 zeigt beispielhaft die Modellierung des Objektes „Baugebiet", mit dessen Hilfe Art und Maß der baulichen Nutzung (§9 Abs. 1 Nr. 1 BauGB, detailliert durch die BauNVO) modelliert werden können.

Jedes Baugebiet setzt sich aus ein oder mehreren Objekten *BaugebietFlaechenTeil* zusammen. Maßgeblich für die Objektbildung ist, dass innerhalb eines *BaugebietFlaechenTeil* Art und Maß der baulichen Nutzung konstant sind. Die Attribute dieser Objektklasse sind (s. Abb. 2):

Die Art der baulichen Nutzung nach Abschnitt 1 der BauNVO;

Die rechtliche Herkunft der Festsetzung;

Eine vorgeschriebene Bauweise (§22 BauNVO);

Die Angebe einer vertikalen Ebene, auf die sich die Festsetzung bezieht;

Festsetzungen zum Maß der baulichen Nutzung (Abschnitt 2 BauNVO);

Festsetzungen zu Gestaltungsmerkmalen, die nach verschiedenen Landes-Bauordnungen möglich sind.

Die ebenfalls regelmäßig vorgenommene Festsetzung der überbaubaren Grundstücksfläche (z.B. durch Ausweisung von Baugrenzen oder Baulinien) geschieht durch spezielle Objekte mit linienhafter Geometrie. Eine direkte Zuordnung zum *Baugebiet* oder *BaugebietFlaechenTeil* ist nicht vorgesehen, da diese Information durch eine geometrische Verschneidung gewonnen werden kann.

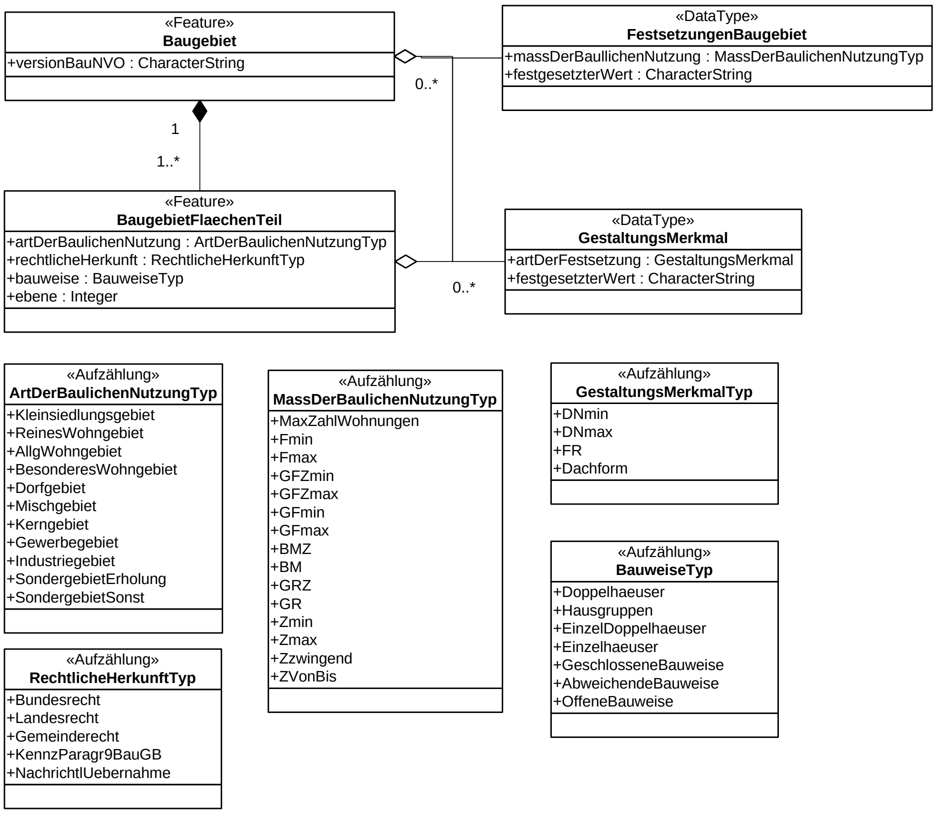

Abb. 2 Objektmodell Baugebiet

4 VISUALISIERUNG EINES BEBAUUNGSPLANS

Den allgemeinen Erstellungsprozess digitaler Karten stellt Abbildung 3 dar.

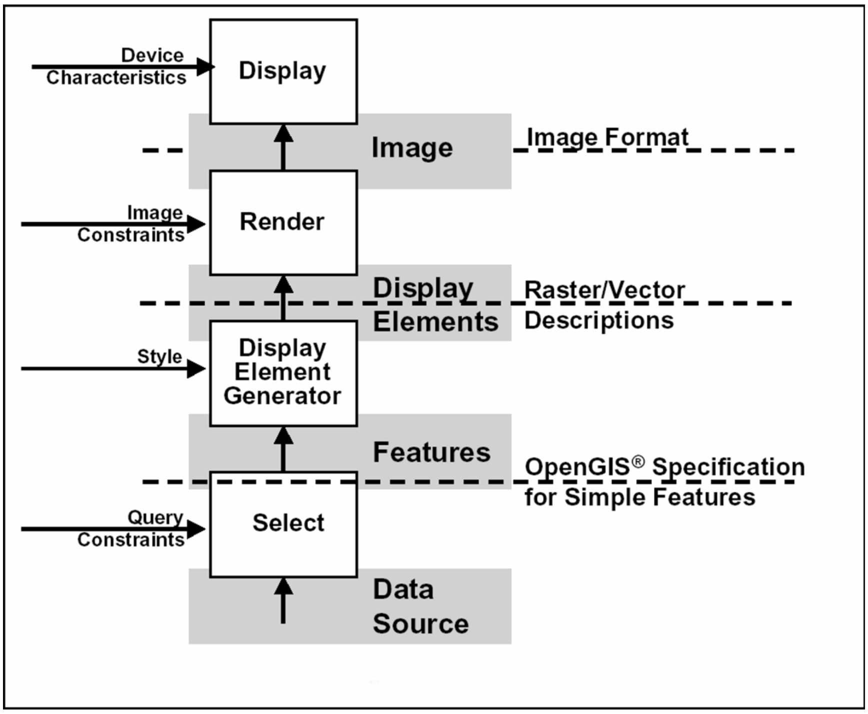

Abb. 3: Portrayal Model (aus Cuthbert 1997)

Grundlage und Rohstoff für die Kartenerstellung sind verschiedene Datenquellen („Data Source"). Dies sind Daten, die in Datenbanken mit raumbezogener Funktionalität vorliegen oder in Vektor- oder Rasterdateien gespeichert sind. Aus diesen Datenquellen und auf Basis bestimmter Anfragebedingungen („Query Constraints") wird eine Menge von Geoobjekten selektiert. Obwohl hier die „OpenGIS Specification for Simple Features" genannt wird, ist, ist diese Vorgehensweise generisch, die Erzeugung von Geoobjekten („Features") kann auch mittels anderer Schnittstellen oder Mechanismen vor sich gehen.

Die selektierte Menge von Geoobjekten wird nun durch Anwendung von Darstellungsinformationen („Style") zu Darstellungsobjekten umgewandelt („Display Elements"). Darstellungsobjekte müssen keine weiteren Informationen enthalten, außer der Angabe wie sie gezeichnet werden müssen, sie bestehen also aus Geometrien, Farben, Strichstärken etc. Darstellungselemente können spezielle Objekte einer Programmiersprache oder API sein aber auch beispielsweise SVG[65]-Elemente. Bei der Erstellung von Darstellungselementen kommt der Standard SLD ins Spiel, dieser definiert auf eine herstellerunabhängige Weise die benötigten Darstellungsinformationen.

Darstellungselemente werden dann eingeschränkt durch „Image Constraints" gerendert, das heißt sie werden gezeichnet und können so für den Nutzer dargestellt werden.

Die Trennung von Geoobjekten und ihren Darstellungsvorschriften, wie sie am Portrayal Model idealtypisch gezeigt wird bringt bestimmte Vorteile mit sich. Insbesondere können die Darstellungsvorschriften und Geoobjekte getrennt voneinander weiterentwickelt werden, wenn die Schnittstelle der beiden Komponenten wohldefiniert ist. Darüber hinaus wird hierdurch ermöglich, dass eine Darstellungsvorschrift auf verschiedene Mengen von Geoobjekten angewandt wird, ohne dass diese jedes Mal neu definiert werden müssen und es ist problemlos möglich, verschiedene Darstellungen aus einem Datensatz zu generieren.

4.1 Styled Layer Descriptors

Der OGC-Standard Styled Layer Descriptor (SLD, Lalonde 2002) definiert ein herstellerunabhängiges Format für Zeichenvorschriften. SLD selbst ist eine XML-Sprache, die mittels definierter Tags die Darstellung von Flächen, Linien, Punkten und Annotationen festschreibt. Der SLD-Standard ist eng verbunden mit dem Web Map Service (WMS)-Standard des OGC (De la Beaujardiere 2004). Über SLD-Funktionalität ist es möglich auf die Darstellung von Layern Einfluss zu nehmen, die durch einen WMS angeboten werden. Das Format kann aber daneben auch eingesetzt werden, um den Austausch von Zeichenvorschriften zwischen Desktop-Applikationen zu ermöglichen.

Der SLD-Standard ist im Umfeld des Web Mapping entstanden und dementsprechend an den WMS-Standard gekoppelt. Ein so genannter SLD-WMS erlaubt es Geodaten auf Basis von SLD zu visualisieren.

SLD definiert verschiedene Konstrukte zur Visualisierung von Geodaten. Es können Flächen, Linien, Punkte und Annotationen mit verschiedenen Farben, Strichstärken und Symbolen dargestellt werden. Für spezielle grafische Symbole ist es möglich, Pixelgrafiken (png, gif oder ähnliches) oder SVG-Grafiken einzubinden oder zu referenzieren.

4.2 Umsetzung der Planzeichenverordnung 1990

Im Rahmen des FLOWS-Projektes (FLOWS 2004) wurde untersucht, welche Möglichkeiten SLD bietet, Planungsdaten zu visualisieren, um so zu einer standardisierten Darstellung zu gelangen. Es wurden alle durch die PlanzV 90 definierten Symbole auf ihre Umsetzbarkeit mit Hilfe von SLD 1.0.0 untersucht. Die Visualierungsvorschriften konnten allerdings in Gruppen eingeteilt werden, die äquivalente Anforderungen an die Visualisierung stellen.

Die Vorgehensweise der Untersuchung sah vor, dass ein spezielles Polygon benutzt wird, um alle Darstellungsvorschriften darauf anzuwenden. Dieses Polygon musste einigermaßen typisch sein, sollte also weder eine zu einfache noch eine ungewöhnlich komplexe Geometrie beinhalten. Das Polygon wurde in einen deegree-WMS (Fitzke et al., 2004) eingebunden, der auch die benötigte SLD-Unterstützung bietet, um die Darstellungsvorschriften zu untersuchen.

Beispiele für einfache Visualisierungen sind in Abbildung 4a) und 4b) zu sehen. Dort werden Planzeichen für Gewerbegebiete dargestellt, in 4a) die farbige Variante (es wurde eine Zeichnvorschrift gewählt, die „farbig" grau ist aus Gründen des Drucks) und in 4b) die entsprechende schwarz-weiß Darstellung. Darstellungen dieser Art sind mit einem so genannten `PolygonSymbolizer` einfach umzusetzen.

Diese Visualisierungsvorschrift kann als stellvertretend für alle Planzeichen für die Art der baulichen Nutzung gelten. Die verschiedenen Flächensignaturen und deren Beschriftungen sind problemlos mit SLD darstellbar. Die einzige Problematik, die hier existiert ist dass die Annotationen beziehungsweise Symbole, so sie direkt auf ein Polygon angewandt werden, nur eingeschränkt verschiebbar sind. Es bleibt der jeweiligen Implementierung überlassen, wo das Planzeichen gesetzt wird, vorgeschlagen von Seiten des Standards wird die Benutzung des Zentroids oder eines vergleichbaren repräsentativen Punktes des Polygons. In der gerade in Entwicklung befindlichen nächsten Version des SLD-Standards wird dieses Defizit zumindest teilweise gelöst, man kann dort `GraphicSymbols` beliebig verschieben.

4c) und 4d) zeigen komplexere Visualisierungen hinsichtlich der Zeichenvorschrift für die Außenbegrenzungen. Bei beiden Nutzungsarten, Flächen für Aufschüttungen und Hochwasserrückhaltebecken, wird die Liniensignatur durch ein sich wiederholendes Symbol definiert. Hier und insbesondere in 4c kann man erkennen, worin im Detail die Probleme liegen, die PlanzV mittels SLD zu visualisieren: Die korrekte Ausgestaltung von Ecken ist schwer umzusetzen.

[65] Scalable Vector Grapics, eine XML-Anwendung zur Beschreibung von Vektorinformationen

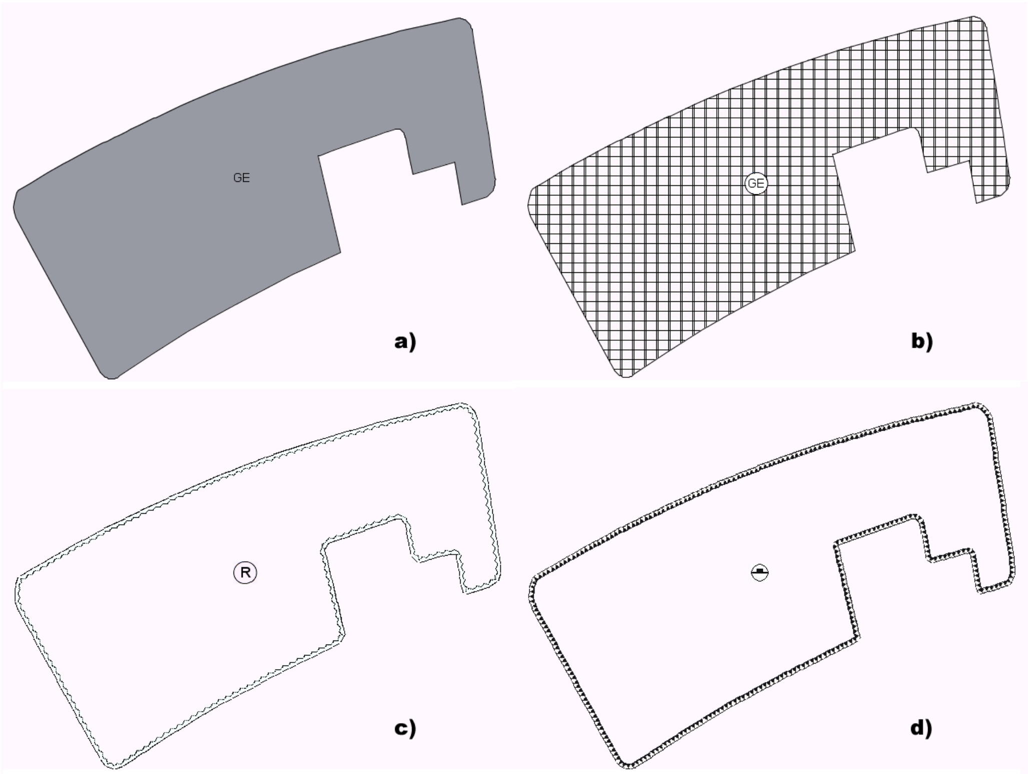

Abb. 4: Visualisierungen verschiedener Nutzungsarten

In Abbildung 5 ist aus Gründen der Anschaulichkeit das Problem noch einmal im Detail dargestellt. Komplexe Visualisierungsvorschriften für Linien werden bei SLD durch das wiederholte Zeichnen einer Pixelgrafik umgesetzt, die wieder und wieder aneinandergesetzt wird. Dies kann zu Lücken, Überschneidungen und teilweise gerundeten Ecken führen. Insbesondere die Ausgestaltung von Ecken, die durch die PlanzV sehr präzise vorgegeben ist, ist mit SLD im vorhandenen Status nicht möglich.

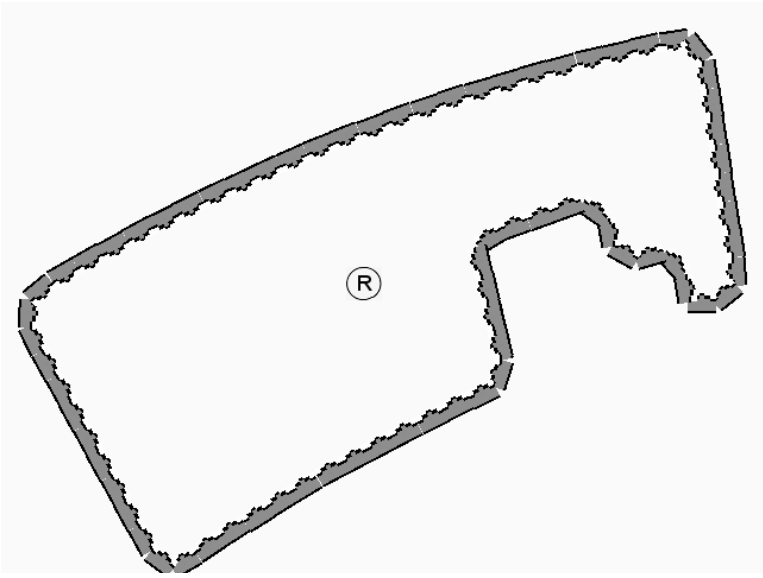

Abb. 5: SLD-Visualisierung eines Hochwasserrückhaltebeckens

Ein weiteres Problem bei der akribischen Umsetzung der PlanzV ist die Darstellungsgröße der Signaturen, die maßstabsabhängig ist. Beispielswiese sollten spezielle Liniensignaturen im Maßstab 1:1000 3 mm breit gezeichnet werden, im Maßstab 1:2000 aber nur in 1,5 mm Breite. SLD erlaubt die Definition von maßstabsabhängigen Zeichenvorschriften, wobei diese immer nur intervallweise definiert werden können. Durch diesen Mechanismus kann man für Standard-Maßstäbe dieses Problem in den Griff bekommen, es ist aber nicht möglich eine kontinuierliche Anpassung der Darstellungsgröße in Beziehung zum Maßstab zu definieren.

4.3 Ergebnisse der Untersuchung

Grundlegend ist es möglich, die PlanzV mit Hilfe des SLD-Standards umzusetzen, die Beschränkungen hierbei liegen im Detail. Insbesondere die saubere Ausgestaltung von Ecken bei komplexen Liniensignaturen ist auch mit kleineren Änderungen am SLD-Standard nicht möglich. Dies rührt daher, dass letztendlich der SLD-Standard aus einer anderen konzeptionellen Welt herrührt als die PlanzV. Die PlanzV wurde als eine Darstellungsvorschrift für analoge Kartenwerke entwickelt, die manuell oder seit der jüngeren

Vergangenheit mit CAD-Systemen hergestellt wurden, während der SLD-Standard im WebGIS-Umfeld entwickelt wurde. Die PlanzV wird normalerweise eng interpretiert, die gezeichneten Planzeichen werden sehr präzise in Bauplänen umgesetzt. Inhaltlich wäre es letztendlich nicht notwendig, eine solch akribische Umsetzung vorzunehmen, wichtig ist die äquivalente Abbildung der Inhalte.

Im Rahmen der Projektgruppe hat man sich entschlossen, über Szenarien der Darstellung der PlanzV nachzudenken, was als Teil der ePlanzV-Umsetzung zu verstehen ist. Für rechtlich nicht verbindliche, rein informative Darstellungen von Bauplänen würde der Einsatz der SLD-Technologie und die Definition vorgegebener SLD-Dokumente, die auf dem ebenfalls in der Initiative entwickelten Objektmodell aufbauen, die standardisierte und einheitliche Visualisierung von Bauplänen erlauben. Die integrierte und vollständig vergleichbare Darstellung von B-Plänen in Web, die durch verschiedene Kommunen erstellt worden sind, wird hiermit möglich.

5 PROJEKTSTAND UND AUSBLICK

Das in der Arbeitsgruppe erarbeitete geometrisch/semantische Objektmodell der Festsetzungen und Regelungen eines Bebauungsplanes hat sich stabilisiert. Das Objektmodell bedarf als nächstem Schritt einer fachlichen Qualitätssicherung durch möglichst viele Akteure. Der Kreis der einzubeziehenden Gremien reicht von den kommunalen Spitzenverbänden (Deutscher Städtetag, Deutscher Städte- und Gemeindebund, Landkreistag) über die berufsständigen Vertretungen von Stadtplanern, wie z.B. dem SRL, dem IVR oder den Architektenkammern, Experten aus dem Vermessungs- und Liegenschaftswesen bis hin zu Applikationsherstellern der Bauleitplanung aus dem CAD / GIS Umfeld. Aufbauend auf diesem Objektmodell gilt es ein GML-3 konformes Applikationsschema für einen Bebauungsplan als Basis eines Austauschformates zu entwickeln. Fachfirmen sollen möglichst schnell an den Ergebnissen der Arbeitsgruppe partizipieren können, um zu ersten Interoperabilitätstests zu kommen. Neben dieser Arbeit wird parallel die Arbeit an der Definition weiterer Objektmodelle wie z.B. ein Modell zur Beschreibung der Darstellungen eines Flächennutzungsplanes oder Vorhaben- und Erschließungsplanes fortgesetzt. Es gilt, die Standardisierungsarbeit im Jahre 2005 möglichst weit voranzubringen, um einerseits die Unterstützung der Arbeit durch die Media@Komm – Transferagentur, vertreten durch die Fa. CapGemini, und andererseits die Diskussion um die ALKIS Implementation zu nutzen. Diese gibt aktuell die Chance, einen neuen technologischen Austauschstandard auf Basis der Standards des OGC durchzusetzen, ohne eine Entscheidung über die Tiefe der Einbindung in das ALKIS Fachverfahren vorwegzunehmen. So formuliert der Leitfaden zur Modellierung von Fachinformationen unter Verwendung der GeoInfoDok u. a das Ziel: „Eine integrierte Führung von ALKIS-Daten und kommunalen Daten muss unterstützt werden, Inkonsistenzen müssen vermieden werden. Beispiel: Wenn ein Flurstück untergeht, dann müssen auch die zu diesem Flurstück ergänzend geführten Fachdaten untergehen." Dies ist natürlich für die Belange der Bauleitplanung problematisch. Die Festsetzungen eines Flurstückes dürfen auf keinen Fall untergehen.

Weiterhin gilt es zu prüfen, in wie weit das Bundesministerium für Verkehr, Bau und Wohnungswesen hinsichtlich einer aktualisierten Fassung einer Planzeichenverordnung gesetzgeberisch tätig werden sollte. Das visuelle Bild der Planzeichenverordnung ist sehr dem analogen Zeichnen mit Hilfsmitteln wie z.B. Selbstklebefolien oder –bändern verhaftet. Die Arbeit an Bauleitplänen wird mittlerweile in großem Umfang digital durchgeführt. Es hat lange genug gedauert, bis das visuelle Bild der Planzeichenverordnung computergestützt wiedergegeben werden konnte. Von einigen Programmen werden immer noch nicht alle Planzeichen digital zufrieden stellend wiedergegeben. Es stellt sich die Frage, ob man die Darstellung der Planzeichenverordnung nicht entschlacken könnte. Die Planzeichenverordnung müsste sowieso ergänzt werden, da das EAG Bau u. a. neue Festsetzungen für das Abstellen von Fahrrädern oder zeitliche begrenzte Festsetzungen ermöglicht, für den es bislang keine adäquaten Visualisierungsvorschläge gibt.

Das visuelle Bild war bislang die einzige Möglichkeit, die Inhalte eines Bebauungsplanes wiederzugeben und für andere transparent zu machen. Die fachlichen Inhalte dieses Bildes waren bislang jedoch meist nur Experten auf den ersten Blick vermittelbar. In Zukunft ist der Träger der Inhalte eines Bebauungsplans nicht mehr das Bild allein. Die Inhalte eines Bebauungsplans sind in einem Datenfile (GML Datei) beschrieben, das auf einem einheitlichen Objektmodell beruht. Auf Grundlage dieses Datenfiles könnten unterschiedliche Visualisierungsvorschriften angewandt werden, um den Inhalt eines Bebauungsplans zielgruppenspezifisch oder jeweils für ein Ausgabemedium (Bildschirm, PDA, Druck, ...) optimiert wiederzugeben. Dieses Vorgehen würde dann eine Abkehr von Karten und Planzeichen als Informationsträger hin zu interoperablen ISO-konformen Datenmodellen und Visualisierungsvorschriften bedeuten. Dieses Vorgehen ist jedoch bislang nicht durch die gesetzlichen Bestimmungen der Planzeichenverordnung gedeckt. Bebauungspläne sind rechtsverbindliche Pläne, die als Satzungen oder Rechtsverordnungen verabschiedet werden und der Unterschrift eines Bevollmächtigten (Bürgermeister, Bezirksamtsvorsteher – näheres regeln die Gemeindeordnungen der Bundesländer) bedürfen. Ein Bebauungsplan ist ein Rechtsdokument. Der semantische Inhalt eines Bebauungsplans kann in Zukunft auch durch den Datensatz eindeutig bestimmt werden. Folgerichtig müsste dann auch dieser digital signiert werden. Ein Ausdruck und eine handschriftliche Signatur sind jedoch auch in Zukunft auf alle Fälle sinnvoll, um auch die längerfristige Lagerung eines Rechtsdokuments zu ermöglichen. Die Gemeindeordnungen müssten um die Möglichkeit ergänzt werden, auch Rechtsdokumente digital signieren zu können.

Die Definition einer elektronischen Planzeichenverordnung, basierend auf einem einheitlichen Objektmodell, kann jedoch nur der erste Schritt eines eGovernment Projektes zur Unterstützung der Bauleitplanung sein. Es gilt das gesamte Verfahren der Aufstellung oder Änderung eines Bauleitplanes digital in Form einer digitalen Planungsakte zu unterstützen. Anstatt Berge von Aktenordern einer Genehmigungsbehörde zu übermitteln, sollte in Zukunft das gesamte Verfahren digital beschrieben und einer Genehmigungsbehörde elektronisch übermittelt werden können. In dieser digitalen Planungsakte wären dann alle Dokumente, die das Verfahren beschreiben, hinterlegt. Weiterhin müssten alle Beteiligungsverfahren dokumentiert werden. Ergebnisse des Media@Komm Transfer Projektes „Beteiligungsverfahren in Planungsprozessen" sollten in die Beschreibung dieses Verfahrens einfließen. Eine digitale Beschreibung und Dokumentation des Verfahrens erleichtert auch in Zukunft die Navigation in den Akten für die Allgemeinheit. Das Verfahren müsste so aufbereitet sein, dass es den Anforderungen an zukünftige Informationsfreiheitsgesetze genügt. Bürger und Bürgerinnen könnten an Terminals in der Verwaltung (unter Wahrung datenschutzrechtlicher Bestimmungen) in der Verfahrensakte eigenständig recherchieren. Dieses Verfahren würde sich in die Reihe der XÖvs Standards einreihen, z.B. als „XPlanung". Diese

Verfahren hätte dann auch eher den Charakter eines Dokumentenmanagementverfahrens (Beispiel: DOMEA). Eine genaue Festlegung auf Inhalte ist in diesem Stadium allerdings noch zu früh. Die Etablierung eines Objektmodells zur Beschreibung der Inhalte eines Bauleitplanes ist jedoch unabdingbare Vorraussetzung, um dieses zukünftige Projekt anzugehen.

An dieser Stelle möchten wir allen Mitgliedern der Arbeitsgruppen EPlanzV bzw. XPlanung sowie der Projektleitung für die äußerst produktive Gruppenarbeit der letzten Monate danken.

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🏆 **reviewed paper**

Monitoring-System „Recreational Use“ Das Beispiel Nationalpark Berchtesgaden

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ABSTRACT

Naturschutz und Erholungsnutzung („Recreational Use“) sind moderne Formen der Landnutzung. In Großschutzgebieten spielen beide eine wesentliche Rolle. Obwohl besonders in europäischen Nationalparken das Spannungsfeld „Schutz versus Erholung” weitgehend von mangelnden oder von geschätzten Daten und Informationen geprägt ist, werden die Zielsetzungen Naturschutz und Erholungsnutzung oft als unvereinbar dargestellt. Maßnahmen im Schutzgebietsmanagement benötigen aber aktuelle Situationsbeschreibungen einschließlich konkreter Zahlen und Angaben zu Ist-Zustand und Veränderungen der Erholungsnutzung. Diese können durch ein entsprechendes Monitoring des „Recreational Use“ bereitgestellt werden. Ein solches Monitoring muss über die wiederholte, systematische und objektive Messung und Beobachtung ausgewählter Parameter der räumlichen und zeitlichen Nutzungsmuster von Besuchern (Anzahl der Erholungssuchenden und ausgeübte Aktivitäten) hinausgehen. Die erhobenen Daten müssen EDV-technisch verwaltet, analysiert und präsentiert werden. In mitteleuropäischen Großschutzgebieten bestehen derzeit jedoch nicht nur bei der Erfassung von Daten zur Erholungs- und Freizeitnutzung Defizite, sondern auch bei den computergestützten Komponenten eines Monitoring-Systems „Recreational Use“.

Momentan wird für den Nationalpark Berchtesgaden ein solches System zum Monitoring landschaftsgebundener Freizeit- und Erholungsnutzung konzipiert. Grundlage hierfür ist die (konzeptionelle) Modellierung des Bewertungsobjektes „Recreational Use“. In einem weiteren Schritt erfolgt die Integration und Harmonisierung von Daten und Information aus verschiedenen Quellen (NPV, Tourismus, ÖPNV, DAV usw.) sowie deren GIS- und Datenbank-gestützte Modellierung (Geometrie-, Sachdaten und Metadaten), die Zeit- und Raummuster der Nutzungen abbilden. Dabei bietet die Realisierung mittels „Personal Geodatabase“ in dem GI-System ArcGIS von ESRI die Möglichkeit komplexe Netzwerk-Topologien und Routensysteme sowie die bestehenden Beziehungen zwischen den einzelnen Features (Besucherzahlen, Naturausstattung, Infrastruktur zur Erholungsnutzung: Wege, Hütten usw.) adäquat darzustellen. Dies verschafft den Vorteil einer angemessenen digitalen Umsetzung des objektorientierten Charakters des abstrakten Gegenstandes „landschaftsgebundene Freizeit- und Erholungsnutzung“ - also des “Recreational Use“ - und bietet langfristig eine wichtige Entscheidungsgrundlage im Management von Schutzgebieten.

1 KONFLIKTFELD MODERNER NUTZUNGSFORMEN IN NATIONALPARKEN

Naturschutz und Erholungsnutzung in ihren unterschiedlichen Ausprägungen - d.h. Tourismus, Bildungs- und Freizeitnutzung sowie, Natur- und Outdoorsportarten usw. - sind moderne Landnutzungen (BACKHAUS & KOLLMAIR 2001; JOB, METZLER & VOGT 2003). Im Englischen wird die Nutzungskategorie “Freizeit und Erholung” zusammenfassend als „Recreational Use“ bezeichnet. Hinsichtlich beider Nutzungsformen nehmen Gebiete mit Funktion des Natur- und Landschaftsschutzes eine besondere Rolle ein: Aufgrund landschaftlicher Schönheit sowie ökologischer Bedeutung sind sie nicht nur mit einem entsprechenden Schutzstatus ausgestattet, sondern sind auch – speziell in Anbetracht wachsender Beliebtheit von Natur- und Schutzgebietstourismus sowie Natursportarten – für den Menschen besonders attraktiv (MOSE 1998). Vor allem Großschutzgebiete wie Nationalparke dienen nach internationalen (IUCN-Richtlinen) und nationalen (z.B. BNatSchG §14 in Deutschland) Vorgaben zum einen der Aufgabe Natur zu schützen, zum anderen sind Erholung und Tourismus vorrangige Managementziele: Für geistig-seelische, erzieherische und kulturelle Zwecke ist der Allgemeinheit der Zugang zu ermöglichen.

In deutschen Schutzgebieten nimmt „Recreational Use“ unter den Belastungsfaktoren seit geraumer Zeit den ersten Platz ein. In Nationalparken wird die Belastungsintensität als gravierend bis bedrohend bewertet (DEUTSCHER BUNDESTAG 2002; GONZALES 2004). Die Konflikte zwischen den Nationalpark-Zielsetzungen Naturschutz und Erholungsnutzung werden als unvereinbar bezeichnet (NELSON 2004). Naturschutz und Nationalparke stehen damit heute – und weltweit - vor einem weitgehend ungelösten Problem: Einerseits ist der Kontakt des Menschen mit der Natur erwünscht (Naturverständnis fördern, mit Naturschutz-Zielen identifizieren), anderseits werden die Belastungen als nicht mehr tolerierbar bezeichnet. Für das Schutzgebietsmanagement ergeben sich damit besondere Herausforderungen (MOSE 1998; NELSON 2004).

Derzeit ist das Konfliktfeld „Naturschutz – Erholungsnutzung“ allerdings durchgängig von mangelnden Daten und Informationen geprägt, die – wenn vorhanden - meist nur auf Schätzungen, Vermutungen und Pauschalisierungen basieren (KEIREL 2002). In Schutzgebieten wird landschaftsgebundene Freizeit- und Erholungsnutzung (Quantität, Qualität, Art, räumlich-zeitliche Ausprägungen usw.) größtenteils ungenügend erfasst (WATSON et al. 2000). Dennoch werden diese Nutzungen mit zahlreichen negativen Einflüssen auf die Natur und mit ökologischen Belastungserscheinungen (Störung, Schädigung, Schwächung, Verarmung, Verlust und Belastung für Flora und Fauna usw.) verbunden (vgl. MOSE 1998; KLEINHANS 2001a; KLEINHANS 2001b). Den unterschiedlichen Nutzungsformen (Wandern, Bergsteigen, Klettern, Moutainbiken, Skiwandern, Raften usw.) müssen jedoch verschiedene Belastungsarten und –intensitäten zugewiesen werden (vgl. BFN 1997, SEEWALD, KRONBICHLER & GRÖßING 1998). Dabei ist allerdings, wie KRONBICHLER (2001) herausstellt, eine klare Unterscheidung zwischen Natursport, Freizeit und Erholung in der Regel schwierig (vgl. Abb. 1): Entsprechend dem individuellen Blickwinkel wird z.B. unter Natursport Verschiedenes - vom Ruhesuchen bis zum Hochleistungssport – subsummiert. Pauschal heißt es, dass die steigende Zahl an Ausübenden von (Trend-)Sportarten und die zunehmende Differenzierung und Individualisierung bei Outdoor– und Natursportarten (Schneeschuhwandern, Rafting, Mountainbiking etc.) dazu führt, dass Naturräume, die bisher keiner oder nur einer geringen Freizeitnutzung unterlagen, heute intensiv genutzt werden. Angaben zu Quantität und Qualität nutzungsbedingter Veränderungen liegen bisher aber nur in wenigen Fällen vor. Dennoch wird der Druck auf die Landschaft durch Freizeit- und Erholungsnutzungen als zunehmend und beinahe flächendeckend beschrieben (HAMELE et al. 1998).

Abb. 1: Formen landschaftsgebundener Freizeit- und Erholungsnutzungen in den Alpen (vgl. URL1)

Viele Aussagen zum Spannungsfeld „Naturschutz versus Erholungsnutzung" sind folglich als Verallgemeinerung und Summe von Einzelfallbetrachtungen zu verstehen, die zu Fehleinschätzungen führen können (WESSELY 2000; FALK 2003). Wie KLEINHANS (2001a; 2001b) z.B. für Natursportarten in den Alpen fordert, ist die scheinbare Unvereinbarkeit von Naturschutzbestrebungen und Erholungsnutzung kritisch zu hinterfragen. Als Grundlage und im Hinblick weitergehender Maßnahmen im Schutzgebietsmanagement werden aktuelle Situationsbeschreibungen sowie konkrete Zahlen und Angaben zum Ist-Zustand der Erholungsnutzung benötigt: Ein Monitoring zum „Recreational Use", ausgerichtet auf die einzelnen Nutzungsgruppen sowie ihre Aktionen hinsichtlich Zeit und Raum, ist für einen entsprechenden Erfolg im Management von Schutzgebieten unabkömmlich. Einem solchen Monitoring kommt in Nationalparken steigende Bedeutung zu: Es ist Grundlage für das Abschätzen der Tragfähigkeit hinsichtlich landschaftsgebundener Erholungs- und Freizeitnutzung, d.h. für „environmental carrying capacity" (LAWSON et al. 2002).

2 MONITORING DES „RECREATIONAL USE" IN GROßSCHUTZGEBIETEN

Nach LASS & REUSSWIG (2001:4) ist Monitoring "… information or data sampling which is repeated in certain intervals of time and serves certain scientific and/or management purposes. It differs from pure oberservation or from surveys due to its repeated and replicable character that enables comparison over time and the evaluation against a target". Monitoring von Erholungs- und Freizeitnutzung („Monitoring of Recreational Use") kann als erweitertes Besuchermonitoring oder ‚Monitoring of Visitor Flows' verstanden werden. Im Gegensatz zur traditionellen Erforschung der Ökosysteme spielt jedoch die systematische Untersuchung der Besucher und ihrer Nutzungen in Großschutzgebieten bisher nur eine untergeordnete Rolle. In europäischen Einrichtungen wird - außer durch sporadische und unsystematische Besuchererfassungen - ein methodisches und systematisches Monitoring der landschaftsgebundenen Nutzungskategorien „Freizeit und Erholung" über einen längeren Zeitraum bislang wenig eingesetzt.

Dabei ist ein Monitoring zum „Recreational Use" nicht nur die wiederholte, systematische und objektive Messung und Beobachtung ausgewählter Parameter zur Erholungs- und Freizeitnutzung. Außer der Erfassung der Erholungssuchenden und Freizeitaktiven, ihren Aktionen, den räumlichen und zeitlichen Nutzungsmustern und ihrem Verhalten mit Auswirkung für das Schutzgebietsmanagement mit Zielsetzung „Schutz der Natur" müssen die erhoben Daten auch verwaltet, analysiert und entsprechend aufbereitet zugänglich gemacht und präsentiert werden (ARNBERGER & HINTERBERGER 2003; CESSFORD & MUHAR 2003). Ein Monitoring bzgl. „Recreational Use" muss den gesamten Workflow (vgl. Abb. 2) von Datenerfassung bis zur Informationsbereitstellung umfassen.

Zusammenfassend kann postuliert werden, dass nicht nur ein spezielles Monitoring-Programm für die Erfassung moderner Landnutzungsformen benötigt wird, sondern ein umfassendes Monitoring-System. Wie Abb. 2 zeigt, können zwei Kernbereiche in einem modular-strukturierten Monitoring-System definiert werden:

- die Daten- und Informations-Erfassung und –Ermittlung sowie
- die EDV-technische Verwaltung, Bereitstellung und Analyse der verfügbaren Daten und Informationen.

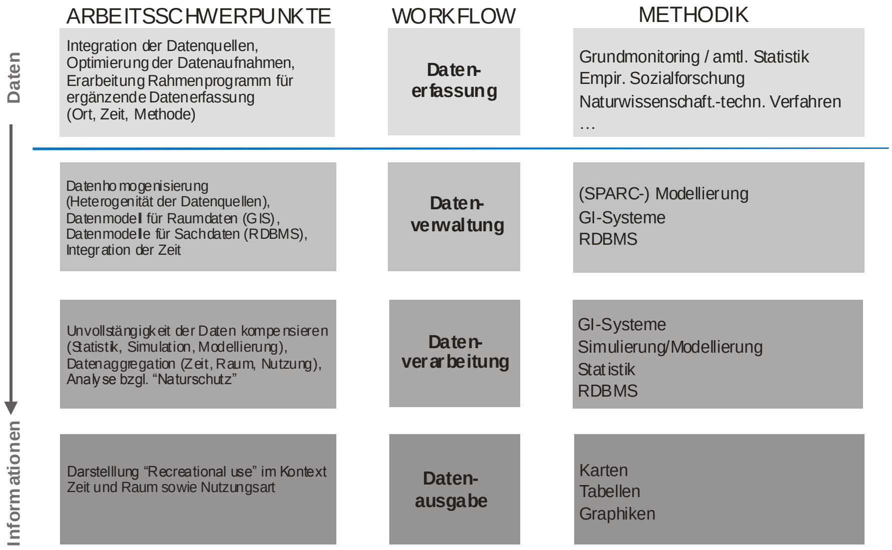

Abb. 2: Modulares Monitoring-System „Recreational Use“

2.1 Datenerfassung und ihren Schwierigkeiten

Generell gestaltet sich die Erfassung von Besucherdaten in Schutzgebieten schwierig. In Anbetracht der Flächenausdehnung und den meist zahlreichen Schutzgebiets-Zugängen sind direkte und kontinuierliche Besucherzählungen und –beobachtungen als kompliziert und fehleranfällig sowie an entfernten Orten als begrenzt durchführbar zu bezeichnen (CESSFORD & MUHAR 2003). Die Angaben zu Besucherzahlen und -dichte in Schutzgebieten beruhen daher vielfach und notgedrungen auf Schätzungen oder Zählungen, die in regelmäßigen Abständen oder stichpunktartig an ausgewählten Spitzentagen und Besucherschwerpunkten (z.B. Wanderwege, Besucherzentren und Parkplätze) durchgeführt werden (MUHAR, ARNBERGER & BRANDERBURG 2002). Neben der Ermittlung der tatsächlichen Besucherzahl gilt die Erfassung der Nutzungsintensität zur jeweiligen spezifischen Aktivität in Raum und Zeit als kritischer Punkt. Einige der derzeit geläufigen Methoden der direkten und indirekten Besuchererfassung nennt Tab. 1.

Methoden	Beispiele
Interviews	mündliche oder schriftliche Befragungen
Direkte Beobachtungen	„wandernde“ Beobachter (z.B. Ranger), feste Beobachtungspunkte
Indirekte Beobachtungen	Automat. Kameras, Video, Luftbilder, Satellitenbilder
Zählungen	Tickets, Genehmigungen, Teilnahme, druckempfindliche Matten
Selbstregistration	Wege-, Gipfel-, Hüttenbücher
Nutzungsspuren	Müll, Vegetationsschäden, Fußspuren, Erosion

Tab. 1: Besuchererfassungs-Methoden (vgl. KEIRLE 2002; MUHAR, ARNBERGER & BRANDERBURG 2002; CESSFORD & MUHAR 2003; FALK 2003)

Die endgültige Auswahl an Methoden und Techniken zur Besuchererfassung und –beobachtung sowie Vorgehensweise und Untersuchungsablauf (Zeit und Ort) erfordern in jedem Schutzgebiet einen Kompromiss zwischen Informationsbedarf und bestehenden personellen, finanziellen und materiellen Kapazitäten (CESSFORD & MUHAR 2003). Generell bestimmen Definition und Eingrenzung von Untersuchungsziel und –gegenstand (Besucherlenkung, Infrastruktur, ökosystemare Auswirkungen etc.) das Monitoring-Programm (EAGLES, MCCOOL & HAYNES 2002; MUHAR, ARNBERGER & BRANDERBURG 2002). Während in Schutzgebieten eine weite Spanne von Methoden zur Besuchererfassung diskutiert und z.T. auch angewendet wird, liegen nur wenige Beispiele für strukturierte Rahmenprogramme und Konzepte zur Datenerfassung (Methoden, Orte, Zeitpunkte) vor.

Bisher werden Themen des Naturschutzes fast ausschließlich im Naturwissenschaftlichen konkret behandelt. Übersehen wird, dass ökologische Fragen immer auch soziale Fragen sind (GONZALEZ 2004). Insbesondere für die Konzeptionierung eines Monitoring-Systems zum „Recreational Use“ müssen neben naturwissenschaftlich-technischen Verfahren auch die Humanwissenschaften (v.a. Kultur-, Sozial-, Verhaltens-, Wirtschaftswissenschaften) und ihre Methoden mit einbezogen werden (ERDMANN 2000; KRUSE-GRAUMANN 2000; KLEINHANS 2001b). Dabei ist auf Grund des wirtschaftlichen Nutzens, d.h. dem Wirtschaftsfaktor „Großschutzgebiet“ für die jeweiligen Regionen, die mit dem Schutzgebiet verbundene regionale Wertschöpfung eine wichtige Frage. Dieser wird im Regional- und Schutzgebietsmanagement bereits seit einiger Zeit mehr Bedeutung eingeräumt (vgl. JOB, METZLER & VOGT 2003; REVERMANN & PETERMANN 2003). Nicht nur die gewonnenen Daten, Informationen und Erkenntnisse, sondern auch die angewandte Erhebungsmethodik der Freizeit- und Tourismusforschung sowie der Marktforschung können als Bestandteil eines Monitoring-Systems zum „Recreational Use“ gewertet werden. GILES (2003: 7) stellt heraus, dass, „… in the context of recreation and tourism planning in parks, the process of informed decision-making has been conceptualized but, in most instances, not operationalized. Data derived from planning or policy-making studies are collected at different times, by different researchers, for different purposes, and using different units of analyses and samples. These often result in incompatibility between data sets and an under-utilization of data that could otherwise be vary valuable to administrators. Only when these data are used in combination with other information or are collected longitudinally can their usefulness be preserved and economically justified". Datenintegration und –harmonisierung sowie die Erstellung eines konkreten Monitoring-Rahmenprogramms sind dabei prinzipiell in Zusammenhang mit den computergestützten Komponeten des Monitoring-Systems zu sehen.

2.2 Computergestützte Monitoring-Komponenten und ihren Anforderungen

Für Monitoring-Systeme zum „Recreational Use" bestehen nicht nur Defizite und Probleme bei der Datenerfassung, sondern auch bei ihrer computergestützten Verwaltung, Verarbeitung und Bereitstellung; und dies sowohl hinsichtlich wissenschaftlicher Fundierung als auch der Umsetzung im Management der Schutzgebiete (LASS & REUSSWIG 2001; MUHAR, ARNBERGER & BRANDENBURG 2002; CESSFORD & MUHAR 2003). Auf Grund der Komplexität der Aufgabenstellung - Managemententscheidungen zur Lösung bestehender Nutzungskonflikte zu unterlegen – kann ein solches Monitoring-System, das Einblick in die zeitliche und räumliche Nutzungen von Schutzgebiets-Besuchern geben soll, nicht ohne EDV-Unterstützung durchgeführt werden. Einschränkungen personeller, finanzieller und materieller Ressourcen sind so teilweise kompensierbar (LAWSON et al. 2002).

Ausgangspunkt für eine edv-technische Unterstützung des Monitorings ist die Integration von verschiedenen und umfangreichen Datenquellen sowie von Geometrie-, Sach- und Metadaten unterschiedlicher zeitlicher Dimension. Die Verwendung von GIS im Hinblick auf den bestehenden Raumbezug bietet die Möglichkeit zur Analyse von Konfliktsituationen mit der Nutzung „Naturschutz". Zudem kann, wie Abb. 2 zeigt, das Monitoring-System neben der statistischen Auswertung zur Kalibrierung und Analyse der beobachteten Besucherdaten, durch die Verwendung von Proxy- oder Indikatorvariablen (z.B. Wetter, Schnee- und Lawinensituation) sowie durch den Einsatz von Modellierungs- und Simulationswerkzeugen unterstützt werden (vgl. ENGLISH et al. 2003).

Es ist jedoch zu bemerken, dass - obwohl der Einsatz in der Umweltplanung weit verbreitet ist – bei Erholungsnutzung und Tourismus die Verwendung von Datenbanken, GIS sowie Modellierungs- und Simulationswerkzeugen bisher gering ist. Neben der Inkonsistenz der Daten besteht ein genereller Mangel an touristischen Datenbanken und der computergestützten Abbildung räumlicher Muster von Erholung und touristischem Nutzen (z.B. „level of use") (GILES 2003). Bis heute erfolgt die Integration der Zeit als weiterer Dimension in GIS gar nicht oder nur unzureichend (ROOSMANN et al. 2004). Dies stellt eine Herausforderung für ein Monitoring-System dar, dessen zu analysierender Gegenstand in verschiedener Weise von der Zeit (Saison und Tageszeit, Nutzungsdauer) bestimmt wird. Wesentliche Grundlage für jede weitergehende EDV-technische Anwendung unter Berücksichtigung der räumlichen, zeitlichen und spezifischen Formen der Erholungsnutzung ist damit zunächst die Bereitstellung geeigneter räumlicher und nicht-räumlicher Datenmodelle, die auch den Anforderungen seitens der vierten Dimension Zeit gerecht werden.

3 MONITORING-SYSTEM „RECREATIONAL USE" IM NATIONALPARK BERCHTESGADEN

Für das alpine Großschutzgebiet Nationalpark Berchtesgaden (vgl. Abb. 3) wird momentan ein Monitoring-System für landschaftsgebundene Freizeit- und Erholungsnutzungen entwickelt. Ein Rahmenkonzept zur systematischen und methodischen Erfassung und Ermittlung sowie computergestützten Verwaltung, Verarbeitung und Darstellung von Daten zu den in dem Schutzgebiet relevanten Formen des „Recreational Use" wird erarbeitet. Dieses muss den einzelnen Nutzungen mit ihren räumlichen und zeitlichen Abhängigkeiten sowie den vorhandenen personellen, finanziellen und materiellen Ressourcen der Nationalparkverwaltung entsprechen. Im Vordergrund steht so wenig wie möglich personelle Zählungen durchzuführen oder neu zu installierende Zählvorrichtungen (z.B. Lichtschranken) zu verwenden. Insbesondere auf Grund der langen und intensiven touristischen Nutzung des Gebietes können Datenquellen anderer Einrichtungen (Gemeinden, DAV usw.) als der Nationalparkverwaltung (NPV) herangezogen werden. Die computergestützte Aufbereitung der Daten unter Berücksichtigung der räumlichen, zeitlichen und spezifischen Form der Erholungsnutzung ist die Grundlage weiterer EDV-technischer Anwendungen.

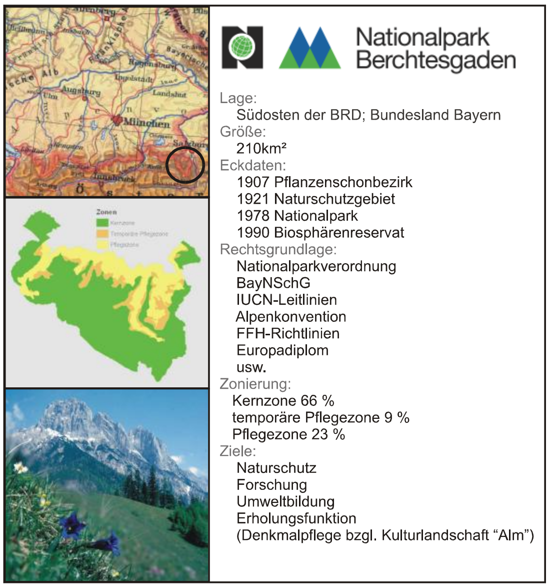

Abb. 3: „Steckbrief" Nationalpark Berchtesgaden (Quelle: HENNIG 2004)

3.1 Das Bewertungs-Objekt „Recreational Use“

Wie oben erwähnt, bestimmen Definition und Eingrenzung von Untersuchungsziel und -gegenstand das Monitoring-Programm (Vorgehensweise und Methodik). Die computergestützten Komponenten des Monitoring-Systems (Datenverwaltung, -analyse und –bereitstellung) verlangen als weiteren Schritt nach der Definition des Untersuchungsgegenstandes für seine digitale Abbildung die Modellierung des Analyse-Objekts „Recreational Use“. Dabei wird in Bezug auf seine relevanten Aspekte das konkrete Bewertungsobjekt „Recreational Use“ aufgelöst, um Informationen zu Struktur und Funktionen zu gewinnen und zu betrachten. Das Modell wird aus der Gesamtheit der zur Verfügung stehenden Informationen entwickelt, ohne dass es alle Informationen enthalten kann oder muss (POSCHMANN et al. 1998). Die wichtigen Komponenten des Objektes „Recreational Use“ zeigt Abb. 4. Die Erholungs- und Freizeitnutzung wird dabei durch die Zahl der Ausübenden mit ihrem räumlichen und zeitlichen Bezug ermittelt. Um die vorhandene Kontextsensitivität zu gewährleisten, müssen Information über diese vorhanden sein, wie es z.B. KRÖSCHE & BOLL (2004) diskutieren. Die Kontextsensitivität wird anhand von Regeln (Regelsystem Nutzung) basierend auf Proxydaten und Expertenwissen beschrieben.

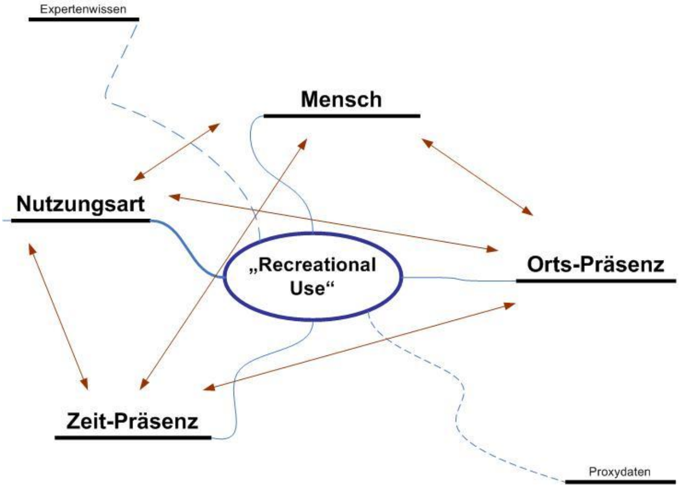

Abb. 4: „Brainstorming“ Bewertungs-Objekt „Recreational Use“

3.1.1 Mensch

Im Bewertungs-Objekt „Recreational Use“ führt der Mensch die einzelnen Nutzungen orts- und zeitgebunden aus. Dabei können diese Menschen anhand verschiedener Eigenschaften, d.h. sozioökonomische und demographische Parametern sowie Aufenthalts- und Nutzungsmerkmale, beschrieben werden. Durch statistische Analysen werden die einzelnen Formen der Erholungsnutzung bzw. Schutzgebietsbesucher beschrieben, Besuchergruppen mit differenziertem Charakter, Erwartungen, Motiven, Aktivitäts- und Nutzungsverhalten werden identifiziert (EAGLES, MCCOOL & HAYNES 2002). Zur Verfügung stehen die zugehörigen Daten durch statistische Erhebungen (Sozialempirie), Expertenwissen und Literaturangaben. Dabei steht die Art der Nutzung, Orts- und Zeit-Präsenz in Abhängigkeit der einzelnen „Menschen-Gruppen“ (z.B. Familien, Ferienzeit, Wandern). Angaben dieser Art sind als Regelsystem der Nutzung zu verstehen.

3.1.2 Nutzungsart

Die verschiedenen Nutzungsarten können durch Expertenwissen und Literatur (z.B. Sportwissenschaften) u.a. hinsichtlich Infrastruktur, Anforderungen, Zeit- und Orts-Bindung, Dauer, Organisationsform, Auswirkungen, Naturintensität, den (ausübenden) Menschen und Bedingungen, z.B. seitens Wetter und Schnee beschrieben werden. Dabei werden nicht alle Nutzungsformen von jeder „Menschen-Gruppen“ durchgeführt. In der Regel bestehen spezifische Zeit- und Orts-Bindungen (Skitouren im Winter; Wandern auf dem Wegenetz).

3.1.3 Orts-Präsenz

Neben der natürlichen Attraktivität des Schutzgebietes sind das Inventar mit künstlichen Einrichtungen und Service-Angeboten eindeutig zu verortende Phänomene, die von bestimmten Besuchergruppen zu bestimmten Zeit sowie bestimmter Nutzung aufgesucht werden. Wege, Parkplätze, Hütten und Gästehäuser, Beschilderungen, Lehrpfade sowie Aussichtspunkte, Gipfel usw. müssen mit Geometrie-, Sach- (Klassifikationen, Fassungsvermögen, Zuständigkeit usw.) und Metadaten, Informationen und Regelsysteme zu ihrer Nutzungsrelevanz (Saison- und Wetterabhängigkeit, Öffnungszeiten Nutzungsart etc.) vorliegen.

Die Bereitstellung geeigneter Geometrien für die räumliche Repräsentation von Inventar und Service verlangt eine Geodatenbasis gemäß den Anforderungen eines Monitoring-Systems zum „Recreational Use“. Dies erfolgt u.a durch Digitalisierung aus aktuellen Orthophotos unter Einbeziehung von Expertenwissen (z.B. relevantes, saisonabhängiges Wegenetz, Skitoren-Aufstiege und -Abfahrten) sowie GPS-Messungen (z.B. Parkplätze). Anhand von Kartenmaterial, Literatur (Berg-, Touren- und Hüttenführer) und Expertengesprächen sowie Geländeerhebungen und –beobachtungen resultiert die entsprechende Informationsbereitstellung hinsichtlich Sachdaten und Regelsystem.

3.1.4 Zeit-Präsenz

Die einzelnen Nutzungen, Nutzungsgruppen und aufgesuchten Orte stehen in Abhängigkeit der Zeit, wie z.B. Jahreszeit, Saison, Ferienzeit, Wochentage, Tageszeit. Des Weiteren kann die Anzahl der Erholungs- und Freizeitaktiven unterschiedlich bzgl. Tagen, Wochen, Monaten, Saison oder Jahren aggregiert werden. Auch spielt die Zeit hinsichtlich der Nutzungsdauer eine Rolle.

3.1.5 Proxydaten

Die lückenlose Erfassung von „Recreational Use“ ist derzeit auf Grund der oben genannten Schwierigkeiten (zahlreiche Gebietszugänge, abgelegene Gebiete, Gebietsausdehnung, personelle und finanzielle Beschränkungen) nicht möglich. Die Kontinuität der Datenverfügbarkeit kann über die Einbeziehung von Indikatorvariablen (Wetter, Schnee, Lawinensituation usw.) verbessert werden. Anzahl, Verteilung, Nutzungsart und Verhalten der Besucher in Raum und Zeit können mit ihrer Hilfe unter Verwendung entsprechender Werkzeuge modelliert bzw. simuliert werden.

3.1.6 Expertenwissen

Nicht nur die Integration von im GIS vorliegendem digitalem Datenmaterial und der in nicht-räumlichen Datenbanken verwalteten Besucherzahlen ist relevant. Vielmehr kommt der EDV-gestützten Bereitstellung von Expertenwissen zur raum-zeitlichen Ausprägung der einzelnen Formen des „Recreational Use“ (Regelsystem zur landschaftsgebundenen Erholungs- und Freizeitnutzung) Bedeutung zu. Die entsprechenden Akteure können Auskunft geben über das Nutzungsverhalten der Besucher, die Frequentierungen von Inventar und Service. Die einzelnen Formen der Erholungsnutzung, d.h. der Schutzgebietsbesucher können detaillierter beschrieben, Besuchergruppen mit differenziertem Charakter, Erwartungen, Motiven, Aktivitäts- und Nutzungsverhalten identifiziert werden. Dies ermöglicht unter Hinzunahme von Literatur, Kartenmaterial sowie Geländeerhebungen und –beobachtungen die Ableitung von Profilen und Regeln bzgl. der einzelnen Formen der Erholungsnutzung sowie der Besucher.

3.2 Daten- und Informationslage: Ausgangssituation im Berchtesgadener Land

Umfangreiche Daten und verschiedene Datentypen müssen für das Monitoring-System zur Verfügung gestellt werden. Dabei besteht durch den Nationalpark und verschiedene tourismusnahe Einrichtungen eine gute Ausgangssituation (vgl. Abb. 5), die dem Schutzgebietsmanagement zur Analyse räumlicher und zeitlicher Muster der Besuchernutzung dienen kann:

Zahlen und Angaben zu Schutzgebietsbesuchern mit räumlicher und zeitlicher Präsenz und Aktivitätsform,

Informationen zu Inventar bzgl. Einrichtungen und Angeboten im Nationalpark, nationalparknahen und angrenzenden Gebieten sowie

Regeln zur Nutzung (Zeit und Raum) aus Beobachtungen und Expertenwissen, Literatur und Kartenmaterial.

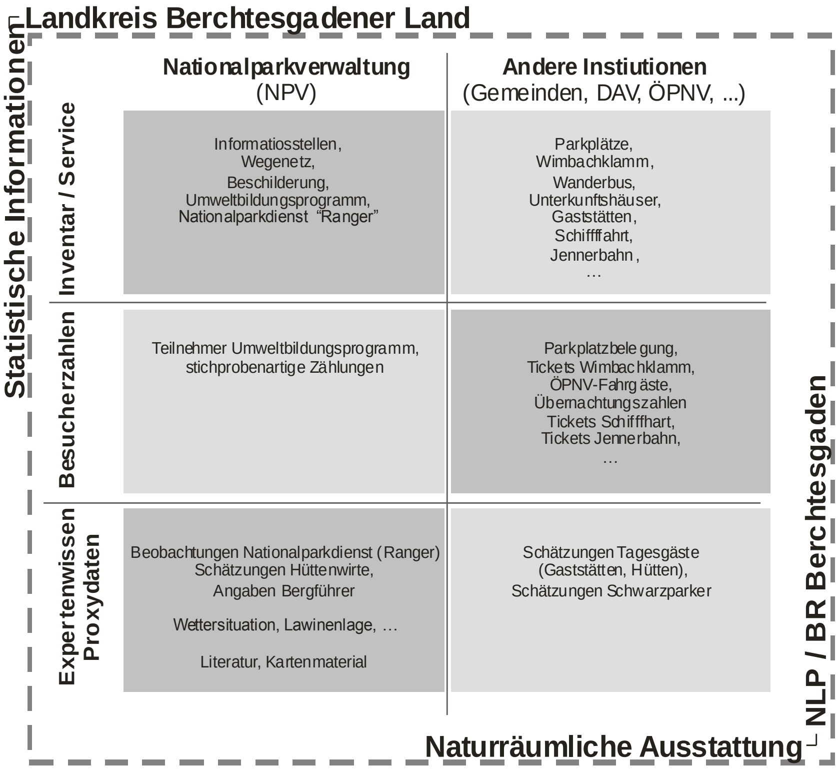

Abb. 5: Bestehende Daten- und Informationsquellen für das Monitoring-System „Recreational Use“

3.2.1 Nationalpark Berchtesgaden

Der 1978 eingerichtete, im Südosten des Freistatt Bayern gelegene Nationalpark Berchtesgaden (IUCN-Kategorie II) wurde 1992 zusammen mit seinem Vorfeld auf die Liste der UNECSO Biosphärenreservate aufgenommen (vgl. StMLU 2001). Derzeit wird von

1,13 Mio. Schutzgebiets-Besuchern, vorrangig in den Sommermonaten, ausgegangen. Ermittelt wird diese Zahl vorwiegend aus den Infostellen-Besuchern, Fahrkarten der Königssee-Schifffahrt und Jenner-Bergbahn, Hütten-Übernachtungen sowie Parkplatzbelegungen (JOB, METZLER & VOGT 2003).

Bereits im Rahmen des UNESCO Forschungsprogramms „Man and Biosphere“ (1981–1991) fanden mit dem Projekt „Der Einfluss des Menschen auf die Hochgebirgsökosysteme“ (MAB 6) u.a. Untersuchungen zu Besuchern und ihrem Verhalten im Nationalpark statt. Zudem liegen zahlreiche andere Arbeiten zu diesem Thema vor. Eine aktuelle zusammenfassende Bewertung der Erholungsnutzung bzgl. Sommer- und Wintersaison findet sich im Nationalparkplan (StMLU 2001). Während die Angaben zu Besuchszahlen und –intensität (Sachdaten) saisonbezogene Schätzungen (Personen/Tag) sind, handelt es sich bei den zugehörigen Raumdaten (Wegenetz, Hütten, Infostellen usw.) um konkrete Phänomene, die im GIS der Nationalparkverwaltung verwaltet werden.

3.2.2 Tourismus

Das Berchtesgadener Land blickt auf eine lange Zeit touristischer Nutzung zurück. Wie in anderen Gebieten der Alpen kann - gemäß den sechs Phasen alpinen Tourismus (BÄTZING 2003)– auch in Berchtesgaden eine erste touristische Expansions- und Erschließungsphase ab 1880 definiert werden. Dabei steht die alpine Erschließung in Zusammenhang mit der Gründung der Sektion Berchtesgaden im Jahr 1875. Wie vor 100 Jahren bezieht sich auch heute das touristische Potential Berchtesgadens primär auf die Naturausstattung des Gebiets (Watzmann, Königssee, Jenner usw.).

Auf Grund der Bedeutung der touristischen Wertschöpfung wurden und werden seitens der verschiedenen, im Tourismussektor tätigen Einrichtungen (Kurverwaltung, Tourismus GmbH Berchtesgadener Land, Gemeinden, Königssee-Schifffahrt, Jennerbahn, DAV, Naturfreunde, RVO usw.) zahlreiche Erhebungen, vor allem sozioökonomische Erfassungen und Zählungen, durchgeführt. Umfangreiches Daten- und Informationsmaterial liegt vor.

Die Tab. 2 gibt zusammenfassend einen Überblick zu Daten- und Informationsquellen mit Bezug auf das Großschutzgebiet und Gebiete außerhalb des Nationalparks. Neben der wichtigen Grundlage, die sie für das Monitoring spielen, sind sie gleichzeitig eine Herausforderung: zum einen hinsichtlich der Integration und Harmonisierung der verschiedenartigen Daten und zeitlichen Dimension der Daten (Tag, Woche, Monat, Saison; Dauer) in das System; zum anderen in Bezug auf eine Zusammenarbeit mit und zwischen den einzelnen Einrichtungen.

Datenquellen	Zuständigkeit	Aufnahmeart	Probleme	Zeitdimension
Forschungsprojekte, Nationalpark-Plan GIS der NPV	NPV, Universitäten, Forschungseinrichtungen	Verschieden	Historisch, verschied. Erhebungsmethodik	
(bewirtschaftete) Unterkunftshäuser	Hüttenbücher, Übernachtungszahlen (DAV, Wirt) Tagesgäste (DAV: M, BGL, TS, SON, Naturfreunde, Wirte)	Freiwillige Registrierung Zählungen Schätzungen, Zählung, Kalkulationen	Genauigkeit, Subjektive Eindrücke	Nach Saison bis täglich
6 Informationsstellen (3 personell besetzt)	NPV	Personelle Zählungen	Nebentätigkeit zur Besucherbetreuung	2-stündig
9 Parkplätze (7 kostenpflichtig)	Gemeinde Ramsau und Schönau	Parkscheinautomat	Schwarzparker, „Notparkplätze“, Parken mit Kurkarte	Täglich bis monatlich
RVO-Fahrgastzahlen	RVO (Deutschland)	Fahrscheinverkauf		
Wimbachklamm	Gemeinde Ramsau	Eintritte		Nach Saison
Königssee-Schifffahrt		Ticketverkauf		
Gaststätten im NLP			Subjektive Eindrücke	
Jenner-Bergbahn		Ticketverkauf		
Almen			Subjektive Eindrücke	
Stichproben-Zählungen	NPV, DAV-Sektionen, Gemeinden		Personalkosten	
Statistische Basisdaten	Statistisches Landesamt			
DWD Wasserwirtschaftsamt	Wetterdaten Schnee- und Lawinensituation			
Expertenwissen Literatur, Kartenmaterial, Geländeerhebungen	NPV (Nationalpark-Dienst), Hütten-, Gastronomiewirte, DAV-Sektionen, Bergführer, ...			

Tab. 2: Auswahl an monitoring-relevanten Institutionen

3.3 Datenmodell „Recreational Use“

Die computergestützte Aufbereitung der Daten unter Berücksichtigung der räumlichen, zeitlichen und spezifischen Form der Erholungsnutzung (vgl. Abb. 3) ist die Grundlage weiterer EDV-technischer Anwendungen. Für die computergestützte Integration werden spezielle Strukturen und Modelle für Verwaltung, Analyse und Präsentation raumbezogener (GIS) als auch nicht-raumbezogener (Datenbanken) Monitoring-Daten benötigt. Dementsprechend sind als ein wichtiger Arbeitsschritt geeignete Datenmodelle für die Verwaltung der temporären und räumlichen Abhängigkeiten zu konzipieren.

Die Realisierung mittels „Personal Geodatabase“ oder „Recreational Database“ in dem GI-System ArcGIS von ESRI bietet die Möglichkeit auch komplexe Netzwerk-Topologien und Routensysteme sowie die bestehenden Beziehungen zwischen den einzelnen Features (Besucherzahlen, Naturausstattung, Infrastruktur zur Erholungsnutzung: Wege, Hütten usw.) angemessen darzustellen. Dies verschafft den Vorteil einer adäquaten digitalen Umsetzung des objektorientierten Charakters des abstrakten Gegenstandes “Recreational Use“ (vgl. Abb. 6) mit Hilfe entsprechender Werkzeuge, wie z.B. Microsoft Visio.

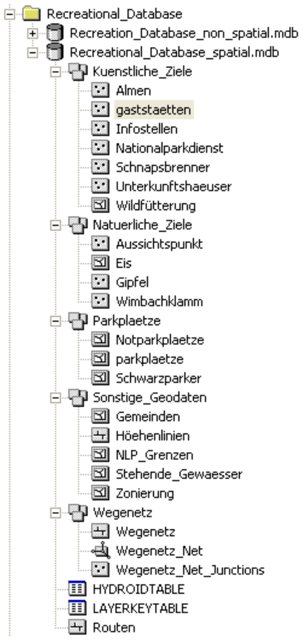

Abb. 6: Ansicht „Recreational Database“ in ESRIs ArcGIS / ArcCatalog

Einen Einblick in das Datenmodell der nicht-räumlichen Daten hinsichtlich der Objekte „Nutzung“, „Mensch“, „Ortspräsenz“ und „Recreational Use“ – modelliert mittels Microsoft Visio – zeigt Abb. 7. Anhand verschiedener Views können unterschiedliche Aggregationsstufen der Zeit realisiert werden

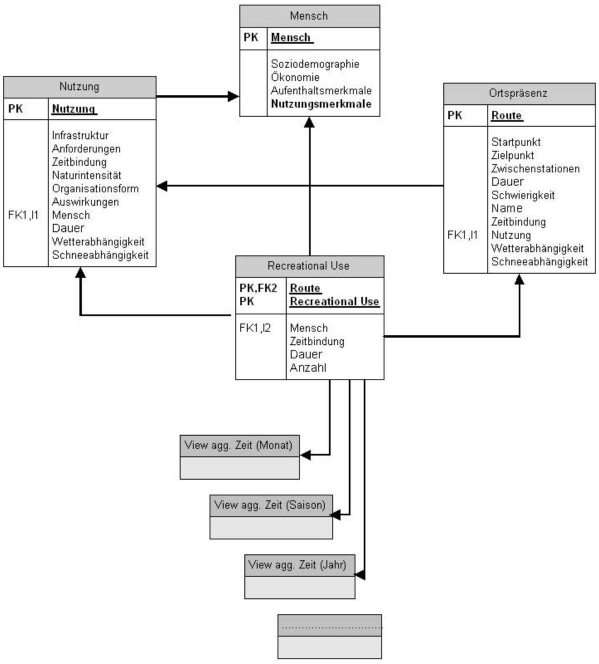

Abb. 7: Datenmodell der nicht-räumlichen Daten

Die ebenfalls in der „Recreational Database“ verwalteten Geodaten (Inventar und Service) umfassen bisher die folgenden Themen (vgl. Abb. 6):

- Parkplätze,
- Wegenetz,
- Natürliche Ausstattung oder Ziele (Eis, Gipfel, Aussichtspunkte)
- Künstliche Ausstattung oder Ziele (Almen, Gaststätten, Unterkunftshäuser, Brennhütten, Infostellen, Wildfütterung, Nationalpark-Dienst (Ranger) usw.),
- Sonstige Geodaten (Gemeindegrenzen, Nationalparkgrenzen, Nationalpark-Zonierung, Höhenlinien, stehende Gewässer).

Besonderes Interesse kommt der Umsetzung des Wegenetzes zu, wie Abb. 8 zeigt. Es wird, um sowohl der durch die Besucher genutzten Wegrichtung gerecht zu werden als auch um die Abspeicherung von „Nutzungs“-Routen zu ermöglichen, in Form eines Netzwerkdatenmodells umgesetzt. Durch die Zuweisung der einzelnen Wegabschnitte zu verschiedenen „Nutzungs“-Routen erfolgt die Anbindung der nicht-räumlichen Daten der Tabelle „Ortspräsenz“ und „Recreational Use“ an die räumlichen Daten des Wegenetzes.

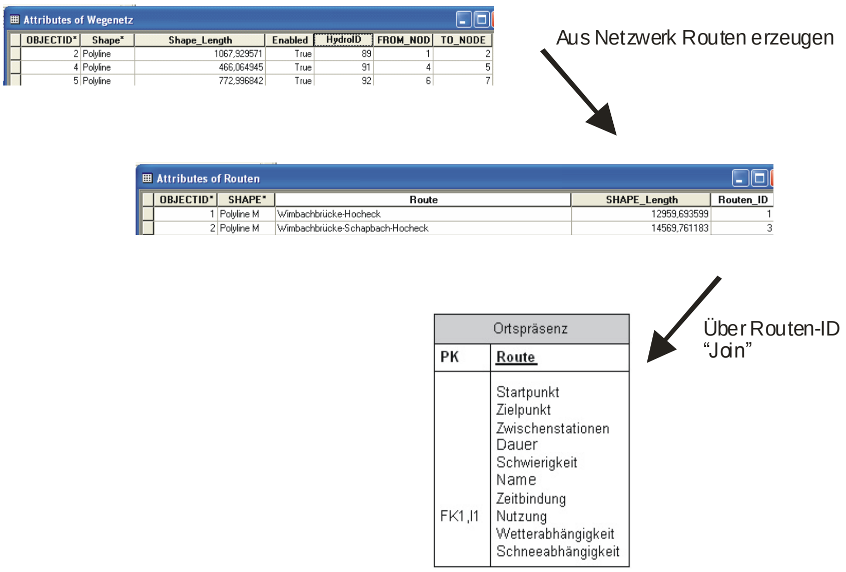

Abb. 8: Datenmodell „Ortspräsenz“ bzw. „Routen“

4 AUSBLICK

Vorrangiges Ziel des Monitoring-Systems „Recreational Use“ ist die Unterstützung von Managemententscheidungen zur Schutzgebietsplanung hinsichtlich „environmental carrying capacity“ und die Lösung bestehender Nutzungskonflikte zum Naturschutz. Hierfür soll das Monitoring-System Daten und Informationen liefern: Veränderungen im Laufe der Zeit sollen nicht nur identifizierbar, sondern auch bewertbar sein. Der Schritt von „observation“ zu „monitoring“ als systematische langzeitliche Erfassung bis hin zum „acting“ ist zu vollziehen. Über die Kombination von räumlichen und nicht-räumlichen Daten zu Inventar und Service, Besucherzahlen, Proxydaten und Expertenwissen unter der Berücksichtigung temporaler Aspekte und der Nutzungsform kann der Schutzgebietsplanung eine fundierte Grundlage zu den verschiedenen Arten der modernen Landnutzungsformen “Recreational Use“ zur Verfügung gestellt werden. Eine sukzessive Verbesserung des Systems muss und wird angestrebt werden.

Die computergestützte Datenaufbereitung und Verarbeitung kann mangelndes Wissen zum „Recreational Use“ identifizieren. Insbesondere unter erweiterter Einbeziehung von Proxyvariablen und Expertenwissen und durch den Einsatz von Modellierungs- und Simulationswerkzeugen kann eine lückenlosere Datenbasis zur Erholungsnutzung erstellt werden. Dies erlaubt die Erarbeitung eines speziell abgestimmten Rahmenprogramms zur Datenerfassung und -optimierung bzgl. der bereits laufenden Ermittlungsverfahren in Zusammenarbeit zwischen Nationalparkverwaltung und anderen Institutionen. Dabei ist zukünftig die Integration und Harmonisierung des Systems mit Daten aus den auf österreichischer Seite an den Nationalpark grenzenden Gebieten als Notwendigkeit zu bewerten. Dies kann, auch in weiterer Konsequenz, als Chance für die „EuRegio Salzburg - Berchtesgadener Land - Traunstein“ für die Erzeugung von Synergien im Tourismussektor zum Alleinstellungsmerkmal Nationalpark gesehen werden.

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Räumliches Monitoring – Anwendungsmöglichkeiten und Perspektiven in der Regionalplanung am Beispiel der Region „CENTROPE"

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KURZFASSUNG

Im Zuge des Projektes „CENTROPE Map" wird besonderes Augenmerk auf den Bereich räumliches Monitoring gelegt, da dieses Thema entscheidend zur künftigen Entwicklung der Kooperationsmöglichkeiten in der Region beiträgt. Daraus ergibt sich ein Teilprojekt, das sich mit der Auslotung der Möglichkeiten für räumliches Monitoring am Beispiel der Region „CENTROPE" beschäftigt. Die grenzüberschreitende „CENTROPE"[66] Region besteht aus den österreichischen Bundesländern Wien, Niederösterreich und Burgenland, den tschechischen Kreisen Jihomoravský (Südmähren) und Jihoceský (Südböhmen), den slowakischen Kraje (Kreisen) Bratislavský und Trnavský sowie den ungarischen Komitaten Györ – Moson– Sopron und Vas, wobei die Grenzen einer solchen Region natürlich fließend sind. Beim räumlichen Monitoring geht es um die Nutzung laufend erhobener Daten, die eine Analyse des Zustandes und der Entwicklung des Raumes in verschiedenen Sachbereichen wie Demographie, Wirtschaft, Infrastruktur, Versorgung und Umwelt erlauben. Räumliches Monitoring dient zunächst Planern und politischen Entscheidungsträgern in Fragen der räumlichen Planung als entscheidungsunterstützendes Instrument, in weiterer Folge ist es durchaus möglich, dass auch Unternehmen die Ergebnisse z.B. für Standortentscheidungen nutzen können. Die Ergebnisse der Umsetzung reflektieren die große Bandbreite des Einsatzbereiches von räumlichem Monitoring im Bereich der Regionalplanung. Außerdem werden Besonderheiten und Probleme im Zusammenhang mit dem Thema diskutiert und mögliche Perspektiven von räumlichem Monitoring beleuchtet.

1 EINLEITUNG

Die meisten europäischen und amerikanischen Städte kämpfen mit dem Phänomen der Zersiedelung und dem Entstehen so genannter Satellitenstädte[67]. Durch eine seit Jahren andauernde Landflucht kommt es zu einem Bevölkerungswachstum in den Stadtregionen (oft bei stagnierender oder sinkender Einwohnerzahl der Kernstädte) was eine zusätzliche Herausforderung für die Stadtentwicklung und v.a. an die Regionalplanung darstellt[68]. Der Erweiterung der EU schafft neue Möglichkeiten der Zusammenarbeit zwischen Regionen, die bisher durch Grenzen getrennt waren. Um bestehende Probleme der Regionalplanung zu lösen, aber auch um Herausforderungen an zukünftige Möglichkeiten anzunehmen, ist eine effektive Raumplanung wichtiger den je. Eine effektive Raumplanung, um Aussagen zur Siedlungs- und Regionalentwicklung zu treffen, setzt die Kenntnis der Ist-Situation sowie eine möglichst gute Einschätzung des Zukunftstrends voraus.

Laufend erhobene geographische Daten und Sachdaten erlauben eine ständige Beobachtung und somit eine Kontrolle der Entwicklungen einer Region. Räumliches Monitoring, basierend auf laufend erhobenen Daten, erleichtert und verbessert die Regionalplanung in verschiedenen Bereichen, zum Beispiel, die Infrastruktur, die Versorgung, die Wirtschaft oder die Umwelt betreffend.

Mit diesem Beitrag werden im Kapitel „Grundlagen" spezifische Begriffe des räumlichen Monitorings genauer definiert, um eine gemeinsame Kommunikationsebene aufzubauen. Das dritte Kapitel befasst sich mit der Umsetzung am Beispiel der Region „CENTROPE", indem auf das Konzept und die Implementierung eingegangen wird und die Ergebnisse präsentiert werden. Schwierigkeiten und Herausforderungen werden im Kapitel „Diskussion" betrachtet. Zum Schluss werden die Hauptpunkte noch einmal zusammengefasst und ein Ausblick auf eine zukünftige Entwicklung gegeben.

2 GRUNDLAGEN

Ein Raummonitoring System steht nicht nur politischen Entscheidungsträgern, dem öffentlichen Dienst und privaten Unternehmen als entscheidungsunterstützendes Instrument in der Regionalplanung zur Verfügung, es kann auch in anderen Bereichen eingesetzt werden: Allen voran erlaubt räumliches Monitoring auch regionales Benchmarking. Damit werden die Vor- und die Nachteile einer Region aufgezeigt und der Vergleich bestimmter Themen mit anderen Regionen ermöglicht. Die Entwicklung in der Informationstechnologie und die damit verbundene Möglichkeit der schnelleren und effektiveren Datenerfassung erlaubt es, Daten viel öfter, genauer und im größeren Umfang zu erheben. Daher stehen Planern in naher Zukunft mehr Daten zur Verfügung. Es ist aber heute schon wichtig, Vorbereitungen zur Erfassung, Verwaltung und Handhabung von Daten zu treffen. Jetzt müssen Richtlinien geschaffen werden, wie die Erhebung und Bearbeitung zu erfolgen hat, damit eine gemeinsame Nutzung von Daten, nicht nur unterschiedlicher Institutionen, sondern auch verschiedener Länder, Realität wird. Räumliches Monitoring kann als Beispiel eines Datenführungsmodells zur Datenverwaltung eingesetzt werden und bietet die Möglichkeit, Synergieeffekte zu nutzen.

2.1 Räumliches Monitoring

Monitoring bedeutet eine laufende Erhebung, Speicherung und Verarbeitung von Daten um auf deren Basis Analysen durchzuführen[69]. Monitoring im Sinne der laufenden Raumbeobachtung liefert eine Datenbasis zu raumrelevanten Themen und lässt

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[66] http://corp.mmp.kosnet.com/PROJEKTE/IS_CENTROPE (letzter Zugriff: 30.11.2004)

[67] http://www.bbr.bund.de/index.html?/raumordnung/siedlung/international.htm (letzter Zugriff: 30.11.2004)

[68] http://pt-uf.pt-dlr.de/Dateien/Megacities_Langfassung.pdf (letzter Zugriff: 30.11.2004)

[69] http://www.isl.uni-karlsruhe.de/module/monitoring/monitoring.html (letzter Zugriff: 30.11.2004)

so aktuelle Entwicklungstendenzen erkennen[70]. Die über bestimmte Zeiträume hinweg erhobenen geographischen und sachlichen Daten dienen zum Ableiten von Indikatoren, welche die Beurteilung der Entwicklung des Raumes und den Vergleich mit anderen Gebieten hinsichtlich bestimmter Themen erlauben. Ein auf Indikatoren basierendes Raummonitoring System wird als unterstützendes Instrument bei Entscheidungen zu einer nachhaltigen „Raum-Bewirtschaftung“ und Siedlungsentwicklung eingesetzt.

2.2 Regionales Benchmarking

Regionales Benchmarking bedeutet das Vergleichen und Bewerten von Regionen nach bestimmten Indikatoren und Regeln, wobei das Ziel von Benchmarking nicht eine Darstellung der am besten oder am schlechtesten abschneidenden Regionen ist - der eigentliche Sinn ist es, die Pluspunkte und Schwachstellen einer Region herauszufiltern. Im Vordergrund steht dabei eine Selbstbewertung der Region und in der Folge ein Vergleich mit anderen Regionen. Somit können Erfahrungen, Ideen und Hilfestellungen zwischen den Regionen zu verschiedenen Bereichen ausgetauscht werden. Das grundlegende Prinzip von Benchmarking ist somit nicht ein Ranking der Regionen zu veranstalten, sondern die Möglichkeit, von den Besten eines Bereiches zu Lernen und Erfahrungen zu sammeln. Aus den resultierenden Erkenntnissen werden Praktiken oder deren vorteilhafte Eigenschaften adaptiert und implementiert, um die eigene Wettbewerbsfähigkeit zu steigern[71].

Regionales Benchmarking ist deshalb wichtig, weil oftmals Branchencluster Regionen prägen und die treibende Kraft für Innovationen darstellen (BÖCHLIGER 2004). Regionen sind im Vergleich zu Ländern oder Staaten raumwirtschaftlich spezialisierter. Im Gegensatz zur Ebene der Länder beziehungsweise Nationalstaaten stimmen die territorialen Abgrenzungen von realer Wirtschaft und Politikzuständigkeiten oft nicht überein. Dies schafft im Vergleich zur Länderebene zusätzliche Informationsbedürfnisse bezüglich des regionalen Vergleichs der wirtschaftlichen Leistungsfähigkeit wie auch der politisch determinierten Rahmenbedingungen in den verschiedenen ökonomischen und politischen territorialen Abgrenzungen (KOELLREUTER 2004).

Regionales Benchmarking mit dem Ziel, die eigene Entwicklung zu verbessern, muss sich vorab mit drei Rahmenbedingungen auseinander setzen. Dabei handelt es sich unter anderem um die Auswahl und genaue Definition der Konkurrenzregionen. Außerdem dürfen die zwei Ebenen des regionalen Benchmarkings nicht außer Acht gelassen werden, das sind einerseits der Vergleich der Performance und andererseits die Qualität der sie beeinflussenden Rahmenbedingungen. Bei der dritten Bedingung handelt es sich um die Anforderungen, die an ein regionales Benchmarking gestellt werden (KOELLREUTER 2004).

2.3 Indikatoren

Um räumliches Monitoring zu realisieren und auch um regionales Benchmarking zu betreiben, ist es unumgänglich, Indikatoren festzulegen. Indikatoren sind Instrumente zur Vereinfachung der Darstellung komplexer Zusammenhänge mit räumlichem Bezug. Mit Hilfe von Indikatoren werden Charakteristiken relevanter Sachverhalte treffend dargestellt, die räumliche Entwicklung wird gemessen und bewertet. Indikatoren der laufenden Raumbeobachtung beschreiben und analysieren den Zustand und die Entwicklung der regionalen Lebensbedingungen in raumrelevanten Beobachtungsbereichen[72]. Räumlich basierende Indikatoren werden identifiziert und berechnet, um eine Einschätzung der urbanen und regionalen Umwelt zu bieten. Indikatoren sind ein wichtiges Instrument zur Erfolgskontrolle im Bereich der Siedlungsentwicklung und Raumplanung. Sie dienen nicht nur der Kommunikation, sondern auch dem Überprüfen von Entscheidungen.

Zur Ableitung und Bildung von Indikatoren als Basis der Kontrolle des Erfolges und der Richtigkeit der planerischen Maßnahmen ist es notwendig, das geforderte Ziel genau zu kennen. Eine explizite und genaue Definition des zu erreichenden Zustandes ist daher Voraussetzung und unumgänglich. Nur eine klare Zielvorstellung erlaubt es, die gesetzten Schritte auf ihre Richtigkeit zu überprüfen und rechtzeitig ausgleichende Maßnahmen zu treffen. Bei der Ableitung der Indikatoren sollte die Zielvorgabe nicht außer Acht gelassen werden und einige Kriterien, wie Einfachheit, Verständlichkeit, Anzahl und Aktualität beachtet werden.

Trotz der vielen Vorteile kommt es auch bei der Verwendung von Indikatoren zur Bewertung von räumlichen Sachverhalten zu negativen Begleiterscheinungen. So kann es durch die Aggregation und Reduktion beim Ableiten von Indikatoren zu Informationsverlusten kommen. Wird jedoch keine Aggregation vorgenommen, geht die Verständlichkeit verloren und die Indikatoren werden zu komplex.

2.4 Datenführungsmodell

Eine wichtige Grundlage für räumliches Monitoring ist die laufende Raumbeobachtung. Auf Grund dieser laufenden Raumbeobachtung kommt es in Zukunft zu einer großen Datenansammlung, die entsprechend strukturiert, abgespeichert und verarbeitet werden muss. Es ist jetzt schon wichtig, Richtlinien zur Erfassung, Speicherung und Verarbeitung der Daten zu definieren. So wird gewährleistet, dass eine gemeinsame Nutzung der Daten erleichtert wird und ein Überblick über die große Datenmenge gegeben ist.

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70 http://www.klett-verlag.de/sixcms/detail.php?id=32452 (letzter Zugriff: 30.11.2004)

71 http://www.prognos.de/tr/p_tr_01_2_5.html (letzter Zugriff: 30.11.2004)

72 http://www.bbr.bund.de/index.html?/raumordnung/raumbeobachtung/deutschland.htm (letzter Zugriff: 30.11.2004)

3 "CENTROPE" REGION

3.1 Ziele

Das Raummonitoring System für die Region „CENTROPE“ dient politischen Entscheidungsträgern, dem öffentlichen Dienst und auch privaten Unternehmen als Planungshilfe und entscheidungsunterstützendes Instrument. Räumliches Monitoring wird bei planerischen Maßnahmen als Unterstützung zur Findung der besten Lösung eingesetzt. Mit einer effektiven Raumplanung und Siedlungsentwicklung gewinnt die Region „CENTROPE“ an Attraktivität als Wirtschaftsstandort und im Bereich der Lebensqualität. Mit Hilfe des Systems ist es möglich, die momentane Situation in verschiedenen Bereichen zu beschreiben und auch die Entwicklung der Region auf Basis der laufend erhobenen Daten zu analysieren. Denkbar ist auch die Simulierung von Entwicklungsszenarien für einen Zukunftsausblick und um planerische Maßnahmen besser einzuschätzen. Weiters erlaubt räumliches Monitoring regionales Benchmarking innerhalb der „CENTROPE“ Region und auch zwischen anderen Regionen durchzuführen. Damit werden die Vorteile und Nachteile der Region aufgezeigt und der Vergleich mit andern Regionen zu bestimmten Themen ermöglicht. Das Raummonitoring System ist auch als Beispiel eines Datenführungsmodells zur Datenverwaltung zu sehen und bietet die Möglichkeit einer gemeinsamen und einheitlichen Datenhaltung in der Region. Außerdem können mit Hilfe des Systems Vorschläge zur Verbesserung von Datenerhebungen gemacht und in weiterer Folge Synergieeffekte genützt werden.

3.2 Konzept

Ein räumliches Monitoring System für die Region „CENTROPE“ steht Benützern und Interessenten online zur Verfügung. Das System kann prinzipiell in drei Hauptkomponenten, die miteinander verbunden sind, eingeteilt werden. Eine Komponente befasst sich mit den Daten, ihrer Erfassung, ihrer Speicherung und ihrer Bereitstellung. Ein weiterer Teilbereich behandelt die Durchführung und Auswertung von Analysen mittels einem Geoinformationssystem (GIS). Der dritte zentrale Punkt beschäftigt sich mit der Darstellung der Hintergründe, Erklärungen und Ergebnisse des räumlichen Monitorings im Internet.

Die Prinzipien des räumlichen Monitorings und seine Anwendungsmöglichkeiten werden an der „CENTROPE“ Region demonstriert. Dafür werden die für die Umsetzung wichtigen Sachverhalte, laut ihrer Definition für die Region bestimmt.

Räumliches Monitoring für die „CENTROPE“ Region wird in den Bereichen Entwicklung und Management von Infrastruktureinrichtung eingesetzt. Außerdem findet es Verwendung bei der Planung und Entwicklung von wirtschaftlichen Schwerpunkten. Das System findet im Bereich der Analyse der demographischen Entwicklung Einsatz. Der Bereich Kontrolle, Analyse und Planung der Versorgungseinrichtungen ist ebenfalls mit dem System abgedeckt. Weitere Themenbereiche, die mit dem räumlichen Monitoring behandelt werden sind Siedlungsentwicklung und Sachverhalte, die die Umwelt betreffen. Der Bereich Verkehrsinformation wird als Folgeprojekt detaillierter für die Städte Wien, Bratislava, Brno und Györ angeboten.

Es gibt mehrere Charakteristiken, welche die Region „CENTROPE“ besonders prägen. Wichtig ist sicher die Tatsache, dass es sich nicht nur um eine grenzüberschreitende Region handelt, sondern sogar die Grenzen zwischen einem EU 15 Staat und drei EU 25 Staaten überschritten werden. Eine weitere Eigenheit besteht darin, dass in allen vier Staaten, die an der „CENTROPE“ Region beteiligt sind, eine andere Sprache gesprochen wird. Eine zusätzliche prägende Eigenschaft ist auch das Vorhandensein von mehreren größeren Städten in der Region (Wien, Brno, Bratislava, Czeske Budejovice, Györ). Mit der Festlegung der Eigenschaften der Region können geeignete Vergleichsregionen definiert werden. Dabei handelt es sich unter anderem um die Region Südfinnland – Baltikum, um das Grenzgebiet zwischen Ostdeutschland – Polen, um die Region Kopenhagen – Malmö – Lund und die Region Bayern – Salzburg – Oberösterreich. Das regionale Benchmarking innerhalb der „CENTROPE“ Region und auch zwischen den Vergleichsregionen beschränkt sich auf die Bereiche wirtschaftlicher Leistungsfähigkeit und Infrastruktur.

Die relevanten Indikatoren für das räumliche Monitoring der „CENTROPE“ Region werden hinsichtlich der Kriterien zur Ableitung von Indikatoren, auf Grund von Vergleichen mit schon vorhandenen Indikatoren[73] und hinsichtlich der gesetzten Ziele definiert. Die Indikatoren werden verschiedenen, vordefinierten Bereichen, zum Beispiel Demographie, Wirtschaft, Infrastruktur, Versorgung und Umwelt zugeteilt und in einer eigenen Liste verwaltet.

Geographische Daten dienen hauptsächlich zur Unterstützung der Visualisierung von Sachdaten, können aber auch selbst als Indikatoren fungieren. Sachdaten sind an räumliche Einheiten gebunden. Um aussagekräftige Analysen durchzuführen, sollen Sachdaten auf der kleinsten verfügbaren Raumeinheit vorliegen, aber mindestens auf der Ebene NUTS 3 (Nomenclature des unités territoriales statistiques[74]). Die Gebietszugehörigkeit muss für die Visualisierung auch angegeben sein. Zur leichteren Verwaltung der Daten sollen schon die Bezeichnungen der Dateien eine Identifizierung des Themas und des geographischen Bereiches, sowie die Zuordnung zu einem Erfassungszeitpunkt zulassen. Der Verwaltung und Abspeicherung der Daten kommt eine große Bedeutung zu. Da mit einer großen Datenmenge, erfasst über einen längeren Zeitraum, umgegangen werden muss, spielt die Datenarchivierung eine große Rolle.

3.3 Umsetzung

Der erste Schritt zur Umsetzung des Konzeptes ist die Recherche und Suche nach geeigneten Daten. Die geographischen Daten können, soweit vorhanden vom vorangegangenen Projekt „Basiskarte und Informationssystem CENTROPE“ mitverwendet werden. Die Sachdaten stammen größtenteils vom Statistischen Amt der Europäischen Gemeinschaften (Eurostat). Seit Oktober 2004 bietet Eurostat verschiedenste Statistikdaten auf der Ebene NUTS 3 kostenlos an. Die Daten stehen unter anderem auch als CSV-Dateien zum Download zur Verfügung. Die notwendigen Daten werden hinsichtlich der definierten Indikatoren ausgewählt und für die

[73] http://text.stmwivt.bayern.de/landesentwicklung/bereiche/raumbeob/inka/inka_b1.htm#content (letzter Zugriff: 30.11.2004)

[74] Die NUTS Gebiete wurden vom europäischen Amt für Statistik (Eurostat) erstellt, mit dem Ziel, eine einheitliche Aufteilung des Raumes für statistische Zwecke zu schaffen. http://www.interreg3c.net/sixcms/detail.php?id=227 (letzter Zugriff 30.11.2004)

weitere Verwendung bearbeitet. Zum Beispiel müssen die Dateien in ein DBF-Format umgewandelt werden, damit sie in späterer Folge mittels ESRI ArcView 3.0 visualisiert werden können.

Nachdem die notwendigen Daten vorhanden und die Vorbereitungen getroffen sind, werden mittels ESRI ArcView 3.0 Beispielsanalysen zu verschiedenen Themen durchgeführt und bewertet. Um die Karten im Internet darzustellen gibt es verschiedene Möglichkeiten, für das Projekt wurde das Tool HTML Image Mapper von alta4 verwendet. HTML Image Mapper ist eine Erweiterung für ESRI ArcView. Mittels diesem Tool können Karten in HTML Code umgewandelt werden und im Internet dargestellt werden. Die mittels HTML Image Mapper erzeugten „interaktiven Karten" der Beispielsanalysen werden in die Homepage des Projektes „CENTROPE Map" eingebunden.

Damit die Benützer eine Zugang zu den Beispielsanalysen haben, aber auch um sich über räumliches Monitoring und die Umsetzung für die „CENTROPE" Region zu informieren, widmet sich ein eigener Teil der „CENTROPE Map" Projekthomepage diesem Thema (http://www.multimediaplan.at/PROJEKTE/CENTROPE_MAP). Diese Internetseite bietet nicht nur Informationen über das Projekt im Allgemeine, sondern auch detaillierte Beschreibungen und Darstellungen zu den Themen räumliches Monitoring, Indikatoren und Regionales Benchmarking.

3.4 Ergebnisse

Als Ergebnis des Projektes „Räumliches Monitoring – Anwendungsmöglichkeiten und Perspektiven in der Regionalplanung", befasst sich ein eigener Teil der Projekthomepage mit diesem Thema. Es werden Informationen über räumliches Monitoring im Allgemeinen und zur Umsetzung für die Region „CENTROPE" angeboten. Die Ergebnisse der Beispielsanalysen zum räumlichen Monitoring und zum regionalen Benchmarking werden ebenso dargestellt, wie eine Beschreibung der „Karten". Zusätzlich werden noch Hinweise auf die Datenführung gegeben. Die Abbildung 1 zeigt eine der Beispielsanalysen, durchgeführt mit der ESRI ArcView Extension HTML Image Mapper. Die Karte stellt die Abnahme, beziehungsweise den Anstieg der Arbeitslosenrate von 2000 auf 2001 in den einzelnen NUTS 3 Gebieten der „CENTROPE" Region dar.

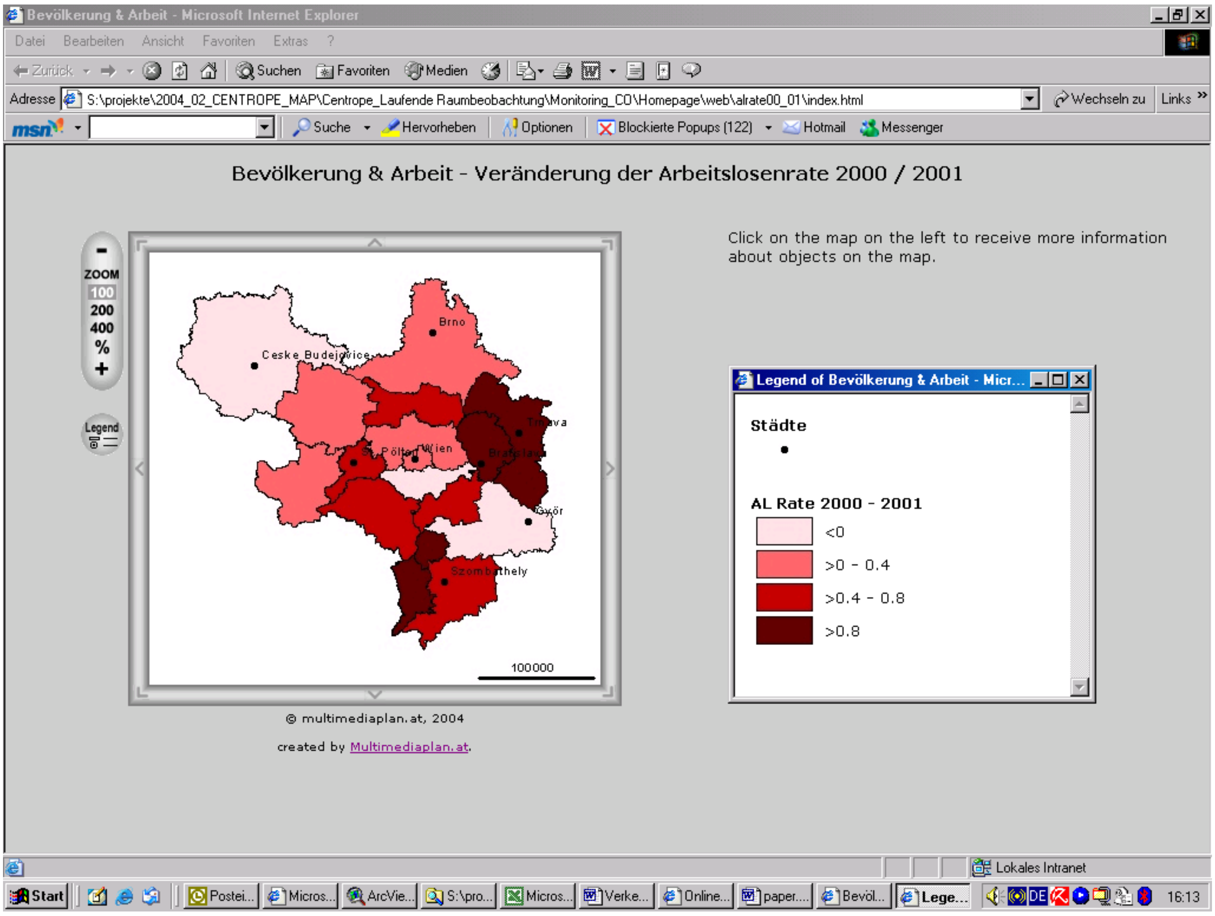

Abb.1: Beispielsanalyse: Veränderung der Arbeitslosenrate von 2000 auf 2001

4 DISKUSSION

Neben den vielen Vorteilen, die die Umsetzung des Projektes für eine Region, an der vier Staaten beteiligt sind bietet, ergeben sich auch einige Schwierigkeiten. Neben den rechtlichen Hintergründen zur Nutzung der Daten über Staatsgrenzen hinweg spielt auch die Bereitstellung der Daten eine große Rolle. Die Erfassungsmethoden und die Möglichkeiten der Weitergabe der Daten sind in den einzelnen Staaten verschieden. Die geographischen Daten sind auch jeweils in anderen Projektionen vorhanden, was die gemeinsame Darstellung zusätzlich erschwert. Das Statistische Amt der Europäischen Gemeinschaften hat mit der Freigabe der Statistikdaten einen großen Schritt in Richtung freie Verfügbarkeit von Daten gemacht.

5 ZUSAMMENFASSUNG UND AUSBLICK

Es ist gelungen, räumliches Monitoring für die Region „CENTROPE“ in bezug auf verschiedene Indikatoren, wie die Wirtschaft, die Arbeitssituation oder die Versorgung betreffen, umzusetzen. Weiters wurden Vergleichsregionen, wie zum Beispiel das Grenzgebiet zwischen Deutschland und Polen definiert und regionales Vergleiche bezüglich Wirtschaftsdaten durchgeführt. Mit den Beschreibungen und Erklärungen zu räumlichem Monitoring und der teilweisen Umsetzung werden die Vorteile für die Regionalplanung demonstriert.

Eine Weiterführung und Verbesserung des Projektes ist ebenso geplant, wie die verstärkte Einbindung und Beachtung von Verkehrsinformationen und Verkehrsdaten. Besonders für die größeren Städte in der Region, aber auch für die Hauptverbindungsrouten zwischen den wichtigsten Wirtschaftzentren ist ein Verkehrsinformationssystem notwendig.

Ein weiterer geplanter Schritt ist, räumliches Monitoring auf Basis von Satellitenbildern durchzuführen. Mit Hilfe der Auswertung aktueller Satellitenbilder werden die Veränderungen des Raumes erkannt und unterstützen die Aussagekraft der Indikatoren.

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http://www.interreg3c.net/sixcms/detail.php?id=227 (letzter Zugriff 30.11.2004)

E-Procurement bei den ÖBB. @-AVA –Die Internet-Vergabeplattform

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Die atemberaubende Entwicklung auf dem Sektor der Kommunikationstechnologie mit der Verbreitung des Internet bildet ein großes Potenzial für die elektronische Gestaltung und Abbildung der Geschäftsprozesse innerhalb sowie zwischen verschiedenen Behörden / Unternehmen und damit eine wesentliche Voraussetzung für die Einführung von „E-Procurement-Lösungen".

1 E-PROCUREMENT / ELEKTRONISCHE VERFAHRENSABWICKLUNG

Die Beschleunigung der Informationsübertragung ist – wenngleich treibende Kraft – allerdings nur eine von mehreren Bedingungen für E-Procurement. Die weiteren Voraussetzungen sind in der Standardisierung der Lieferungen / Leistungen und in der Festlegung eines gemeinsamen Aus-tauschformates zu sehen. Erst wenn diese Voraussetzungen erfüllt sind, kann sich – im Zusam-menwirken mit den neuen Kommunikationstechnologien – der volle Nutzen von E-Procurement entfalten, ja kann überhaupt erst von E-Procurement gesprochen werden.

E-Procurement heißt zusammengefasst die durchgängige elektronische Gestaltung des Vergabe-verfahrens.

Die allgemeinen Voraussetzungen für E-Procurement sind daher die Standardisierung von Leistungen (Standardleistungsverzeichnisse) die Standardisierung des Datenaustausches (Datenträger) die Festlegung der Informationsübertragung / Informationsaustausch Nachdem für den (Bau)-Leistungsbereich in Österreich[75] die ersten beiden Voraussetzungen in Form der ÖNORMen B 2062, B2063 und B 2114 vorliegen[76], geht es nunmehr darum, das Potenzial den die neuen Entwicklungen auf dem Kommunikationssektor für den Austausch von Informationen (Dateien, Dokumente) bieten, zu erkennen und für die elektronische Verfahrensabwicklung zu nutzen.

1.1 Nutzen und Ziele von E-Procurement

Der Nutzen von E-Procurement besteht in der Beschleunigung, Kostenreduktion und Erhöhung der Transparenz /Sicherheit des Vergabeprozesses.

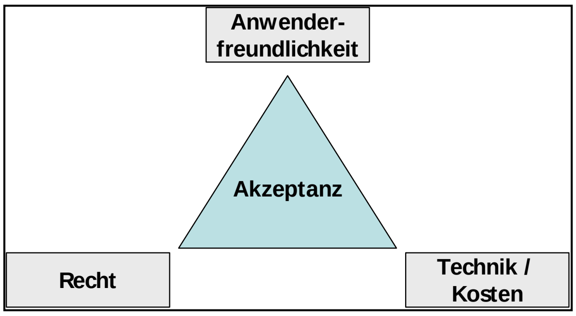
Die Beschleunigung ergibt sich aus dem Ersatz des Postweges durch die elektronische Übermitt- lung der erforderlichen Dokumente (Up- und Download). Gleichzeitig wird die Flexibilität ge-steigert, nachdem der Prozess beinahe zu jeder Zeit und an jedem Ort abgewickelt werden kann.

Die Transaktionskosten der Datenübermittlung werden wesentlich verringert. Die Verviel-fältigungskosten können auf den genauen Bedarf abgestimmt und Vorhaltekosten reduziert werden.

Die sensiblen Daten des Vergabeprozesses werden auf einen genau definierbaren Personenkreis eingeschränkt. Sämtliche Informationen stehen jedem Anwender zeitgleich und nachweisbar zur Verfügung. Damit kann die Sicherheit und Transparenz der Verfahren erhöht werden.

1.2 Einzelziele / Spannungsdreieck

Die Abbildung von Vergabeverfahren in durchgängige elektronische Prozesse befindet sich im Spannungsfeld aus rechtlichen Rahmenbedingungen (Sicherheit), Anwenderfreundlichkeit (Komplexität der Prozesse) und Kosten (Technik).



1.3 Gesamtziel

Elektronische Lösungen sind grundsätzlich so zu gestalten, dass das Ziel, die Akzeptanz der Anwender (Auftraggeber und Auftragnehmer) erreicht wird um so zur Verbreit(er)ung von E-Procurement-Lösungen beizutragen und den Nutzen dieser Lösungen voll zu entfalten.

[75] Die österreichische Bauwirtschaft kann für sich in Anspruch nehmen, eine absolute Vorreiterrolle bei der elektronischen Verfahrensabwicklung einzunehmen. Kaum eine andere Industriesparte und kaum kein anderes Land verfügt mit den zit. Normen über bessere Grundlagen für E-Procurement.

[76] Daneben sollte es das Ziel der normsetzenden Instanzen sein, die zit. Normen weiterzuentwickeln in dem das überholte ASCI-Format auf ein xml-Format zu übertragen.

2 DIE SPANNUNGSFELDER

2.1 Spannungsfeld Recht

Öffentliche Auftraggeber und Sektorenauftraggeber haben bei der Gestaltung von E-Procurement-Lösungen den Bestimmungen

des Bundesvergabegesetzes 2002 (BVergG.) der E-Procurement-Verordnung 2004 des Signaturgesetzes 1999 (SigG.) zu entsprechen.

Die rechtlichen Rahmenbedingungen zielen darauf ab, den Prozess der elektronischen Verfahrens-abwicklung mit jener Rechtssicherheit auszustatten, die mindestens dem bisherigen „Papier-basierten" Prozess entspricht. Sie bilden somit eine wesentliche Grundlage um die Akzeptanz aller Prozessbeteiligten zu erreichen.

Folgende einzelne Bestimmungen aus diesen Gesetzen beeinflussen maßgeblich die Art der technisch-funktionalen Gestaltung:

a) die Verwendung einer sicheren elektronischen Signatur,

b) die Einhaltung der Grundsätze der Echtheit, Unverfälschbarkeit und Vertraulichkeit,

c) die Sicherstellung, dass der Auftraggeber vom Inhalt der Angebote erst nach Ablauf der Ange-botsfrist Kenntnis nehmen kann und

d) die Maßnahmen, dass der Zeitpunkt der Angebotsabgabe (Zeitstempel) festgestellt werden kann.

Aus diesen Rahmenbedingungen leiten sich technische Lösungen ab, die im Wesentlichen aus einer Kombination von Verfahrens(Internet)-Plattform und Signaturinfrastruktur bestehen. Das E-Mail kann eine unterstützende bzw. untergeordnete Rolle einnehmen.

2.2 Spannungsfeld Kosten / Technik

Die Kosten für E-Procurement-Lösungen hängen i.w. davon ab ob sich der Auftraggeber einer eigenen (internen) oder fremden (externen bzw. „Third-Party-") Verfahrensplattform bedient und ist daher mit einer strategischen Entscheidung verbunden.

Eigene Verfahrensplattformen sind mit einem einmaligen Investitionsaufwand von ca. € 120.000,00 verbunden. Der Aufwand für „Third-Party"-Plattformen richtet sich nach dem jeweiligen Kostenmodell des Anbieters solcher Plattformen.

Unabhängig von dieser strategischen Entscheidung kann aber davon ausgegangen werden, dass die elektronische Gestaltung des Vergabeprozesses – neben der Vereinfachung und Beschleuni-gung des Verfahrens – zu einer wesentlichen Verminderung der Transaktionskosten führt und daher die Umstellung auf den elektronischen Weg jedenfalls rechtfertigen.

Als Mindestanforderung für Verfahrensplattformen gilt, dass die umseitig zitierten Grundsätze lit. c) und d) erfüllt werden. Das bedeutet, dass die Datenübertragung über eine sichere SSL-Ver-bindung hergestellt wird, die Plattform über eine Zeitsperre verfügt, die eine vorzeitige Öffnung des(r) Angebot(e) verhindert und eine Bestätigung über die (rechtzeitige) Einreichung des Ange-botes vergibt. Zusätzlich muss durch eine Verschlüsselung der Daten dem Grundsatz der Vertrau-lichkeit entsprochen werden (lit.b)).

3 ANWENDUNGS–HARD- UND SOFTWARE

E-Procurement-Lösungen können im Bau-Sektor auf vorhandene Anwender-Standards aufbauen. Die Einführung der elektronischen Verfahrensabwicklung ist daher mit keinen außergewöhnlichen Mehrkosten verbunden.

Eine Ausnahme bildet lediglich die die erforderliche „Signatur-Infrastruktur" mit der die eigenhän-dige Unterschrift ersetzt wird. Allerdings hält sich der dafür erforderliche Investitionsaufwand mit ca. € 220,00 (Einzelplatz) in Grenzen.

E-Procurement-Lösungen erfordern daher folgende Einzelplatz-Ausstattung:

3.1 Allgemeine Hardware

Standard-PC mit Internetanbindung

Ein leistungsfähiger PC, sowie eine ausreichende Leitungsanbindung (Breitband) entscheiden die Qualität der Bearbeitung und Datenübertragung.

3.2 Allgemeine Software

IE-Browser / Office- und AVA-Software / Acrobat-Reader

Die bisher bekannten Verfahrens-Plattformen bauen auf dem IE-Explorer (ab Version 6.0) auf. Es kann davon ausgegangen werden, dass es sich bei diesen und bei den weiteren erforderlichen Software-Produkten wie MS-Office oder Adobe Acrobat um einen vorhandenen, weit verbreiteten Standard handelt. Für die Erstellung oder Betrachtung von Plänen sind entspr. Autocad-Produkte zumindest aber sog. „Viewer" erforderlich.

3.3 Spezielle Hard-/ Software: Signaturinfrastruktur

Die Beteiligten (Auftraggeber und Auftragnehmer) an einem elektronischen Verfahren müssen über die Komponenten (Signaturinfrastruktur) einer sicheren elektronischen Signatur (lit.a)) ver-fügen. Diese Komponenten setzen sich zusammen aus:

3.3.1 Signaturkarte mit einem qualifizierten Zertifikat

Als qualifiziert gelten nur jene elektronischen Signaturen, bei denen die Identität des Besitzers eindeutig festgestellt und abgefragt werden kann. Nur damit kann der Grundsatz der „Echtheit" bzw. Authentizität (lit. b)) erfüllt werden. Qualifizierte elektronische Signaturen werden durch sog. Trust-Center, in Österreich durch die Firma A-Trust[77] ausgegeben.

3.3.2 Kartenleser

Als Kartenleser gelten nur jene als geeignet, die der Anwender unter seiner eigenen Kontrolle halten kann. Die Eignung wird in der Regel durch Trust-Center festgestellt. Die Kartenleser selbst sind im Spezial-Elektrohandel erhältlich.

3.3.3 Signatursoftware (Secure-Viewer)

Die Signatursoftware sorgt u.a. dafür, dass jene Datei (Dokument) die der Signator elektronisch signieren möchte, sicher am Bildschirm angezeigt wird (Secure-Viewer) und jede spätere Veränderung unmöglich bzw. nachvollziehbar wird. Damit kann der Grundsatz der Unverfälsch-barkeit (lit. b)) sichergestellt werden. In Österreich wurde von der Firma IT-Solution ein ent-sprechendes Produkt entwickelt.

3.4 Spannungsfeld Anwenderfreundlichkeit

Für den Erfolg von E-Procurement-Lösungen ist eine Vertrautheit mit den erforderlichen Systemen ausschlaggebend. Neben allgemeinen EDV-Grundkenntnissen sind für die Bedienung von Verfahrensplattformen in jedem Fall Erfahrungen mit dem Medium „Internet" erforderlich.

Entscheidend sind allerdings Kenntnisse in Bezug auf die Geltung und Anwendung von Rechtsnormen, wie des Bundesvergabegesetzes. Verfahrensplattformen können den Anwender, insb. den Auftraggeber unterstützen, in dem sie Prozesschritte im Vergabeprozess standardisieren, sie ersetzen aber nicht eine profunde Kenntnis dieser speziellen Materie.

Sofern diese Voraussetzungen gegeben sind, stellen E-Procurement-Lösungen jedenfalls keine erhöhten Anforderungen an die Prozessbeteiligten im Vergleich zu den traditionellen „Papier-basierenden" Prozessen.

Als völlig neu gilt allerdings die Technik der „elektronischen Signatur", die aufgrund der Anzahl der Beteiligten, insb. auf der Auftragnehmerseite einen relativ hohen Erklärungs- und Schulungsauf-wand erfordert.

4 DER LÖSUNGSANSATZ DER ÖBB

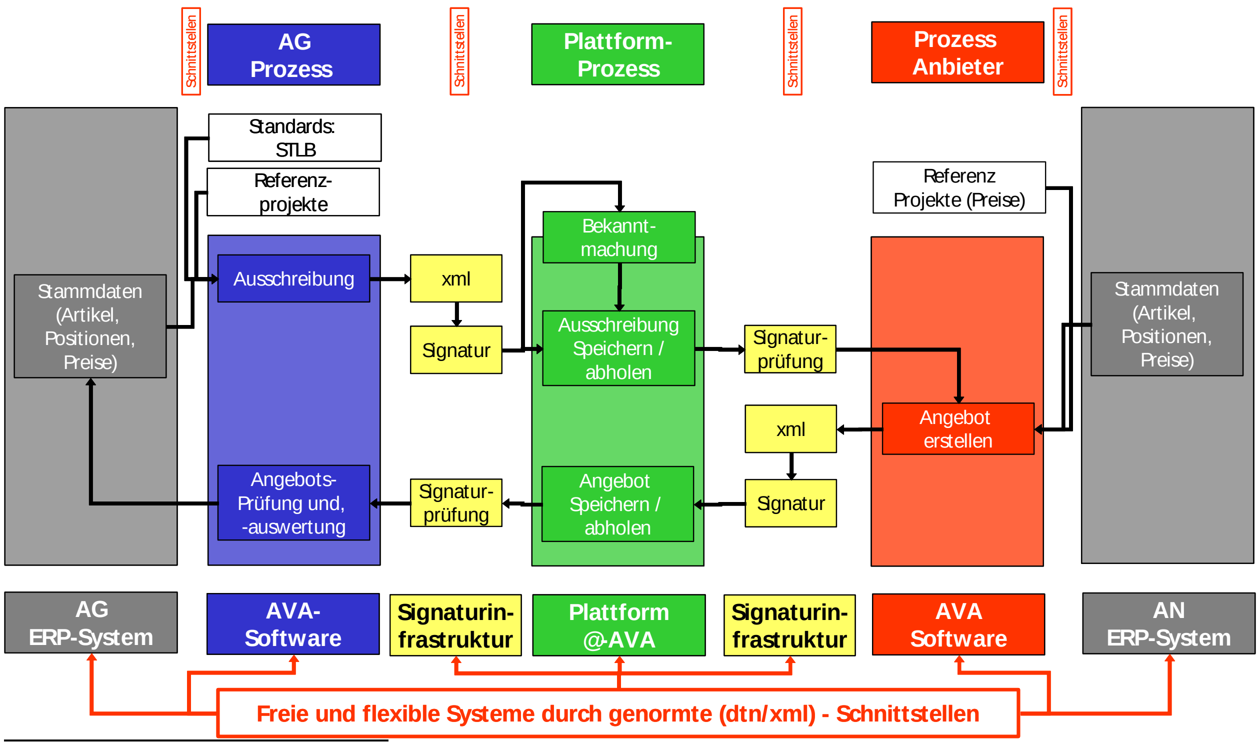
Von den ÖBB wurde ein Lösungsansatz gewählt der auf eine Kombination von 3 Tools aufbaut:

der Vergabeplattform „@-AVA"

der Signaturinfrastruktur „trustview"

der Verfahrenssoftware „AVA"

4.1 Daraus ergibt sich folgender Gesamtprozess:



77 Die Fa. A-Trust bietet unter www.a-trust.at umfangreiche Informationen zum Thema „Elektronische Signatur" an.

Der Prozess der elektronischen Verfahrensabwicklung ist generell durch eine Vielzahl von Schnitt-stellen gekennzeichnet. Durch den Rückgriff auf den vorhandenen ÖNORM-Standard des Daten-trägeraustausches und dessen Verknüpfung mit dem xml-Format können diese Schnittstellen überwunden und Datenbrüche vermieden werden – es ergibt sich ein durchgängiger elektron-ischer Prozess von der Ausschreibung bis zur Angebotsauswertung und die Möglichkeit der Ver-knüpfung mit ERP-Systemen.

4.2 Systemintegration

Von den ÖBB erfolgte die Einführung der elektronischen Verfahrensabwicklung schrittweise. Zunächst wurde – im Zuge eines Pilotprojektes – der Prozess des Verhandlungsverfahrens auf einer einfachen Verfahrensplattform elektronisch abgebildet und im Jahre 2002 implementiert. Auf Basis der Erkenntnisse mit dem Pilotprojekt wurde diese Lösung im Jahre 2004 um die Abbildung aller Verfahren nach dem BVergG. und die Integration eines internen (Genehmigung-) Workflows zur Plattform „@-AVA“ erweitert.

Die ÖBB sind damit das erste und bislang einzige Unternehmen im öffentlichen Bereich, dass über eine vollintegrierte Lösung für die elektronische Verfahrensabwicklung verfügt.

Die bisherigen Erfahrungen sind als durchwegs positiv zu bezeichnen – eine Rückkehr zum „alten“ System der Papier-basierten Vergabe erscheint für die meisten Anwender jedenfalls völlig undenk-bar.

5 PARTNER

Die elektronische Verfahrensabwicklung bei den ÖBB wurde mit folgenden Partnern umgesetzt:

Sequax – Software Solutions / Entwicklung der Internetplattform @-AVA / www.sequax.net

A-Trust / Signaturkarten / www.a-trust.at

IT-Solution / Signatursoftware / www.itsolution.at

IB-Data / AVA-Software / www.ib-data.at

Lieferanzeiger / Veröffentlichungen / www.lieferanzeiger.at

Semi-automatische Landschaftsanalyse mit dem ArcGIS 9.x ModelBuilder

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ZUSAMMENFASSUNG

Das Verständnis des Landschaftshaushaltes ist für die Zukunftsplanung essentiell, um einerseits mittelfristige Strategien der Landschaftsentwicklung aufzuzeigen und andererseits deren langfristige Auswirkungen hervorzusagen. Dieser Artikel analysiert in diesem Zusammenhang die Rolle der Integrationsmöglichkeit wissenschaftlicher Methoden in die Landschaftsplanung und erörtert die Perspektive von praxistauglichen, semi-automatischen Operationalisierungsmethoden in ArcGIS. Das entwickelte technische Instrumentarium konzipiert bestehende wissenschaftliche Methoden unter Transformation dieser in binäre Strukturen eines GIS teilweise neu und stellt diese in Kontext eines übergeordneten Gesamtsystems. Die systematisch zusammengeführten, modular aufgebauten Prozessstrukturen sind anwendungsneutral, auf Mitteleuopa abgestimmt und damit räumlich übertragbar. Der Ansatz verfolgt damit die Strategie der Europäischen Union, weite Landschaftsteile Europas "standardisiert" unter Berücksichtigung der jeweiligen Standortvoraussetzungen und -potenziale zu bewerten, deren Entwicklungspotenzial aufzuzeigen um schlussendlich regionale Vergleiche von Landschaften zu ermöglichen. Dafür wird in der vorliegenden Studie ein von Klug zugrundegelegter, Ansatz aufgegriffen und weiterentwickelt, in dem das Ziel die mesoskalige Zukunftsentwicklung von Landschaften ist. Das Konzept integriert sozio-ökonomische Erfordernisse und politische Zwänge, die das Bestreben nach einer transdisziplinären Sichtweise aufgreifen.

Schlussfolgernd kann herausgestellt werden, dass die der Analyse vorausgehende These der Machbarkeit halbautomatischen Operationalisierung von wissenschaftlich begründeten Methoden zur Landschaftsanalyse bestätigt werden kann. Dabei wurde der Aufwand des Datenmanagements deutlich unterschätzt. Obwohl die Möglichkeiten der semi-automatischen Operationalsierung von Geodaten im GIS zweifelsohne zugenommen haben, bleiben die Probleme in der Datenbeschaffung und dem aufwendigen Datenmanagement ungeklärt. Die beobachteten Mängel in der Geodatenbeschaffung und der -qualität könnten durchaus im Einklang mit der Prozessierung stehen. Allerdings wäre dazu die Geodatenpolitik der Staaten Europas zu überdenken. Es lässt sich demzufolge behaupten, dass sowohl eine ländergebundene zentrale Geodatenhaltung, -pflege und -verbreitung die Landschaftsplanung bereichern und die teilweise erheblichen Missplanungen unterbinden würde.

Keywords: Landschaftsanalyse, Landschafsplanung, Leitbild, Entscheidungsunterstützungssystem, semi-automatische Analyse, ArcGIS, ModelBuilder

1 EINLEITUNG

Die Vergangenheit der EU Agrarpolitik hatte vor allem die Marktregulierung und die Marktentlastung zum Ziel. Diese Ziele waren gekoppelt an sozio-ökonomische Stabilität sowie die Einkommenssicherung in der Landwirtschaft (http://europa.eu.int/scadplus/leg/de/lvb/l04000.htm, 22.10.2001). Zukunftsaufgaben der modernen Landschaftsplanung propagieren darüber hinaus Aufgaben des Ressourcenschutzes, des Umweltschutzes und Naturschutzes sowie raumplanerische Aspekte bezogen auf Landschaften. Daher werden mit Neugestaltung der EU Agrarpolitik transdisziplinäre Ansätze eine besondere Bedeutung erfahren, in der verschiedene ökologische Aspekte ökonomische, soziale als auch politische Rahmenbedingungen integrieren (Tress et al. 2003). Dabei geht es vor allem um die Herausstellung von Perspektiven der mittelfristigen Landschaftsentwicklung, sowie die Beurteilung der Konsequenzen des angestrebten mittel- und langfristigen Managements. Das damit verbundene Interesse an detaillierten räumlichen Informationen, lassen Möglichkeiten einer transdisziplinären Sichtweise von Problemen auf eine höhere Stufe stellen. Die integrative Basis von interdisziplinären Fachdaten innerhalb eines Geografischen Informationssystems (GIS), gekoppelt mit aktuellen Landnutzungs- und Landbedeckungsaufnahmen spektral und räumlich hoch auflösender und kostengünstiger Satellitenbilddaten sowie flugzeuggetragenen Scannerdaten tragen im Zusammenhang mit landschaftsökologischen Methoden dazu bei, dass die Zukunftsplanung transparenter und damit auch zielgerichteter eingesetzt werden kann. Zweifelsohne steigt mit der wissenschaftlichen Erkenntnis von landschaftsökologischen Komplexen ebenfalls die Komplexität der Modelle. Differierende Angaben aus der Literatur hingegen lassen erkennen, dass eine Zunahme der Komplexität in Modellen nicht zwingend zu besseren Ergebnissen führen muss (Marks et al. 1992). Gerade bei der Berücksichtigung von angestrebten Maßstabsbereichen und deren Daten-, Funktions- und Prozessäquivalenten spielt diese begründete Aussage eine entscheidende Rolle. Nicht desto trotz bin ich der Meinung, dass eine wohlbegründete Komplexität in Modellen durchaus angebracht ist, um das zu untersuchende Landschaftssystem in ausreichendem Maße zu repräsentieren. Es kann jedoch nicht oft genug betont werden, dass die Berücksichtigung der fokussierten Skalenbereiche mit den dort vorherrschenden und zu untersuchenden Funktionen und Prozessen zwingend einzuhalten sind.

Im Allgemeinen werfen Haber (1993) und Bastian (2000) die Frage nach der Planbarkeit von Landschaften auf und hinterfragen das Prinzip der Leitbildableitung als Patentrezept für die Landschaftsplanung. Auch wenn die Leitbildplanung nicht als Patentrezept angesehen werden kann, steht außer Frage, dass es notwendig erscheint, Zukunftsplanung zu betreiben. Nur so können innerfachliche Vor- und Nachrangigkeiten des Natur- und Umweltschutzes, der Landschaftsplanung und der Landschaftspflege für Schutzgüter durch zielgerichtete Fördermaßnahmen festgelegt werden. Darüber hinaus wird eine begründete und argumentierbare Basis für die Auseinandersetzung mit den Naturgütern, deren Nutzungsansprüchen oder Eingriffen in die Landschaft mit der Herausstellung von gesellschaftlichen Wertorientierungen zugrundegelegt.

Abgestimmt auf die Gegebenheiten Mitteleuropas wurde von Klug (2000, 2002) ein prozess-orientiertes, funktional-haushaltliches Methodenkonzept vorgestellt, mit dem landschaftsökologische Zukunftszustände für weite Teile Europas raumübergreifend planbar sind. Dieses Modell wurde jedoch bisher nur auf eine disziplinübergreifende ökologische Basis gestellt, die nach der Sichtweise von Haber (1971) Vorrangflächen für die Landwirtschaft in Bezug auf dessen ökologischen Potenzials ausweist. Solche, rein auf ökologischer Basis optimierte Analysen sind durchaus, durch ihre wissenschaftlich begründbaren Fakten, sehr gut nachvollziehbar und damit transparent, berücksichtigen aber grundlegende Steuerungsmechanismen in der Planung nicht. Zu diesen zählen die politischen Einflüsse, die den Rahmen von Analysen und Entwicklungsrichtungen durch eine definierte Förderungspolitik vorgeben. Darüber hinaus ist die ebenfalls an Förderbedingungen gekoppelte Finanzierung von Vorhaben ein entscheidendes Kriterium, welches eine Maßnahmen- oder Entwicklungsplanung kippen oder zum Erfolg werden lässt. Wichtigster Einflussfaktor sind ethisch-soziale Verhaltensweisen der lokalen Bevölkerung mit den die Landschaft formenden und prägenden Landwirten (Zimdahl 2004). Wird die Akzeptanz von Entwicklungsrichtungen und die damit verbundenen Veränderungen im System Landwirtschaft-Umwelt nicht hergestellt, so ist eine diesbezügliche Planung undenkbar. Diese planungsbezogene Prozesskausalitäten haben auch schon Tress und Tress (2001) erkannt und propagieren daher seit längerem eine transdisziplinäre Herangehensweise. Sie stellen jedoch auch klar heraus, dass dieser "bottom-up"-Ansatz unter Partizipation aller Beteiligten ein langwieriger und schwieriger Prozess ist. Nicht zuletzt führen fehlende methodisch-technische Mechanismen sowie personen- und interessensgebundene Aspekte zu diesem Resultat.

Als Konsequenz wurde in dem vorgestellten Ansatz versucht, wissenschaftliche Methoden und bestehende Regeln so aufzunehmen und umzuwandeln, dass eine semi-automatische Prozessierung der zugrundeliegenden Daten möglich wird. Grundvoraussetzung dafür ist das Systemverständnis und die Funktionsweise der Landschaft, dessen ökologischen Abhängigkeiten und der anthropogenen Beeinflussung dieser. Ferner müssen diese Eingriffe in gesellschaftsfähige Wertnormen gefasst werden. Diese Bewertung erfolgt für jeden der für die Landschaft als signifikant angesehenen Einzelprozesse und Funktionen über eine fünfstufige Skala. Je nach Priorität der im Vordergrund stehenden Einzelaspekte, ändert sich die in einem Szenario dargestellte Entwicklungsrichtung der Landschaft. Szenarien mit unterschiedlichen Systemeinstellungen stellen zunächst die Hauptelemente der Beeinflussung heraus. Diese Planungen unter Zugrundelegung bestimmter Entwicklungsprioritäten werden mit einem als ökologisch "optimal" angesehenen Systemzustand als Verifizierungsschritt abgeglichen. Dieser Abgleich erfolgt, um die zur Verfügung stehenden ökologischen Ressourcen adäquat zu nutzen und um eine nachteilige Ausbeutung der vorhandenen Landschaftspotenziale zu unterbinden.

In der Landschaftsplanung kann das Modell schlussendlich in einer Diskussionsrunde involvierter Planungspersonen prozessiert werden. Die Werte für jede einzelne GIS-Abfrage werden in Datenbanken abgelegt und ein resultierendes Szenario berechnet. Danach muss ein transdisziplinärer Konsens über Abwägungsmechanismen für die Inwertsetzung eines jeden Diskussionspunktes gefunden werden, der das abschließende Szenario und damit das Leitbild der zukünftig anzustrebenden Landschaft darstellt. Dies repräsentiert einen mittelfristig anzustrebenden Landschaftszustand, der unter den gegebenen Voraussetzung angestrebt werden soll. Diese Zustandsentwicklung ist über geeignete Kontrollmechanismen zu überprüfen und gegebenenfalls durch neu auftretende Umstände und Sachlagen zu verifizieren und abzuändern.

2 DER KONZEPTIONELLE RAHMEN

Die Entwicklung von Modellkonzepten für die Zukunftsplanung von Landschaften über Leitbilder wurde in ersten Ansätzen bereits von Haber (1971) durchgeführt. Diverse ideologische Ansätze führten von Reanimationen historischer Landschaften über biotisch orientierte Aspekte zu Raumplanungsperspektiven mit ästhetischen Gesichtspunkten. Diese leiteten über zu einer breit disukutierten, naturschutzorientierten Planung in den neunziger Jahren des vergangenen Jahrhunderts (Wiegleb 1997, Fink et al. 1997). Autoren wie Mosimann et al. (2001), Jedicke (1998) und Zepp (1999) griffen diese Ansätze auf und entwickelten sie in prozessorientierter Typisierung landschaftlicher Ökosysteme weiter. Diese Landschaftsplanung über Leitbilder basierte bis zu diesem Zeitpunkt ausschließlich auf einer soliden naturwissenschaftlichen Basis. Als Grundvoraussetzung für eine "optimale" Zukunftssicherung von Ressourcen wurde von Bastian (1999) die langfristig Gewährleistung von Funktionen und Prozessen des Landschaftshaushaltes angeführt. Der daraus resultierende "Benefit" für die Gesellschaft sowie die aus der Landschaftsleistung abgeleiteten "Services" wurden von de Groot (2002) näher konkretisiert. Diese methodischen Weiterentwicklungen kamen soweit in Mode, dass sie als "Zauberwort" und Allerheilmittel angesehen wurden (Jessel 1994). Dennoch zeigen Jessel (1995, 1998) und Bastian (2000) deutlich die Möglichkeiten und Grenzen die mit der Planung von Landschaften verbunden sind. Daraus lässt sich ableiten, dass Leitbilder als regelmäßig zu hinterfragende Planungsstrategie und nur mit Inhalt gefüllt und konkretisiert als Orientierungshilfe angesehen werden können (Schwineköper et al. 1992). Unter Berücksichtigung der These, dass Landschaftsplanung unter Beachtung von Rechtsverbindlichkeiten und politischer Akzeptanz verbessert werden kann und muss (Bastian 2000) wurde im Rahmen dieser Analyse ein entsprechendes Modellkonzept kontruiert (siehe Abb. 1). Dies hat die vereinfachte Darstellung komplexer zukünftiger Entwicklungszustände zum Ziel, welche räumlich repräsentativ und verständlich dargestellt werden können. Die Herausstellung der Verständlichkeit und Einsichtigkeit von Umweltproblemen und Naturschutzmaßnahmen in der Gesellschaft kann nach Bernhard und Jäger (1985) sowie Barth (1997) über die Darstellung der zunehmend unüberschaubar und irreversibel werdenden Veränderungen in der Landschaft erfolgen. Die Illustration der Veränderungssignifikanz durch ihre Art der Ausprägungen in Form von Häufigkeit, Totalität und Reichweite fördert die Einsichtigkeit zunehmend.

2.1 Die methodische Basis für die Leitbildentwicklung

Die vorliegende Analyse fokussiert die für die nachhaltige Entwicklung von ländlichen Gebieten notwendige Planungsausrichtung von Landschaften. Ziel ist eine Feststellung von mittelfristig zu erreichenden Zielvorstellungen, in welche eine Landschaft in der zukünftigen Dekade entwickelt werden soll. Dies erfolgt, wie bereits Usher und Erz (1994) und Bastian (1999) fordern, nach einer holistischen Betrachtungsweise. Diese soll nicht nur verschiedene ökologische Fachdisziplinen vereinen, sondern darüber hinaus auch sozio-ökonomische Rahmenbedingungen und politische Zwänge in die zukunftsweisende Planung mit einbeziehen. Damit wird eine Annäherung der zwei von Wiegleb et al. (1999) herausgestellten Hauptwegen der Leitbildfindung angestrebt. Es erfolgt eine Angleichung von den in i) Expertenmodellen akademischer Ansätze von außen aufgezwungene Entwicklungszielen an ii) diskursive Methoden der Landschaftsplanung, indem von Experten herausgestellte Zielvorgaben offeriert werden, aber die Entscheidung zu deren Verwendung oder Modifizierung bei den Teilhabenden der Diskussionsrunde verbleiben. Damit wird gewährleistet, dass die Belange des Natur- und Landschaftsschutzes nicht ausschließlich über Gesetze erzwungen werden, sondern durch sachliche Überzeugung von Mehrheiten (Barth 1997) gestützt werden.

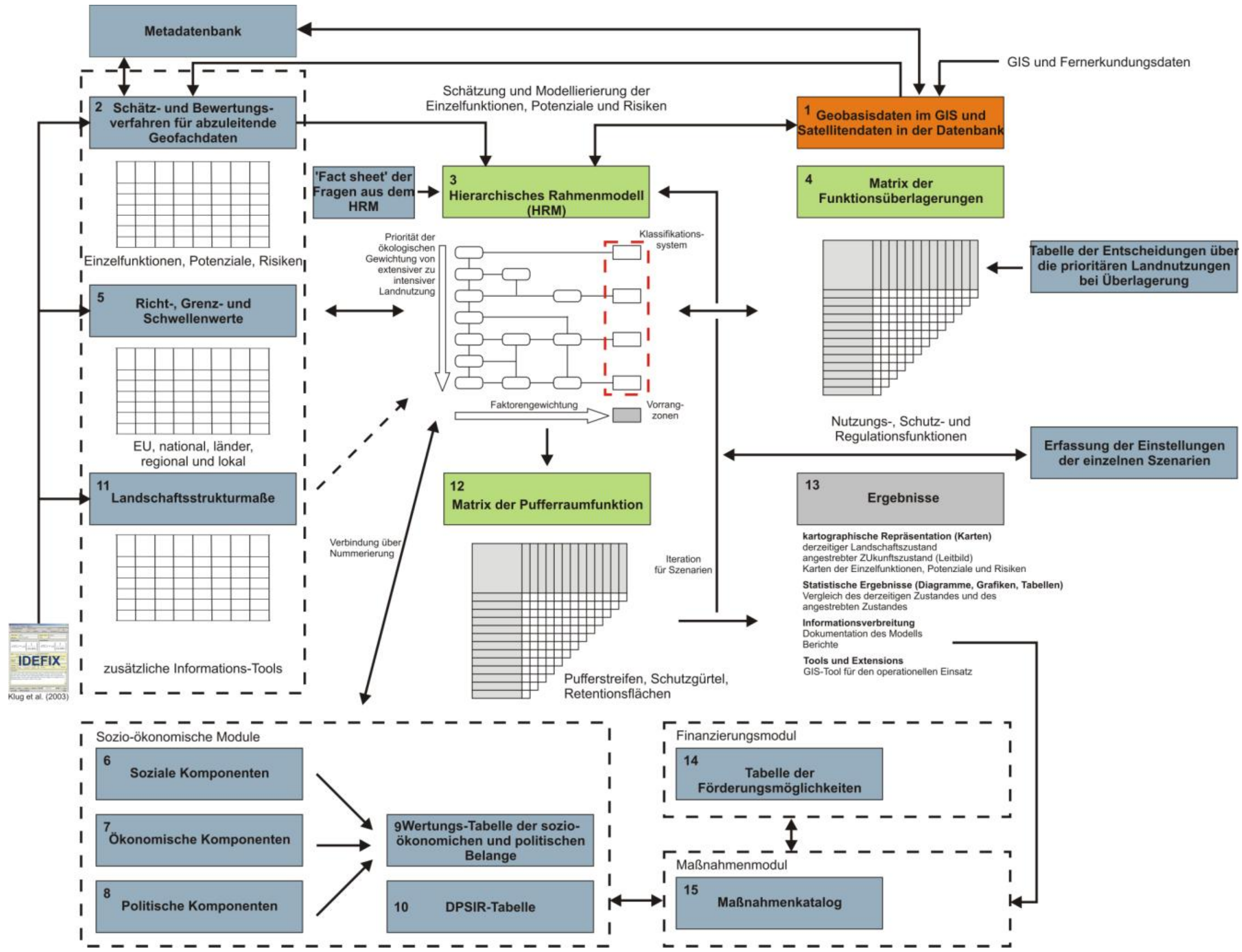

Abb.1: Das Modellkonzept der Leitbildableitung

Grundlegendes Ziel der Analyse ist es, Grundmerkmale des Naturhaushaltes mit seinen wesentlichen naturbürtigen Faktoren zu erfassen und darüber hinaus das Leistungsvermögen der landschaftlichen Funktionen und Potenziale gemessen an ökonomischen und sozialen Kriterien zu bestimmen. Die dabei aufgebaute Basis soll Planer in die Lage versetzen, die Leistungsfähigkeit, Belastbarkeit und Tragfähigkeit des Naturhaushaltes abschätzen zu können und infolgedessen durch eine standortgerechte Nutzung der Resourcen unwiederbringliche Schäden an diesen und der Umwelt in der Zukunftsplanung vorzubeugen. Es wird unter Berücksichtigung methodischer Gesichtspunkte Rücksicht auf die Wertschätzung des zugrundeliegenden Landschaftsökosystems genommen, indem Einzelleistungen und -potenziale ermittelt und miteinander in Beziehung gesetzt werden. Die Bewertungsmethode weist zudem entsprechende Vorgaben hinsichtlich gesetzlicher Rahmenrichtlinien auf. Damit wird ersichtlich, das das Verfahren auf raumplanerische und raumordnerische Belange zum Schutz, zur Pflege und zur Entwicklung von Landschaften konzipiert wurde und nicht den technischen Umweltschutz per se fokussiert.

Das Modell zeigt, dass eine Vielzahl unterschiedlicher räumlich expliziter Standortfaktoren "on demand" erfasst, bearbeitet und in einer Standortanalyse umgesetzt werden kann. Dies wiederum stellt eine der Grundfunktionen für eine partizipatorische Planung mit GIS dar. Diskutierte anthropogene Wertvorstellungen kombiniert mit ökonomischen Werten und politischen Rahmenbedingungen können so über in den Datensätzen vordefinierten Klasseneinteilungen "auf Zuruf" abgerufen und die Auswirkungen der Parameterfestlegungen direkt als Szenario visualisiert werden.

Das Konzept ist mehrschichtig aufgebaut und besteht aus einem Gesamtmodell (siehe Abb. 1) mit derzeit 15 Modulen. Die aggregierte Sichtweise auf das Konzept soll dessen übergeordnete Struktur verdeutlichen, ohne im Detail auf die einzelnen Module eingehen zu müssen. Bei der folgenden Vorstellung werden insbesondere die Module herausgehoben, die direkt in die Modellierung mit dem ModelBuilder involviert sind.

Die Struktur des Modells folgt dem praxisorientierten Arbeitsablauf zur Umsetzung von Landschaftsanalysen. Beginnend mit der Geodatenakquise von Geobasisdaten aus Quellen wie GIS und Fernerkundung **(1)**, werden Informationen zu deren Qualität und Herkunft in einer Metadatenbank abgelegt. Letzteres ist notwendig, um die Qualität der Analyse zu gewährleisten. Alle Daten werden schlussendlich in einer Geodatenbank mit Geobasisdaten zusammengeführt, ihre Attributdateien organisiert und die mit den Attributen zu verbindenden Tabellen aufgebaut.

Datenbestände die nicht vorliegen, können teilweise über Schätz- und Bewertungsverfahren **(2)** als Sekundärdaten ermittelt werden. Diese Schätz- und Bewertungsverfahren sind in diversen Einzelpublikationen als auch in Handbüchern publiziert (Marks et al. 1992, Zepp und Müller 1999, Bastian und Schreiber 1999, Usher und Erz 1994). Die in der Tabelle aufgeführten Verfahren sind aufgrund ihrer Struktur nicht immer direkt in einem GIS umzusetzen. Anpassungen sind zur Überführung in eine dem Computer verständliche binäre Struktur oftmals notwendig. Diese Anpassungen werden dokumentiert und mit den eruierten Daten wiederum in der Metadatenbank abgelegt. Die Sekundärdaten können als eine Inwertsetzung vorhandener Geobasisdaten zu "Konzeptkarten" angesehen werden, was in vielen Fällen eine aufwendige Gelände- und Laborarbeit vermindert. Der Ausdruck Konzeptkarte soll verdeutlichen, dass es sich um vorhersageorientierte Modelle der Verbreitung von räumlichen Einheiten handelt, die gegebenenfalls im Gelände verifiziert werden müssen.

Die Geobasisdaten und Sekundärdaten stellen schließlich die Basis für das hierarchische Rahmenmodell **(3)** dar. Das Herz des Modells beinhaltet eine auf Funktionen und Prozessen aufbauende Struktur, welches die Zuordnung von bestimmten Landnutzungs- / Landbedeckungseinheiten zur Erfüllung von "Benefits" und "Services" nach de Groot et al. (2002) zum Ziel hat. Die in der Einleitung angesprochenen komplexen Landschaftsökosystemzusammenhänge wurden in diesen Ablauf integriert und führen über prioritäre Ableitungen ökologischer Gewichtungen von extensiven zu intensiven Nutzungsformen. Eine entsprechende Faktorengewichtung führt schließlich zu einer für eine bestimmte Fläche vorgesehene Vorrangnutzung nach dem Prinzip von Haber (1971). Um bereits während der Erarbeitung von landschaftsspezifischen Problemen das wesentliche Merkmal der Leitbildfindung in Repräsentanz des expliziten Raumbezugs aufzugreifen und die Möglichkeiten einer tiefgehenden Analyse bieten zu können, ist es notwendig, die Untersuchungen in ihrem Detail auf unterschiedlichen räumlichen Skalen zu platzieren (Peterson und Parker 1998). An ihnen lassen sich Inhalt und Aussageschärfe separiert nach Betrachtungsebenen innerhalb dieses Systems messen und verschiedenen Planungs- und Zielebenen als Bezugseinheiten definieren.

Unter Beachtung der zugrundegelegten Umweltziele sind räumlich differenzierte Anfoderungen, Aussagen und Entwicklungsziele sowohl an die Daten als auch die Methoden zu stellen. Der deduktive Aufbau des hierarchischen Modells leitet Unterziele aus Oberzielen logisch, konsequent und konsistent ab. Das vorliegende Konzept mit dem Akronym OBELIX (***O***bject ***B***ased ***E***cological and Socio-Economical ***L***andscape Analys***i***s E***x***pert System) arbeitet derzeit auf zwei räumlichen Dimensionen (national, regional), wohingegen sich die dritte, die lokale Dimension, noch im Ausbau befindet. Bei der steigenden Komplexität des Modells ist jedoch stets darauf zu achten, dass bestimmte Funktionen und Prozesse als beobachtbare Phänomene zwingend dem richtigen Skalenbereich zuzuordnen sind, um eine Vergleichbarkeit mit anderen Prozessen und deren Interaktion zu ermöglichen. Entsprechend an die Dimensionen angepasst wurde ein Klassifikationssystem entwickelt, welches den jeweiligen Landnutzungs- und Landbedeckungseinheiten Rechnung trägt (vgl. Brown und Duh 2004). Bei der Erstellung des Klassifikationssystems wurde auf die Kompatibilität zu bestehenden Systemen wie Corine Land Cover oder Eunice geachtet, um Verbindungen zu anderen Ansätzen zu ermöglichen.

Zur Ableitung des aktuellen Landschaftszustandes in Repräsentation der Anordnung und expliziten Verortung von Flächen werden die Landbedeckungseinheiten auf eine ASTER Satellitenbildszene ermittelt. Einhergehend werden diejenigen Funktionen betrachtet, die sich flächenhaft überlagern / mit Einschränkungen überlagern / nicht überlagern dürfen **(4)**.

Ferner integriert das hierarchische Rahmenmodell diverse Richt-, Grenz- und Schwellenwerte aus der Literatur sowie der staatlichen bzw. der übergeordneten EU Gesetztgebung **(5)**.

Als wesentliche Neuerung des Systems sind die Module **6 - 10** integriert. Diese greifen für den Entscheidungsprozess wichtige sozio-ökonomische und politische Fragestellungen auf und dokumentieren diese Entscheidungen für eine definierte Entwicklungsrichtung unter Verknüpfung im hierarchischen Rahmenmodell numeriert vorliegender Prozesse in Datenbanken.

Modul **11** integriert Landschaftsstrukturmaße indirekt in die Leitbildanalyse. Eine direkte Integration ist aufrund derzeit noch bestehender Problemen nicht möglich (Klug und Blaschke 2003, Klug und Zeil 2004). Im Zusammenhang mit dem Modul der Landschaftsstrukturmaße steht das Tool IDEFIX (***I***ndicator ***D***atabas***e*** for Scienti***fi***c E***x***change), welches von Klug et al. (2003) im Rahmen des im fünften Rahmenprgramm der EU finanzierten Projektes SPIN (Spatial Indicators for Nature Conservation, www.spin-project.org) entwickelt wurde.

Nach dem semi-operationellen Durchlauf des hierarchischen Rahmenmodells wird die Untersuchungslandschaft in einem Zwischenergebnis mit flächenexpliziten Vorrangnutzungen repräsentiert. Das Zwischenergebnis kann jedoch noch horizontal ungeschlossene Stoffkreisläufe aufweisen. Eine Matrix der Pufferraumfunktionen gibt Aufschluss darüber, welche Nutzungen noch durch Retentionsstreifen wie Kompensationszonen zu entkoppeln sind **(12)**.

Als Resultat wird ein Szenario abgebildet, welches unter gegebenen Umständen die Entwicklungtendenz der zukünftigen Landschaft darstellt. Eine Iteration des Modells führt zur weiteren Ausdifferenzierung dieses Szenarios bzw. zu neuen Szenarien optionaler Entwicklungsrichtungen mit unterschiedlich prioritären Sichtweisen von Einzelparametern. Die Szenarien bilden schlussendlich die Diskussionsbasis aufgrund dessen ein transdisziplinärer Konsens hinsichtlich der Entwicklungsrichtung zu ergründen ist. Aufgrund festzulegender Kriterien aus der partizipatorischen Diskussion werden Vorrangflächen für bestimmte Landnutzungen/Landbedeckungen ausgewiesen, die die jeweilig definierten Rahmenbedingungen wie Förderungen, ökonomisches Wirtschaften etc. berücksichtigen. Um die bestehenden flächenhaften Diskrepanzen im Vergleich der aktuellen Umweltsituation mit dem zukünftig anzustrebenden Landschaftszustand näher zu analysieren, wurden kleinere Tools entwickelt. Mit diesen Werkzeugen wird über Tabellen, Diagramme und Karten das Handlungspotenzial der Landschaft dargestellt. Das sich ergebende Handlungspotenzial muss trotz der bereits im hierarchischen Rahmenmodell berücksichtigten Finanzsituation über Fördermittel und Ausgleichszahlungen **(14)** auf Grundlage des erstellten Maßnahmenkatalogs **(15)** noch einmal überprüft werden. Erst diese abschließende Prüfung gibt Gewissheit, ob die angestrebte Entwicklung auch umsetzbar ist. Ist die Finanzierung nicht gesichert, sind die in den sozio-ökonomischen Modulen erfolgten Entscheidungen zu überprüfen und gegebenenfalls zu revidieren.

Abschließend ist herauszustellen, dass die einzelnen Module wie zum Beispiel die Tabelle der Schätz- und Bewertungsverfahren als auch die Tabelle der Richt-, Grenz- und Schwellenwerte keinen Anspruch auf Vollständigkeit erheben können. Vielmehr werden Informationen bereitgestellt, auf Grundlage dessen eine Weiterarbeit möglich ist.

2.2 Die technische Umsetzung

2.2.1 Einführung in die technische Basis

Das die derzeitige Landschaftsökologie und Landschaftsplanung und dessen methodischen Fähigkeiten nicht immer, wie so oft reklamiert, im diametralen Verhältnis zu den Anforderungen der Praxis stehen, soll mit dem voliegenden Prototyp OBELIX demonstriert werden. Es wird argumentiert, dass eine Abschätzung von derzeitigen Landschaftszuständen auf zugrunde liegende Funktionen und Prozesse sowie der Auswirkungen zukünftiger Einflussnahmen und Steuerungen auf diese nur über Geografische Informationssysteme im Vorfeld abgeschätzt werden können. Das Management der ungeheuren Informationsflut mit GIS soll verhindern, dass Prozessstrukturen sich in eine Richtung entwickeln, die zu einer Reihe nachteiliger Wirkungen tendieren. Die dafür in Kapitel 2.1 zugrundegelegte Methode versteht sich als offenes System, dessen Einzelkomponenten jederzeit adaptiert oder ausgetauscht werden können. Dies folgt den Anforderungen von Bastian (1999), der bereits treffend feststellte, dass es nicht nur *eine* Lösung für ein Problem gibt - schon gar nicht bei der Vielfältigkeit an Landschaften. Trotz der zunächst einmal zur Resignation verleitenden Diversität an Möglichkeiten einer Zukunftsplanung und deren potenziellen Fehlplanungen, lässt sich zweifelsohne im Umkehrschluss nicht ableiten, dass eine Steuerung und Einflussnahme sinnlos wäre. Daher ist es für ein Vorantreiben einer pro-aktiven Zukunftsplanung notwendig, die richtigen Prinzipien und Ansätze, kombiniert mit nützlichen Tools an der Hand zu haben. Technisch stehen dafür, in der ArcToolbox von ArcGIS, mehr als 200 Methoden bereit die durch im Internet vorhandene Tools und Skripte ergänzt werden können. Diese können in Form von Dialogen, über die Kommandozeile, einem Skript oder einem Modell genutzt werden. In dieser Arbeit wird eine Kombination aus letzteren als zielführend erachtet. Die entwickelten Modelle und Python-Skripte können, unter etwaiger Modifizierung und Anpassung an die Datenlage sowie den räumlichen Gegebenheiten, direkt in die Arbeitsabläufe der Leitbildfindung integriert werden. Die einzelnen Tools (oder auch Entitäten genannt), wie die hier exemplarisch vorgestellte Ableitung der Hangneigung, werden schließlich zu einem Toolset, dem hierarchischen Rahmenmodell (vgl. Abbildung 1, Punkt 3), zusammengesetzt und bilden die Basis der semi-operationellen Ableitung von Leitbildern über Zukunftsszenarien. Der Benutzer wird damit in die Lage versetzt, nicht nur monodisziplinäre Prozesse zu berechnen, sondern darüber hinaus Abläufe über Prozessketten in ihrer Wechselwirkung in Kontext zu stellen. Bei der technischen Implementation stellte sich heraus, dass verschiedene Lösungswege möglich sind, wohingegen einige efektiver und zielgerichteter sind als andere. Damit wird die Notwendigkeit ersichtlich, dass das bereitgestellte Modell ebenso wie die methodische Basis zu dokumentieren ist. Dies erfolgte mit den ArcGIS immanenten Dokumentationstools.

Hauptziele der Anwendung sind demzufolge die Präparierung, (Geo-)Prozessierung und Manipulation von Daten. Dies dient dem Hintergrund der Informationsgewinnung durch gesteigerten Kenntnis des aktuellen Landschaftshaushaltes sowie dessen auszunutzenden endogenen Potentialen.

2.2.2 Datenpräparierung

Komplexe raumbezogene Fragestellungen und Informationssysteme leben maßgeblich von den verfügbaren Daten, deren Qualität und Aufbereitung. Aus dem Grund ist die Datenbasis mit dem Datenmanagement die tragende Säule in OBELIX. Zunächst werden die benötigten Daten über eine Akquise erhoben, aufbereitet (geometrische Korrekturen, Umprojektionen, Metadatenmanagement, Genauigkeitsvalidierung, etc.) und in einer Geodatenbank abgelegt. Fehlende Daten werden über Schätz- und Bewertungsverfahren zu Sekundärdaten abgeleitet und in einer zweiten Geodatenbank abgelegt (vgl. Kapitel 2.2.3). Das Management der Geodaten in separaten Datenbanken (Geobasisdaten, Sekundärdaten, Zwischenderivatdaten) dient der Sicherung der Originaldaten, der prozessierten Daten sowie den während der Ableitung anfallenden Zwischenderivaten.

Im Allgemeinen ist es zwingend notwendig, die Herkunft der in einem Modell verwendeten Daten zu kennen. Dies impliziert vorhandene Informationen über Daten - sogenannte Metadaten. Nur sie stellen die Aktualität, die Qualität des Produkts, die Auflösung und räumliche Dimension sowie die Genauigkeit der räumlichen Repräsentation dar. Dies wiederum ist erforderlich, um sich durch Verschneidung multiplizierende Fehler, infolge intransparenter Generalisierungen, Reklassifizierungen oder anderweitig beeinflusste Datenbestände, auszuschließen.

2.2.3 Analyse

Von der Theorie erfolgt die Überleitung zum Kern der ungelösten Probleme in der Praxis. Die Erfassung, Verwaltung und Verarbeitung digitaler Geoinformationen erfolgt seit geraumer Zeit mit Geoinformationssystemen (GIS), dessen Plattform auf die in einer Datenbank abgelegten Daten interagiert. Mit Hilfe entsprechender Analysewerkzeuge wie dem ArcGIS 9.x ModelBuilder als fester Bestandteil der ArcToolbox, die wiederum in ArcMap und ArcCatalog integriert ist, können in der Folge durch Extraktion, Kombination und Präsentation (Visualisierung) der Datenbankinhalte neue Informationen gewonnen werden. Diese fungieren ihrerseits als Steuer- und Entscheidungsgrößen für die Landschaftsplanung. Um das Management der vielfältigen Daten, deren Prozessierungsschritte, Parameterzuweisungen, Annahmen und Regelwerke zu erleichtern, wurde zur Umsetzung auf Grundlage der in Kapitel 2.1 beschriebenen Methode ein räumliches Modell im ModelBuilder entwickelt. Die modulare Struktur der Leitbildmethode wird direkt übertragen und die einzelnen Module - wie zum Beipiel die Umsetzung der einzelnen Schätz- und Bewertungsverfahren - als Modelle in das übergeordnete hierarchische Rahmenmodell integriert. Dies stellt die Möglichkeit zur Verfügung, in sich abgeschlossene Prozeduren jeweils an den aktuellen Stand der Wissenschaft anzupassen und damit auch das Gesamtmodell im Verlauf der Zeit weiter zu adaptieren und zu optimieren. Ferner wird unter Berücksichtigung der zugrundeliegenden Submodule, deren Daten und den Operationen auf ihnen die Möglichkeit zuteil, die sequenziellen Prozessierungsschritte innerhalb eines Flussdiagramms abzubilden. Das Flussdiagramm repräsentiert wie in Abbildung 2 exemplarisch für das Submodell zur Berechnung der Hangneigung dargestellt, miteinander verbundene Elementtypen der in der analytischen Struktur definierten Prozedur. Während der Prozessierung werden alle Einzelschritte in einem Fortschrittsfenster und dem Informationsfenster der Kommandozeilenoberfläche mitprotokolliert. Über die "history toolbox" besteht zudem die Möglichkeit der nachträglichen Überprüfung der einzelnen Prozessschritte.

Obschon eine Prozessierung des Gesamtmodells in einem Ablauf möglich wäre, ist dies im Sinne der Performance wenig sinnvoll. Vielmehr wird mit der Einzelprozessoperationalisierung eine modulare Abarbeitung angestrebt. Die dafür verwendeten Skripte wurden auf generische Weise programmiert. Die generische Codierung beinhaltet, dass alle Eingaben und Ausgaben durch Argumente in Form einer grafischen Benutzeroberflächen abgehandelt werden und durch ein Verzicht einer "harten Codierung" die Weiterverbreitung der Modelle ermöglicht wird. Ferner wurden die Funktionalitäten der Modelle und Skripte über das Projekt hinaus soweit ergänzt, dass eine Prozessierung verschiedener Datensätze (Geodatenbank "feature class", Shapefile, Coverage) möglich wird.

Nach der erfolgreichen Umsetzung der Submodule mit den zugrundeliegenden Projektdaten wird der im ModelBuilder erzeugte Arbeitsablauf so abgeändert, dass Variablen als Modellparameter definiert werden. Die Ausweisung von Modellparametern verleiht dem Praktiker die Flexibilität der Spezifizierung von Wertparametern und zu verändernder Variablen für die Szenarioanalysen in einer dialoggestützen Umsetzung des Modells. Kriterien zur Gewichtung der Submodulparameter und damit die Einflussnahme auf Ergebnisse auf Grundlage von Entscheidungskriterien können damit transparent umgesezt werden. Zur Erleichterung der Integration der Submodule in das Primärmodell erfolgt die Exportierung des im ModelBuilder erstellten Submoduls als Python Skript. Diese werden in der ArcToolbox eingebunden und weisen den Vorteil der umgänglicher strukturierten und besser kontrollierbaren Prozessierung des hierarchischen Rahmenmodells in einem separaten Modell auf. Durch eine automatische Addierung der berechneten Ergebnisse steht auch nicht-GIS-Experten die Möglichkeit offen, verschiedene Szenarien umzusetzen, damit Alternativen zu erzeugen, diese zu interpretieren und zu bewerten.

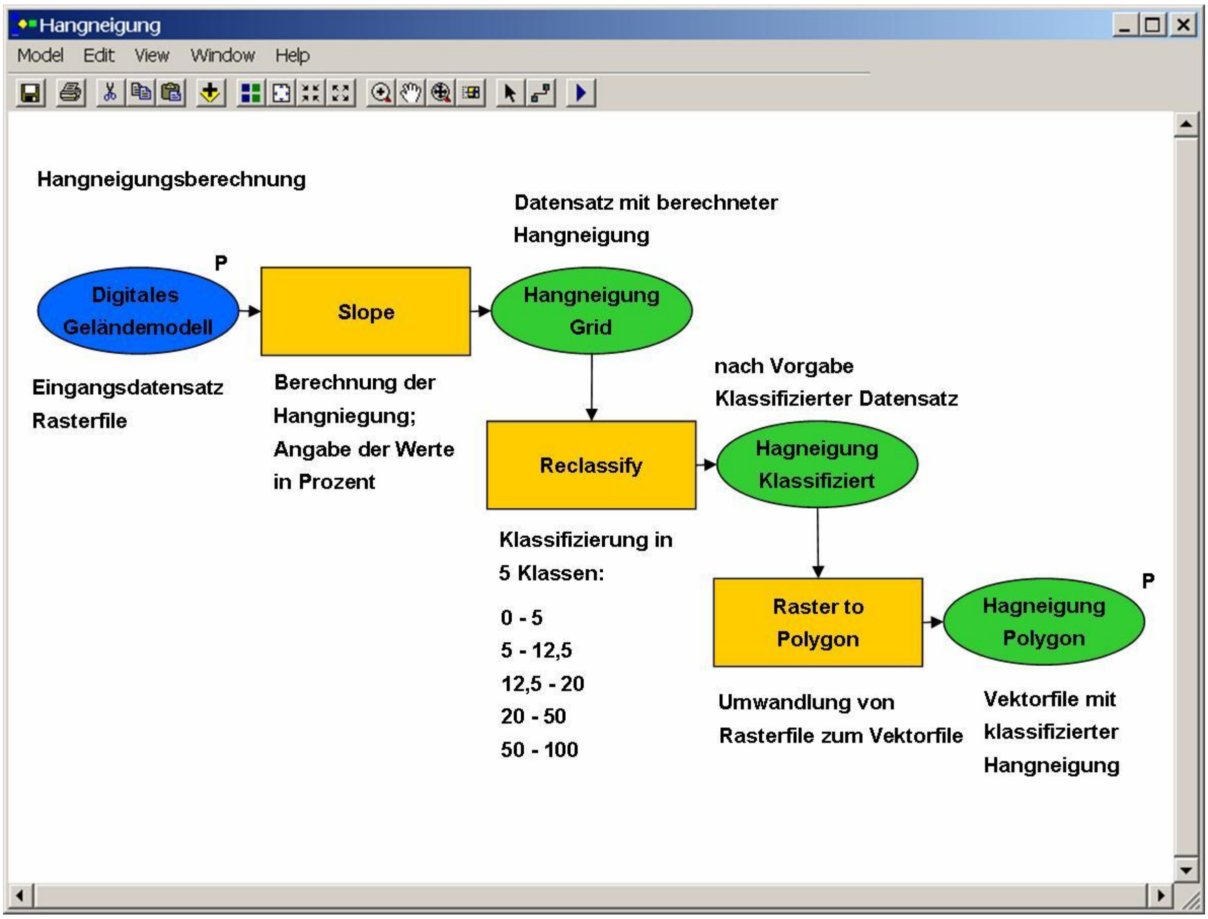

Abb.2: Berechnung der Hangneigung als Beispiel für ein Modul aus dem Gesamtmodell

2.2.4 Modellvalidierung

Die Modellvalidierung von OBELIX ist noch nicht abgeschlossen. Bereits durchgeführt wurde die Verifizierung der Berechnungsergebnisse aus den Submodulen. Ferner ist eine Berechnung mit identischem Ergebnis durch Wiederholungen der Analyse mit gleichen Wertparametern sichergestellt. Darüber hinaus muss noch das Verhalten und die Bedeutung der Einzelvariablen im Gesamtmodell überprüft werden. Die Gewichtung der Parameter der Submodule als auch die Kategorisierung der Ergebnisse und deren Stellung im Gesamtmodell sind entscheidende Kriterien zur Plausibilitätsprüfung des Endergebnisses der Analyse. Es ist wichtig herauszustellen, welche Signifikanz und damit Einfluss ein Aspekt auf das Gesamtergebnis hat. Diese Einflussanalyse des bestehenden Projektes ist noch nicht abgeschlossen, wird aber im Rahmen des Interreg IIIa Projektes "Seenlandwirtschaft" (www.seenandwirtschaft.net) durchgeführt.

2.2.5 Dokumentation

Begleitende Informationen zur Umsetzung und zum Zweck der Anwendung sowie die zu spezifizierenden Parameter und deren inhaltliche Bedeutung sind entscheidene Kriterien zur Beweisführung der getroffenen Einzelentscheidungen sowie den resultierenden

Ergebnissen. Inbegriffen sind die Evaluierungen, inwieweit Parameter sich auf das (Zwischen-)Ergebnis auswirken und welche Bedeutung ihnen damit zukommt. Diese Beschreibung dienen zur folgerichtigen Darlegung und Überzeugung von zur Entscheidung befugten Personen sowie der Legitimation der Analyse. Metadaten geben als hilfreiche Instruktionen Aufschluss über Modellkennzeichnungen. Tooltips erklären die Modulebausteine und deren Verhalten. Die Bedeutung der zugrundeliegenden Daten, deren Aussagegehalt, deren Skalierung und Dimension sowie Hinweise auf mögliche Fehler, Limitationen, Einschränkungen, Anwendungsgrenzen und Vorteile gegenüber anderen Methoden sind in Form eines roten Fadens durch die GIS-Analyse abgelegt. Diese Art der Anwendungs- und Anwenderkommunikation trägt unterstützend zur Wiederholbarkeit und damit zur Transparenz der Analyse bei und erlaubt darüber hinaus ein regelgerechtes adaptieren und weiterverarbeiten bzw. die Verifizierung der Methode.

3 ERGEBNISSE

Der Wissenschaft wird oft nachgesagt, anstehende Probleme zu theoretisieren, was sich schlussendlich in der Entwicklung von nicht praxistauglichen Methoden widerspiegelt. Bedenken dieser Art sind mir wohl bekannt, allerdings ist diese Polarisierung wenig zielführend. Wie das vorliegende Modell zeigt, lassen sich mit theoretisch abstrahierten Überlegungen sehr wohl praxisrelevante und praxistaugliche Werkzeuge generieren. Im Rahmen der Forschungen ist es gelungen, die wichtigen Vorteile wie die Automatisierung von Arbeitsabläufen, deren leichten Anpassbarkeit durch ihre grafische Repräsentation, der Übertragbarkeit unter Anwendern sowie der Transparenz der Umsetzung durch Spezifizierung der Eingangsparameter als Prozessbausteine für die semiautomatische Abhandlung in ArcGIS 9.x anzubieten. Ferner lassen sich simple Module als Submodule zu komplexen Modellen aggregieren, um die umfassenden Abhängigkeiten und Verbindungen der Submodule untereinander zu visualisieren und zu prozessieren. OBELIX steht damit für innovative Methoden, die effizient über maßgeschneiderte Softwarelösungen in ArcGIS 9.x mit hoher Performance realisiert sind. Zur Ergänzung zu bereits bestehenden GIS-Lösungen wird damit ein Tool angeboten, das in der Lage ist, umweltrelevante Standardprobleme mittels räumlichen Datenverarbeitung anzugehen. Neben der technischen Stärke der Werkzeuge ist aber zu beachten, dass die Tools nicht als "trial and error Legobaukasten" misbraucht werden. Die Aussagekraft der einzelnen Modelle per se als auch deren Kombination ist stets im Sinne ihrer Abhängigkeiten und der zur eruierenden Frage zu hinterfragen.

Das Modell ist derzeit ein Prototyp, welcher noch in keiner partizipatorischen Planung eingesetzt wurde. Erste Testläufe auf Basis von Datensätzen eines Gebietes nördlich von Braunau am Inn (Deutschland) und im Einzugsgebiet von Mondsee und Irrsee (Österreich) enttäuschen die Erwartungen nicht. Allerdings kann herausgestellt werden, dass OBELIX stark von der Datenbasis und deren Struktur abhängig und deswegen derzeit auf die dem Z_GIS (Zentrum für GeoInformatik, Universität Salzburg) vorliegende GIS-Datenbasis ausgerichtet ist. Eine Nutzung des Modellsystems ist deshalb noch an diese Infrastruktur gebunden, wobei die methodische Basis der Teilmodelle als generische, parameterisierte Module weiterverbreitet werden können. Letztere zeigen, dass OBELIX ein System mit offener Struktur ist, welches über Modifikationen der einzelnen Module im ModelBuilder an die regionalen Rahmenbedingungen adaptiert werden kann. Es trägt damit zur raumübergreifenden und übertragbaren Methodik bei. Dadurch wird ersichtlich, dass der Transfer der theoretischen Basis in die Praxis zumindest in den vorliegenden zwei Testgebieten sichergestellt ist. Darüber hinaus zeigt sich, auch nach Erfahrungen von Klug (2000), dass die räumliche Übertragbarkeit der Methode und damit auch der Tools möglich ist.

Die Erfahrungen der Umsetzung zeigen, dass bestehende ökologisch-wissenschaftliche Methoden teilweise erheblich modifiziert werden müssen, um sie in eine dem Computer verständliche binäre Modellstruktur zu überführen. Ferner ist der benötigte Zeitaufwand der Zusammenführung der Datenbestände sowie des Datenmanagements enorm. Andererseits kann der Semiautomatismus für eine komplexe Landschaftsanalyse eine finanziell günstige Form der Zukunftsplanung von Landschaften sein, wenn bestehende Datenstrukturen genutzt werden können.

Es lässt sich konkludieren, dass die Möglichkeit der Eruierung verschiedenster Potenziale und Risiken mit Herausstellung sensibler Bereiche für die Landschaftsplanung und direkte Umsetzung der Sensibilitäten in eine den Standorten angepassten Vorrangnutzung diverse Anwendungsmöglichkeiten von OBELIX im Naturschutz und Planungsdisziplinen offerieren. Damit kann das Projekt einerseits Hilfestellung in der Umsetzung wissenschaftlicher Methoden in die Praxis leisten, andererseits aber die Missstände der fehlenden Datengrundlagen, die Schwierigkeit der Datenzusammenführung und der nicht vorhandenen Metadatenbestände nicht lösen. Schlussfolgernd ist zu bemerken, dass erst mit einer Änderung der Geodatenpolitik der Staaten Europas und der Art der Datenhaltung bei den Behörden eine zeitgerechtere und damit kostengünstigere Umsetzung komplexer Fragestellungen möglich sein wird.

4 SCHLUSSFOLGERUNG UND AUSBLICK

Wie bereits einleitend dargelegt, ist die derzeitige Landschaftsplanung bestrebt, monodisziplinäre Betrachtungsweisen durch fachübergreifenden Analysen weiter zu entwickeln. Diese Absichtserklärungen stecken ebenso wie die Entwicklung eines Qualitätsstandards für Landschaften innerhalb der EU sowohl methodisch als auch praktisch noch in den Kinderschuhen. In der behördlichen Planungspraxis sind sie zum Teil nur theoretisch verankert. Auch Universitäten und Forschungseinrichtungen tun sich schwer, interdisziplinäre Forschung zu betreiben bzw. konkret umzusetzen. Mit dieser Arbeit kann gezeigt werden, dass die Erweiterung des Verständnisses über landschaftshaushaltliche Prozessstrukturen innerhalb eines transdisziplinären Ansatzes als eine Erweiterung der Interdisziplinarität durchaus große Perspektiven in der Landschaftsplanung aufweist. Als Schlüssel für eine disziplinübergreifende Landschaftsplanung, unter Integration der lokalen Bevölkerung sowie sozio-ökonomischen und politischen Interessensvertretungen, werden technologische Errungenschaften wie Geografische Informationssysteme angesehen.

Mit der Tendenz der immer geringer zur Verfügung stehender finanziellen Ressourcen von Ländern, Staaten und der Europäischen Gemeinschaft, müssen Fördergelder und Subventionen zielgerichtet und den Handlungsanforderungen entsprechend verteilt werden. Bei allen Planungen wird daher vor allem durch methodische Ansätze des Flächenmanagements darauf hinzuwirken sein, maximale Effekte mit möglichst minimalen Ressourceneinsatz zu erzielen. Jeder Landschaftsraum besitzt zahlreiche Funktionen und Potenziale die je nach ihrer Ausprägung Handlungsspielraum für zukünftige Nutzungen bieten. Die "optimale" Inwertsetzung dieser Potenziale soll über die Bewertung und Inbezugsetzung der einzelnen Teilvermögen sowie über strategische sozio-ökonomiche Planungsziele als auch über ökologische Risiko- und Konfliktbewertungen einer räumlichen Gesamtabwägung ermittelt werden. Mit dem vorgestellten System lassen sich gemessen an ihrem Potenzial extrem unterentwickelte Landschaftstypen ausweisen und durch speziell zu eruierende Maßnahmenprogramme eine zielgerichtete Aufwertung der Landschaft gewährleisten. Damit kann ebenfalls ein Wettbewerb von Landschaftsregionen hervorgerufen werden, die durch konkurrierende Konzepte einen positiven Impuls in Richtung ökologisch nachhaltiger Landschaftsplanung geben können. Durch konkrete Zielvorstellung der Entwicklung von Landschaften kann ebenfalls über Monitoringprogramme halbherzig durchgeführten Renaturierungen und Entwicklungen entgegengewirkt werden. Darüber hinaus besteht durch Evaluationsprozeduren die Möglichkeit, den zielgerichteten Einsatz der Mittel nachzuvollziehen und zu bewerten. Der Vergleich des ökologischen Zustandes der Landschaft innerhalb des propagierten Monitoringverfahrens garantiert damit eine effiziente Nutzung der finanziellen Ressourcen.

Die Zielvorstellung einer in Europa raumübergreifenden Bewertung von Landschaften begründet sich aus den Betrebungen diverser EU Rahmenrichtlinien heraus. Wie bereits gesetzlich verankert, wird in der EU Wasserrahmenrichtlinie (Richtlinie 2000/60/EG) und der Natura 2000 Richtlinie (Richtlinie 79/409/EG und Richtlinie 92/43/EWG) versucht, europaweite Bewertungsrichtlinien zu formulieren, anhand dessen einzelne Staaten, Länder und Regionen gemessen und miteinander verglichen werden können. Dieser Modellkomplex wurde unter anderem entwickelt, um eine praktikable Vorgehensweise für europaweit vergleichbare Berichten mit Bewertungs-, Beurteilungs- und Darstellungsstandards, die skalenübergreifend anzuwenden sind, anzustreben. Das vorliegende Modell widerspiegelt einen ersten ausbaufähigen Versuch, diverse Landschaftstypen mitteleuropas nach ähnlichem Schema auf vergleichbare Art und Weise zu analysieren. Es ist jedoch deutlich herauszustellen, dass mit dem vorliegenden Modell weder der planerische noch politische Entscheid aufgehoben ist. Gesellschaftliche Normen bestimmen letztendlich die Güte eines landschaftlichen Potenzials oder Leistungsvermögen und bestimmen, für welchen Zweck oder in welcher Intensität dieses genutzt werden um die daraus gezogenen Benefits und Severices zu ernten. Abschließend sei noch angemerkt, dass im heutigen Computerzeitalter GIS und Fernerkundung als technische Hilfsmittel einen wichtigen Anteil an der Umsetzung von Planung beitragen, diese aber kein Ersatz für Datenerhebung und Bewertungsmethodik sein kann.

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Soziale Tragfähigkeitsgrenzen für Freizeitaktivitäten in städtischen Erholungsgebieten

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KURZFASSUNG

Für das Hauptwegenetz des Erholungsgebietes Wienerberg in Wien wurde die soziale Tragfähigkeitsgrenze der Besucher für die Freizeitaktivitäten Joggen und Radfahren erhoben. Anhand eines Wahlmodells wurden 128 Szenarien des Besucheraufkommens mittels computergenerierten Fotomontagen dargestellt. Diese Szenarien enthielten systematisch sechs Attribute in jeweils unterschiedlicher Ausprägung. Die dargestellten Attribute waren Besucheranzahl, Nutzerzusammensetzung, Verteilung der Besucher im Bild, Gruppengröße, Gehrichtung sowie Hundeanzahl und Anleinrate.

Die Befragten evaluierten diese Szenarien mittels eines „trade-off"-Ansatzes und hatten dabei die Bedeutung der jeweiligen Ausprägung der sechs Attribute abzuwägen. Die soziale Tragfähigkeitsgrenze wurde erfasst, indem die Besucher gefragt wurden, ob die ausgewählten Szenarien für die beiden Freizeitaktivitäten noch tolerierbar seien oder nicht. Ergebnis war der jeweilige Anteil an Befragten, die ein Ausweichverhalten in Abhängigkeit der gezeigten Szenarien anwenden würden. Alle Attribute hatten einen Einfluss auf die Ausübung der Aktivität Radfahren, fünf Attribute auf die Aktivität Joggen. Eine hohe Besucheranzahl, eine heterogene Nutzerzusammensetzung, freilaufende Hunde, Personen die im Bildvordergrund dargestellt waren und eine kleine Gruppengröße behinderten die Ausübung der Aktivitäten. Für die zwei untersuchten Freizeitaktivitäten ergaben sich auch unterschiedliche Toleranzgrenzen. Für die Aktivität Radfahren lagen die Toleranzgrenzen deutlich niedriger als für die Aktivität Joggen.

1 EINLEITUNG

1.1 Tragfähigkeitsgrenzen und Ausweichverhalten

Im urbanen Umfeld, welches eine Vielzahl an alltäglichen Sozialkontakten mit sich bringt, sind Erholungsgebiete, die eine ungestörte Ausübung von Freizeitaktivitäten ermöglichen, von großer Bedeutung. Hohe Besucherzahlen, Nutzerkonflikte oder unerwünschte Verhaltensweisen anderer Besucher reduzieren jedoch das Erholungserlebnis und behindern die Ausübung von Freizeitaktivitäten. Aufgrund überschrittener sozialer Tragfähigkeitsgrenzen (Shelby, Heberlein 1986) wenden die Erholungssuchenden adaptives Verhalten an, welches sich in einem räumlichen Ausweichen innerhalb des Erholungsgebietes oder auf andere Erholungsgebiete, in der Ausübung anderer Freizeitaktivitäten oder in einem zeitlichen Ausweichen beispielsweise zu Tagesrandzeiten manifestieren kann (Robertson, Regula 1994, Shelby et al. 1988, Arnberger, Brandenburg 2002). Substitutionseffekte können auch dahingehend auftreten, dass bisher nicht als Erholungsgebiete deklarierte Flächen einer Erholungsnutzung unterworfen werden.

Personen, die mobil sind bzw. denen ein leistungsfähiges öffentliches Verkehrsnetz zur Verfügung steht, können Erholungsgebiete mit einer für sie angenehmen Besucherdichte und Besucherstruktur aufsuchen, wodurch eine Erhöhung des Erholungsdruckes in diesen Gebieten induziert wird. Personen hingegen, die eine niedrigere Empfindungsschwelle gegenüber einem hohen Besucheraufkommen haben, sowie Personen, denen ein Ausweichen nicht möglich ist, werden künftig am Besucheraufkommen in diesem stark besuchten Erholungsgebiet stärker vertreten sein (Graefe et al. 1984, Manning 1999).

Von hohen Besucherströmen sind insbesondere jene Besuchergruppen betroffen, für die das Erholungsgebiet Teil des alltäglich aufgesuchten Wohnumfeldes darstellt (Kerstin-Koeberle 1979, Arnberger, Brandenburg 2001). Diese oft immobilen Gruppen sind auf einen nutzbaren Erholungsraum vor ihrer Haustür angewiesen, wo sie den Hund ausführen, joggen, Rad fahren, Kinder an die frische Luft bringen oder einen kurzen Spaziergang unternehmen können. Neben den maximalen sozialen Tragfähigkeitsgrenzen in Erholungsgebieten spielen auch soziale Minimumkapazitäten eine Rolle. Ein mangelndes Sicherheitsgefühl, hervorgerufen durch zu geringe Besucherzahlen in einem urbanen Erholungsgebiet (Luymes, Tamminga 1995), führt ebenfalls zu einem Ausweichverhalten oder zu einer Verlagerung der Nutzungszeiten seitens bestimmter Nutzergruppen.

Die durch Überschreitungen der sozialen Tragfähigkeitsgrenze ausgelösten Verdrängungs- und Ausweichprozesse (Manning 1999, Shelby, Heberlein 1986) induzieren somit nicht nur auf lokaler, sondern auch auf stadtregionaler Ebene Auswirkungen. Die Kenntnis sozialer Tragfähigkeitsgrenzen für Freizeitaktivitäten wie Joggen und Radfahren ist aufgrund der weitreichenden Auswirkungen des Ausweichverhaltens sowohl für das Gebietsmanagement als auch für die Stadtplanung von außerordentlicher Relevanz. Doch fehlen für Erholungsgebiete solche Grundlagendaten. Die zentrale Fragestellung ist somit, ab welchen Zuständen des Besuchsaufkommens die oben angeführten Auswirkungen zum Tragen kommen. Ab welcher Anzahl an Personen, Art der Zusammensetzung der Nutzergruppen oder Ausmaß an unerwünschten Verhaltensweisen entschließen sich die Besucher das Erholungsgebiet künftig zu anderen Zeiten aufzusuchen oder überhaupt von einem Besuch Abstand zu nehmen, um ihre präferierten Freizeitaktivitäten ausüben zu können?

1.2 Sozialpsychologische Grundlagen über die Wahrnehmung des Besucheraufkommens

Zwei Konzpte, die für die Beurteilung des Besucheraufkommens in Erholungsgebieten herangezogen werden, sind die Theorie der sozialen Reizüberflutung ("stimulus overload") und die Theorie der sozialen Interferenz ("social interference"). Beide Theorien entstammen der Umwelt- und Sozialpsychologie und wurden für die Erklärung des wahrgenommenen Besucheraufkommens in Erholungsgebieten adaptiert (Andereck, Becker 1993; Gramann 1982).

Soziale Reizüberflutung

Die Theorie der Reizüberflutung basiert auf sozialpsychologischen Erkenntnissen über Stresserscheinungen in städtischen, dicht besiedelten Wohnbereichen (Milgram 1970). Eine Reizüberflutung entsteht, wenn es zu zu vielen unerwarteten, unerwünschten und unkontrollierbaren sozialen Interaktionen und Kontakten kommt (Andereck, Becker 1993). Unsicherheit und Unkontrollierbarkeit, die Anzahl und Dauer an Interaktionen und die Heterogenität der Angetroffenen verursachen bei den Erholungssuchenden hohe psychische Stresszustände (vgl. Gramann 1982). Hochkomplexe und unübersichtliche Umwelten (Sundstrom 1978) sowie durch hohe Besucherzahlen negativ beeinflusste Gebietskonditionen verstärken die negative Wahrnehmung von Besucherströmen. Liegen diese über dem präferierten individuellen Stimulationszustand, und schlagen die individuellen adaptiven Verhaltensstrategien zur Reduktion dieser Reizüberflutung fehl, so kommt es zum subjektiven Empfinden zu hoher Besucherströme (Andereck, Becker 1993). Strategien zur Reduktion zu vieler sozialer Stimuli inkludieren eine Reduktion der Interaktionen mit der Umwelt, eine Konzentration auf das nur Allernotwendigste, Selbstisolation und eine Reduktion motorischer Aktivitäten (Evans 1978, Baum, Paulus 1991). So reduzierten Personen, die einem hohen Level an sozialen Stimuli ausgesetzt sind, Augenkontakt und Berührungen mit ihren Mitmenschen.

Soziale Interferenz

Die Wahrnehmung zu hoher Besucherströme stellt sich auch dann ein, wenn die Besucherdichte, die räumlichen Minimalbedürfnisse eines Individuums, die Nähe zu vor allem fremden Personen oder ein inkompatibles Besucherverhalten mit den Aktivitäten und Zielvorstellungen des Subjektes in Widerspruch stehen ("social interference", Sundstrom 1978). Kann das Individuum seine eigenen Zielvorstellungen und Besuchsmotivationen, beispielsweise Einsamkeit, Stressabbau, körperliche Bewegung oder soziale Interaktion aufgrund oben genannter Faktoren und aufgrund eines Mangels an Kontrollierbarkeit durch die Anwendung von adaptiven Verhaltensweisen nicht erreichen („goal blocking“), so tritt ebenfalls die subjektive Empfindung von zu hohen Besucherströmen ein (Gramann 1982, Andereck, Becker 1993). Reaktionen basierend auf zu hohen Besucherströmen können aggressives und kompetitives Verhalten (Sundstrom 1978) oder die Einschränkung motorischer Aktivitäten (Evans 1978) sein.

2 UNTERSUCHUNGSGEBIET

Das Erholungsgebiet Wienerberg liegt im Südwesten des 10. Wiener Gemeindebezirkes. Nach jahrzehntelanger Nutzung des Südhanges des Wienerberges als Ziegeleigelände, Hausmüll- und Bauschuttdeponie wurde dieser vom Forstamt der Stadt Wien in den Jahren 1984-1990 zum Erholungsgebiet umgestaltet. Umgeben ist das Erholungsgebiet von Wohnsiedlungen, ganzjährig bewohnbaren Gartensiedlungen, einem Pensionistenheim, sowie Büro- und Gewerbekomplexen. Seit Jahren erfolgt eine permanente Verkleinerung des vorhandenen Grünraumes durch Wohn- und Bürobauten oder eintrittspflichtige Freizeiteinrichtungen, als auch eine Verdichtung der umliegenden Siedlungsgebiete. Weitere große Wohnbauten im direkten Nahbereich des Erholungsgebietes befinden sich in Bau. Das Erholungsgebiet umfasst eine Fläche von 121ha. Zentrum des Parks ist ein 16ha großer Teich, der sowohl als Wildbade- und Eislaufplatz als auch als Angelteich genutzt wird. Der Park weist einen hohen Waldanteil mit dazwischen liegenden Wiesen- und Ackerflächen auf. Ein 14km langes Wegenetz durchzieht das Areal, ein sekundäres Wegenetz wird durch unzählige Pfade gebildet. Zwei Radrouten verlaufen in West-Ost-Richtung im nördlichen beziehungsweise südlichen Parkteil. Der Park verzeichnet im Jahr knapp über 1,2 Millionen Erholungsbesuche (Arnberger, 2004)

3 METHODEN

Bei der Erfassung sozialer Tragfähigkeitsgrenzen kommt der Methodenauswahl eine entscheidende Rolle zu. Mittels einer bestimmten Methode können unter Umständen nur selektiv Faktoren erfasst werden. Für die Fragestellung über die soziale Tragfähigkeit von Freizeitaktivitäten ist aber ein holistischer Ansatz erforderlich, da sich die soziale Tragfähigkeitsgrenze über eine Vielzahl an Faktoren wie die Nutzerzusammensetzung oder das Besucherverhalten definiert (Arnberger, 2003). Bisher wurde zur Bestimmung der sozialen Tragfähigkeit immer nur die Anzahl der Personen herangezogen (Shelby, Heberlein 1986, Manning et al. 1999). Daher wurde ein methodischer Ansatz gewählt, der das komplexe Zusammenspiel mehrerer Faktoren zur Bestimmung der sozialen Tragfähigkeit für die Freizeitaktivitäten Radfahren und Joggen erfasst.

3.1 Befragungen

Die Befragungen über die soziale Tragfähigkeit des Hauptwegenetzes des Erholungsgebietes Wienerberg für die beiden Freizeitaktivitäten erfolgten anhand eines strukturierten Interviews an sechs zufällig ausgewählten Tagen, sowohl Sonn- wie auch Werktage, des Jahres 2002 (Arnberger 2003, 2004). Es handelte sich hierbei um eine Zielgebietsbefragung. Die Interviewer forderten jeden vorbeikommenden Besucher an den Erhebungstagen aktiv zu einer Befragung auf. Die Interviews dauerten jeweils 15 bis 20 Minuten. Die Interviewpersonen waren neben dem Autor Studenten die sorgfältig in die Thematik und das Handling der Fragebögen eingewiesen wurden.

Im Rahmen der Befragungen wurden insgesamt 952 Interviews durchgeführt, davon 292 zu den Fotodarstellungen (Arnberger, 2003). Knapp über 50% der insgesamt Angesprochenen verweigerten die Beantwortung des Fragebogens. Unterschiede bei der Bereitschaft zur Teilnahme ergaben sich auch aus der Art der Freizeitaktivität. Fahrradfahrer sowie Jogger waren ungleich schwieriger zu befragen als Fußgänger, da sie kaum zum Anhalten zu motivieren waren. Einige Befragte konnten Fragen zu den Fotos nicht beantworten, da sie keine Brille bei sich trugen. Neben soziodemographischen, freizeitbezogenen und besuchsspezifischen Fragen wurden die Gebietsbesucher anhand von manipulierten Bildern, die verschiedene Erholungsszenarien darstellten (siehe Abbildung 1), befragt, ob sie hier noch joggen bzw. Rad fahren würden. Die endgültigen Analysen beruhen auf insgesamt 153 Befragte, da einige der 292 Interviewten, zumeist ältere Personen, die Aktivitäten Radfahren und Joggen nicht ausübten. 126 der Befragten gaben Antworten zu den Tragfähigkeitsgrenzen für die Aktivität Radfahren, und 115 zu der Aktivität Joggen.

Abb.1: Beispiele für die bildlich dargestellten Erholungsszenarien

3.2 Generierung der Bilder und ihrer beschreibenden Attribute

Die für diese Arbeit angewendeten bildlich dargestellten Szenarien des Besucheraufkommens determinierten sich über sechs Attribute: Besucheranzahl (zwischen 0 und 12 Personen), Hundeaufkommen, Besucherverhalten (Gruppengröße und Anleinrate der Hunde), Nutzergruppen, Gehrichtung und Verteilung der Besucher im Bild. Für jedes dieser Attribute wurden basierend auf Zählergebnissen unterschiedliche Ausprägungen (drei, vier oder acht Levels) formuliert (siehe Tabelle 1). Ziel war es, sowohl reale, als auch realitätsnahe Zustände seitens der Befragten evaluieren zu lassen. Die Zusammenstellung der Bilder (Szenarien) erfolgte nach einem orthogonalen „fractional factorial"-Design (Addelman 1962, Louviere et al. 2000), wobei dieses Design auch zweifache Interaktionen zuliess. Benötigt wurden insgesamt 128 bildlich dargestellte Szenarien des Besucheraufkommens. Da jedem Befragten 16 Szenarien (Choice-Version) vorzulegen waren, wurden den Befragten vier Choice-Sets bestehend aus je vier Szenarien gezeigt. Die befragte Person musste aus jedem der vier Choice-Sets bestimmen, ob eines oder mehrere der Szenarien für die Ausübung der Freizeitaktivitäten Joggen bzw. Radfahren für sie noch tolerierbar sei.

Als Fotostandort wurde ein Teilstück des Hauptweges im nordöstlichen Gebietsbereich ausgewählt. Dieser Abschnitt ist ein bekannter und stark genutzter Wegabschnitt. Die Farbbilder, die als Basis für die Erstellung der Choice-Sets notwendig waren, stammten alle von einer Aufnahmesession zwischen 15 und 16 Uhr an einem sonnigen Werktag im Juni 2002. Dabei wurde das Erholungsgeschehen immer vom gleichen Fotostandort und mit dem gleichen Aufnahmewinkel mit einer Digitalkamera aufgenommen. Ziel war es ein Set an Besuchern („dummies") zu erhalten, um die erstellten Attribute und ihre Levels bildlich darstellen zu können. Die Fotos wurden mit Adobe Photoshop bearbeitet und dann auf einem hochqualitativen Farbtintenstrahldrucker auf Fotopapier in der Größe von 9 cm x 11 cm ausgedruckt. Jeweils vier Fotos (entspricht einem Choice-Set) wurden auf einem A4 Blatt angeordnet. Jede Interviewperson hatte mehrere Choice-Versionen zur Verfügung, die sie immer abwechselnd verwendete. Innerhalb der Choice-Versionen wurden die Choice-Sets ebenfalls in abwechselnder Reihenfolge angewendet. Die Befragten evaluierten diese Szenarien mittels eines „trade-off"-Ansatzes, und hatten dabei die Bedeutung der jeweiligen Ausprägung der sechs Attribute abzuwägen.

3.3 Wahlmodell

Die Analyse der Befragungsergebnisse über die sozialen Tragfähigkeit für die Freizeitaktivtäten Radfahren und Joggen erfolgte über ein Wahlmodell. Es handelt sich dabei um ein multi-attributionelles, dekompositionelles Verfahren, welches aus dem ganzheitlichen Gesamturteil von hypothetischen Auswahlalternativen (Szenarien) auf die Beiträge der einzelnen Eigenschaften der Alternative zum Zustandekommen des Urteils mittels geeigneter stochastischer Verfahren schließt. Damit werden sowohl Wahlentscheidungen als auch „trade-off"-Verhalten erfasst (Haider, Rasid 2002). Die Analyse eines Wahlmodells basiert auf einem Zufallsnutzenmodell ("random utility model", McFadden 1974). Stochastische Modelle werden angewendet, da das individuelle Verhalten eines Befragten wegen vieler Faktoren nicht vollständig erklärt werden kann, aufgrund der Versuchsanordnung nie alle für das jeweilige Individuum zum Zeitpunkt der Befragung relevanten Variablen dargestellt werden können, und die individuellen Wahlentscheidungen über Individuen aggregiert werden müssen (Ben-Akiva, Lerman 1985).

Der Gesamtnutzen (U_i), den eine Alternative erzielt, setzt sich folglich aus der Nutzenfunktion zweier Komponenten zusammen: der deterministischen (V_i) und der stochastischen (ε_i) Komponente. Die Auswahl einer Alternative über eine andere impliziert, dass der Nutzen einer Alternative höher ist als der Nutzen jeder anderen Alternative (Train 1986). Damit lässt sich eine Wahrscheinlichkeitsaussage über die Auswahl einer Alternative treffen. Der deterministische Nutzen einer Alternative setzt sich dabei aus erfassten positiven wie negativen Attributeigenschaften zusammen. Das binäre logistische Modell für die Analyse kann wie folgt spezifiziert werden (Ben-Akiva, Lerman 1985):

$$\text{Prob}\,\{\text{i gewählt}\} = e^{V_i} / (e^{V_i} + 1). \qquad (1)$$

Damit kann die Auswahlwahrscheinlichkeit einer Alternative als eine Funktion ihrer Attribute im Vergleich zu den Attributen der anderen Alternativen bestimmt werden. Somit werden prädiktive Aussagen darüber gewonnen, inwiefern die Veränderung der Attribute einen Einfluss auf die Wahlentscheidung hat. Die Analyse erzeugt Regressionsschätzer für jeden Level eines Attributes. Aus der vergleichenden ganzheitlichen Bewertung der Szenarien wird somit letztlich der partielle Nutzenbeitrag ("part worth utilities") der einzelnen Attribute in ihrer jeweiligen Ausprägung für das Zustandekommen des Gesamturteils abgeleitet. Die Schätzung erfolgte mit dem Programm LIMDEP 7.0.

4 RESULTATE

4.1 Charakteristika der Befragten

Knapp 55% der Befragten waren männlich, die Altersklasse mit den meisten Befragten war die zwischen 31 und 45 Jahren (36%). Nur 3% waren jünger als 15 Jahre, und 10% älter als 60 Jahre. Innerhalb einer fußläufigen Entfernung von 15 Minuten lebten knapp 60% der Befragten. Nur zwei Interviewte wohnten nicht in Wien. 55% der Befragten waren Fußgänger, 23% Fußgänger mit Hund, 11% Jogger und 10% Radfahrer. Im Sommer kamen 78% der Befragten mindestens einmal in der Woche in das Erholungsgebiet, im Winter lag der Anteil bei 69%. Ein Viertel der Befragten hielt sich unter einer Stunde im Erholungsgebiet auf, weitere 60% zwischen einer und zwei Stunden. Die Befragten zeigten sich recht zufrieden mit dem Erholungsgebiet (Schulnote 1,6). Durchschnittlich gingen die Befragten 27 Mal im Jahr Radfahren, und 50 Mal im Jahr joggen.

4.2 Vergleich zwischen den Freizeitaktivitäten Radfahren und Joggen

Die Ergebnisse der Wahlmodelle für die Freizeitaktivitäten Radfahren und Joggen sind in der Tabelle 1 dargestellt. Beide Modelle zeigen eine sehr gute Anpassung an die Daten mit rho² -Werten (Louviere et al. 2000) von 0,80 für die Aktivität Radfahren und 0,91 für die Aktivität Joggen. Für die Aktivität Radfahren waren alle sechs Attribute bzw. zumindest deren zweifache Interaktionen signifikant. Überraschenderweise war für die Aktivität Joggen das Attribut Hunde nicht signifikant. Basierend auf dem Vorzeichen der Parameter wird aber deutlich, dass es sich bei nicht angeleinten Hunden um den am wenigsten bevorzugten Attributlevel handelt. Alle anderen fünf Attribute waren zumindest schwach signifikant. Die unterschiedlichen Konstantenwerte besagten, dass die Aktivität Joggen für die Befragten auf den meisten Bildern noch ausübbar war, für die Aktivität Radfahren hingegen mehrere Szenarien nicht mehr tolerierbar waren.

Prinzipiell wurden die Szenarien für das Radfahren umso schlechter beurteilt, je höher die Anzahl an gezeigten Personen war. Die Grenze an noch tolerierbarer Personenanzahl lag bei sechs Personen im Bild (siehe Abbildung 2). Zusätzlich erhöhten Personen im Bildvordergrund und ein hoher Anteil an Einzelpersonen und Zweiergruppen insbesondere bei hohen Besucherfrequenzen, die Präsenz von unangeleinten Hunden, eine auf die Betrachter zukommende Gehrichtung, aber auch ein Gemisch an Gehrichtungen die Wahrscheinlichkeit, dass die Befragten ausweichen würden. Eine heterogene Nutzerzusammensetzung (20% Fußgänger, 40% Jogger, 40% Radfahrer) erwies sich insbesondere bei einem hohen Nutzungsdruck als intolerabel, hingegen wurde ein hoher Anteil an Fußgängern positiv bewertet.

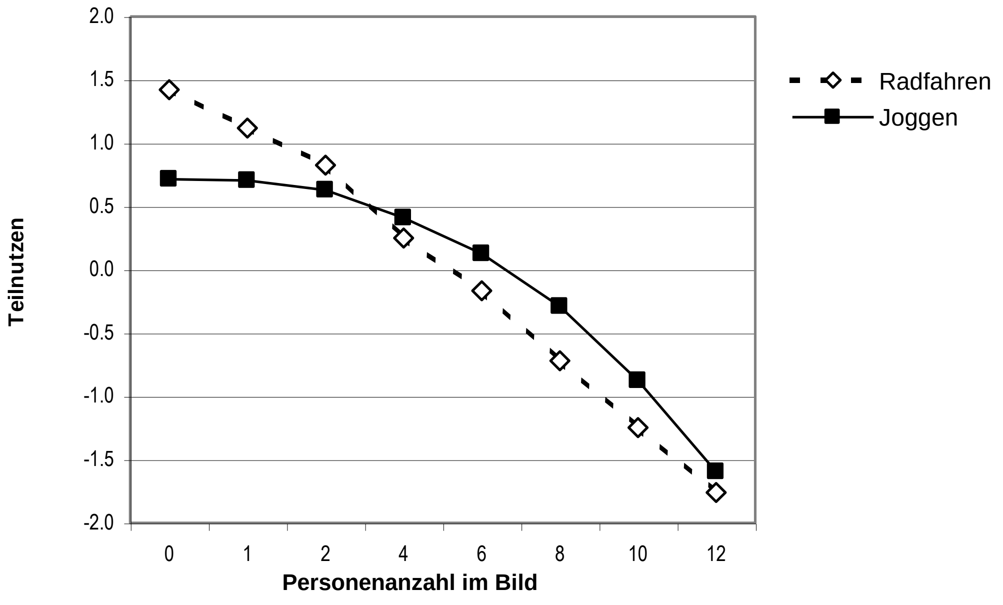

Abb.2: Teilnutzenwerte für die Beurteilung des Attributes Personenanzahl im Bild für die Aktivitäten Radfahren und Joggen

Attribute und Atttributlevels	Radfahren		Joggen	
	Schätzparameter	SE	Schätzparameter	SE
Konstante	***4,238	0,190	***4.981	0.207
Anzahl an Personen im Bild:				
Linear (L).	***-0,560	0,095	***-0.352	0.100
Quadratisch (Q).	-0,009	0,030	(*)-0.067	0.035
Verteilung der Personen im Bild:				
30% Vorne, 40% Mitte, 30% Hinten.[a]	0.090		0.251	
60% Vorne, 40% Mitte, 0% Hinten.	0.172	0,253	**-0.429	0.146
0% Vorne, 40% Mitte, 60% Hinten.	-0.234	0,222	(*)0.331	0.172
10% Vorne, 60% Mitte, 30% Hinten.	-0.029	0,125	-0.153	0.153
Hundeanzahl und Anleinrate:				
Kein Hund.[a]	0.253		0.126	
Hund angeleint.	0.186	0,133	0.054	0.179
Hund unangeleint.	***-0.439	0,131	-0.180	0.167
Gruppengrößenanteile:				
30% Einzel-, 40% Zweier-, 30% Dreiergruppen.[a]	0.936		0.451	
60% Einzel-, 40% Zweier-, 0% Dreiergruppen.	**-0.343	0,107	**-0.443	0.144
0% Einzel-, 40% Zweier-, 60% Dreiergruppen.	(*)0.226	0,135	0.073	0.176
30% Einzel-, 60% Zweier-, 10% Dreiergruppen.	***-0.819	0,204	-0.081	0.154
Nutzerzusammensetzung:				
80% Fußgänger, 10% Radfahrer, 10% Jogger.[a]	0.396		-0.104	
40% Fußgänger, 50% Radfahrer, 10% Jogger.	-0.611	0,165	-0.105	0.152
40% Fußgänger, 10% Radfahrer, 50% Jogger.	0.010	0,114	(*)0.332	0.173
20% Fußgänger, 40% Radfahrer, 40% Jogger.	0.205	0,191	-0.123	0.178
Gehrichtung:				
50% herkommend, 50% weggehend.[a]	-0.198		-0.150	
75% herkommend, 25% weggehend.	-0.083	0,109	-0.166	0.145
25% herkommend, 75% weggehend.	*0.281	0,119	(*)0.316	0.167
Interaktionen:				
L x 60% Vorne, 40% Mitte, 0% Hinten.	**-0,450	0,150		
L x 0% Vorne, 40% Mitte, 60% Hinten.	***0,494	0,131		
L x 30% Einzel-, 60% Zweier-, 10% Dreiergruppe.	***0,453	0,122		
L x 40% Fußgänger, 50% Radfahrer, 10% Jogger.	***0,290	0,075		
L x 20% Fußgänger, 40% Radfahrer, 40% Jogger.	*-0,201	0,080		
Q x 60% Vorne, 40% Mitte, 0% Hinten.	**0,149	0,048		
Q x 0% Vorne, 40% Mitte, 60% Hinten.	**-0,161	0,051		
Q x 30% Einzel-, 60% Zweier-, 10% Dreiergruppe.	*-0,106	0,042		
Rho²	0,804		0,909	
$Rho^2_{adj.}$	0,758		0,896	
Log Likelihood (0)	-5877,89		-17754,24	
Parametermodel	-1154,54		-704,11	
N	126		115	

Signifikanz: ***p <0,001; **p <0,01, *p <0,05, (*)p <0,10

[a] = Referenzkategorie, die aus der negativen Summe der anderen Schätzparameter gewonnen wird

SE = Standardfehler

Tab. 1: Schätzparameter und Standardfehler für die Aktivitätsarten Radfahren und Joggen

Auch für die Freizeitaktivität Joggen stieg die Wahrscheinlichkeit für das Ausweichverhalten mit der dargestellten Personenanzahl im Bild. Ab sieben Personen wurde die Situation als intolerabel eingestuft. Die Attributlevels keine Person, eine Person und zwei Personen im Bild wurden in etwa gleich bewertet basierend auf den schwach signifikanten quadratischen Effekt, während bei der Aktivität Radfahren die Situation mit keiner Person im Bild die am meisten präferierte war. Waren hauptsächlich Jogger dargestellt, so wurde dies als positiv gewertet, ebenso wie Personen im Bildhintergrund. Große Gruppen wurden gegenüber dargestellten Einzelpersonen präferiert. Von den Betrachtern weggehende Personen erhielten den höchsten Teilnutzen, während ein Gemisch an Gehrichtungen und auf die Betrachter zukommende Personen negativ beurteilt wurden.

Mit der Integration der Schätzparameter in Formel 1 konnte der jeweilige Anteil an Befragten, die hier nicht mehr Radfahren oder Joggen würden, berechnet werden (siehe Abbildungen 3 und 4). Beispielhaft wurden vier Szenarien analysiert. In Szenario 1 ist ein Nutzermix (20% Fußgänger, 40% Jogger, 40% Radfahrer) bestehend aus größeren Gruppen im Bildvordergrund mit einer gleichverteilten Gehrichtung dargestellt. Es sind keine Hunde im Bild vorhanden (siehe Abbildung 3). Während bei sehr hohen Besucherfrequenzen (12 Personen) nur 5% der Befragten nicht mehr Joggen gehen würden, ist der Anteil für die Aktivität Radfahren mehr als doppelt so hoch. Wird nun ein Szenario generiert, in dem nicht angeleinte Hund dargestellt sind, so steigt der Anteil an Befragten mit Ausweichverhalten für die Aktivität Radfahren bei sehr hohen Besucherfrequenzen auf 23%, während sich für die Aktivität Joggen kaum Änderungen ergeben.

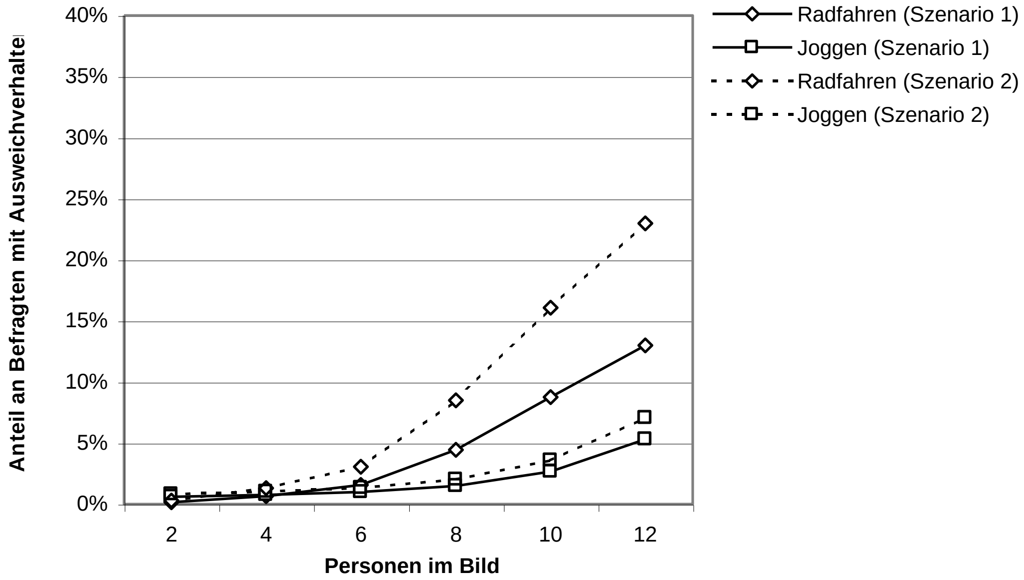

Abb.3: Anteile an Befragten mit Ausweichverhalten für die Aktivitäten Radfahren und Joggen basierend auf verschiedenen Wegeszenarien

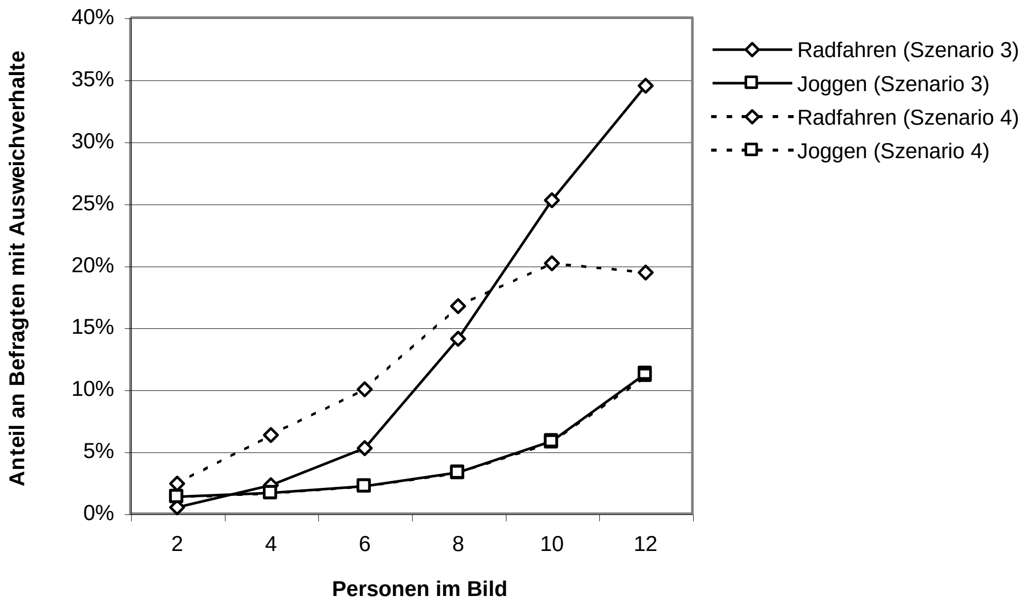

Abb.4: Anteile an Befragten mit Ausweichverhalten für die Aktivitäten Radfahren und Joggen basierend auf verschiedenen Wegeszenarien

In Szenario 3 (siehe Abbildung 4) wird nun das Attribut Gruppengröße dahingegend variiert, dass anstelle von Großgruppen vor allem Einzelpersonen dargestellt sind. Die Anteile an Befragten mit Ausweichverhalten steigen weiter an, insbesondere aber für die Aktivität Radfahren. Im vierten Szenario wird die Nutzerzusammensetzung variiert. Ein hoher Anteil an Radfahrern (50%) und

Fußgänger (40%) im Bild reduziert für die Aktivität Radfahren das Ausweichverhalten bei hohen Besucherfrequenzen, erhöht dies aber leicht bei einer mittleren Besuchermenge. Hingegen bleiben die Anteile für die Aktivität Joggen unverändert.

5 DISKUSSION

Mit dem eingesetzten bildergestützten Wahlmodell können soziale Tragfähigkeitsgrenzen für die Freizeitaktivitäten Joggen und Radfahren definiert werden. Diese Grenzen sind nicht nur von der Anzahl der dargestellten Personen abhängig, sondern werden auch vom Nutzertypus, Besucherverhalten (Nicht-Anleinen des Hundes), Gruppengröße, Verteilung der Personen im Bild und Gehrichtung beeinflusst. Hinsichtlich der sozialen Tragfähigkeitsgrenze unterscheidet sich die Beurteilung für die beiden Freizeitaktivitäten erheblich. Der Anteil an Befragten, die nicht mehr Radfahren würden, ist mindestens doppelt so hoch wie der für die Aktivität Joggen (siehe Abbildungen 3 und 4). So liegt die Grenze an gerade noch tolerierbarer Besuchermenge für die Aktivität Radfahren bei sechs Personen, für die Aktivität Joggen hingegen bei sieben Personen (siehe Abbildung 2). Diese Beurteilung liegt in der höheren Geschwindigkeit und dem größeren Raumbedarf der Aktivität Radfahren begründet, die auch ein Mehr an Aufmerksamkeit erfordert. Deswegen ist keine Person im Bild die am meisten präferierte Situation.

Die Beurteilung der Nutzerzusammensetzung zeigt einige Unterschiede zwischen den beiden Aktivitätsarten, erkennbar ist jedoch bei beiden eine Präferenz für die jeweilige eigene Nutzergruppe. Die Theorien der sozialen Reizüberflutung (Milgram, 1970) und der „alikeness" (Mannning, 1999), dass Besucher präferiert werden, die einem ähnlich sind und ihr Verhalten damit vorhersagbarer erscheint, kann auch für diese Studie festgestellt werden. Fußgänger waren für die Ausübung beider Aktivitätsarten nicht störend. Allerdings beurteilen die Befragten für die Aktivität Radfahren Jogger als störend, die gegeläufige Tendenz konnte für die Aktivität Joggen festgestellt werden. Mit dem Aufeinandertreffen von Joggenden und Radfahrenden implizieren die Befragten Nutzerkonflikte, ausgelöst durch die erhöhte Geschwindigkeit mit der sich beide Nutzergruppen bewegen. Dies trifft insbesondere bei einem stark heterogenen Gemisch aus den Nutzergruppen Fußgänger, Jogger und Radfahrer zu, da aufgrund der unterschiedlichen Aktivitätsarten und Fortbewegungsgeschwindigkeiten die Vorhersagbarkeit des Verhaltens des Besucherstromes erschwert ist. Dies erfordert eine erhöhte Aufmerksamkeit des Besuchers, die über einen längeren Zeitraum hinweg ermüdend wirkt (vgl. Baum, Paulus 1991) und dem Erholungsbedürfnis entgegensteht.

Unerwünschtes Besucherverhalten in Form des Nicht-Anleinen des Hundes ist vor allem für die Ausübung der Aktivität Radfahren störend. In dem Erholungsgebiet ist derzeit nur jeder fünfte Hund an der Leine (Arnberger, 2004). Hier zeigt es sich, dass durch stärkere Gebietskontrollen zur Einhaltung des Anleingebotes die soziale Tragfähigkeit für die Aktivität Radfahren erhöht werden kann. Überraschend ist, dass für die Ausübbarkeit der Aktivität Joggen Hunde kaum eine Rolle spielen. Eine Segmentierung der Befragten in solche die sehr oft Joggen gehen (mindestens 50 Mal im Jahr) und Befragte, die weniger oft Joggen gehen, zeigt aber, dass bei der Gruppe, die diese Aktivität häufig ausübt, freilaufende Hunde sehr wohl einen signifikanten und negativen Einfluss haben.

Einen starken Einfluss auf die Beurteilung des Besuchsaufkommens für beide Freizeitaktivitäten hat auch die Stellung der Personen im Bild. Zu einer negativen Bewertung des Besuchsaufkommens führen Besucher im Bildvordergrund, jene im Bildhintergrund hingegen zu einer positiven. Bei hohen Besucherzahlen verstärkt sich diese Beurteilung für die Aktivität Radfahren, wie dies die Interaktion zwischen der Besucheranzahl und der Stellung der Personen im Bild belegen. Viele Besucher im Bildvordergrund assoziieren bei den Befragten aufgrund der Nähe zu anderen Besuchern, der beengten Situation und der Vielzahl an sozialen und unkontrollierbaren Stimuli ein negatives Besuchserlebnis.

Bei der Beurteilung der Gruppengröße sind keine größeren Unterschiede für die beiden Aktivitäten ersichtlich. Hier präferieren die Befragten größere Gruppen gegenüber Einzelpersonen. Damit sind zwischen den Gruppenbegegnungen Ruhephasen gegeben, weil anderen Nutzergruppen weniger oft ausgewichen werden muss. Ein permanenter Reizstrom ist somit nicht existent und die Situation ist vor allem bei sehr hohen Frequenzen übersichtlicher. Für die Aktivität Radfahren spielt dieser Faktor aufgrund der größeren Fortbewegungsgeschwindigkeit eine größere Rolle als bei der Aktivität Joggen.

Das Attribut Gehrichtung zeigt zum einen, dass weggehende Personen gegenüber herkommenden Personen und gegenüber einem Gemisch an herkommenden und weggehenden Personen bevorzugt wird, da dadurch ein sozialer Kontakt vermieden wird. Ein Gemenge von zu- und weggehenden Besuchern erscheint den Befragten für das Radfahren allerdings nachteiliger als für das Joggen, da diese heterogene Situation für diese schnellere Fortbewegungsart mehr Aufmerksamkeit erfordert. Das Vermeiden von sozialen Kontakten ist eine typische Bewältigungsstrategie, die stattfindet, wenn ein Zuviel an sozialen Stimuli in der Umwelt vorhanden ist (Baum, Paulus 1991). Diese Erkenntnisse zeigen, dass vor allem für die Ausübung der Aktivität Radfahren zu hohe und heterogene Besucherströme als störend empfunden werden. Somit kann bei der Beurteilung der sozialen Tragfähigkeit für die Aktivitäten Radfahren und Joggen die Theorie der sozialen Reizüberflutung und die Theorie der sozialen Interferenz herangezogen werden (Andereck, Becker 1993; Baum, Paulus 1991, Gramann 1982, Sundstrom 1978).

6 SCHLUSSBEMERKUNGEN

Direkt angrenzend an das Erholungsgebiet Wienerberg wird zur Zeit eine Wohnhausanlage mit 1.100 Wohnungen gebaut. Der Nutzungsdruck auf das Erholungsgebiet wird dadurch drastisch steigen, da für diese neuen Bewohner der Park ein Teil des Wohnumfeldes darstellt, den sie, verglichen mit anderen Nutzergruppen, sehr häufig, das heißt mehrmals wöchentlich oder sogar täglich, besuchen werden (Arnberger, 2003). Damit werden die sozialen Tragfähigkeitsgrenzen für die Aktivitäten Radfahren und Joggen noch häufiger überschritten.

Die Feststellung teilweiser übernutzter städtischer Grünflächen impliziert somit eine Kapazitätserweiterung bestehender Erholungsgebiete und deren Erholungsinfrastruktur, beziehungsweise die Bereitstellung zusätzlicher nutzbarer Freiräume, da eine Zugangsbeschränkung städtischer Grünflächen im Gegensatz zu entlegenen Großschutzgebieten keine mögliche Managementstrategie zur Entlastung darstellt, weil im Prinzip jeder urbane, erholungsnutzbare Freiraum einen Teil des „alltäglichen Bedarfs" darstellt. Daher ist von Vorneherein ein rechtzeitiges Einplanen ausreichender Freiräume im Wohnumfeldbereich erforderlich, um nachfolgend Nutzerkonflikte, Verkehrsbelastungen hervorgerufen durch das Ausweichverhalten etc. zu minimieren. Gerade mit dem Wissen um soziale Tragfähigkeitsgrenzen verfügt die Stadtplanung über ein Instrument, um vorausschauend und nachhaltig die Planung und das Management von Erholungsgebieten betreiben zu können. So könnten in Erholungsgebieten, deren soziale Tragfähigkeitsgrenzen noch lange nicht erreicht sind, neue Nutzergruppen untergebracht werden, um andere, überfüllte Erholungsgebiete zu entlasten. Mittels dem Angebot attraktiver Alternativen ist eine Steuerung von Besucherströmen möglich. Voraussetzung ist ein zielgerichtetes Ansprechen dieser Nutzergruppen, basierend auf Erkenntnissen über deren Bedürfnisse und Vorstellungen. Für solche Aussagen sind Forschungen über einen längeren Zeitraum erforderlich, ein Besuchermonitoring gewährleistet ein rechtzeitiges Erkennen von Änderungen des Erholungsdruckes und damit der Überschreitung sozialer Tragfähigkeitsgrenzen.

Eine relativ geringe Stichprobengröße und das Fehlen von Quellgebietsbefragungen reduzieren die Aussagekraft dieser Pilotstudie. So konnte nicht festgestellt werden, inwieweit Besucher das Erholungsgebiet aufgrund von zu hoher Besucherzahlen oder erwarteter Nutzerkonflikte generell meiden und auf andere Erholungsgebiete ausweichen, um hier zu Joggen oder Rad zu fahren.

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Discrete Choice Experiment unter Verwendung von 3D-Visualisierungen: Ein Ansatz zur Analyse von Präferenzstrukturen privater Bauherren hinsichtlich Themen der zukunftsfähigen Siedlungsplanung

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1 ZUKUNFTSFÄHIGES BAUEN IN LÄNDLICHEN RÄUMEN

Die Probleme, die aus der vorherrschenden Baukultur im ländlichen Raum resultieren, sind offensichtlich und von gravierender Auswirkung für die Umwelt (vgl. z.B. Deutsche Institut für Urbanistik (Hrsg.); 2000; Spies-Wallbaum, H., 2002; Bayerisches Staatsministerium für Ernährung, Landwirtschaft und Forsten (Hrsg.); H. 38; 2000). Umweltgerechtere Planungskonzepte und ökologische bzw. „nachhaltige“ Formen des Bauens wurden und werden daher ständig weiterentwickelt und in Fachkreisen oder Planungszirkeln intensiv diskutiert und gefordert (vgl. Oberste Baubehörde im Bayerischen Staatsministerium des Innern; 1999; S. 6f). Ausgangssituation dieser Überlegungen sind ökologische Forschungserkenntnisse, die mit dem Brundtland Report Ende der 80er Jahre begründet worden sind. Im Rio-Nachfolgeprozess wurde das Konzept der „Nachhaltige Entwicklung“ auch auf das Problem der Siedlungsplanung übertragen und z.B. in der Agenda 21 und in HABITAT 1 und 2 formuliert. In den letzten Jahren sind diese Forderungen einer dauerhaft-umweltgerechten Entwicklung zumindest teilweise zu juristisch verbindlichen Richtlinien - siehe z.B. § 1 a Abs. 1 BauGB im Siedlungsbau umgesetzt worden.

Dennoch ist zu beobachten, dass die Aspekte und Forderungen des ressourcenschonenden Bauens in der Planungspraxis deutscher ländlicher Gemeinden noch kaum Eingang gefunden haben. Innovative und zukunftsfähige Siedlungsplanungen zählen noch längst nicht zum Standard in der deutschen Planungspraxis, sondern werden meist als „Wohn-Experimente“ (vgl. Oberste Baubehörde im Bayerischen Staatsministerium des Innern (Hrsg.); 2004) bezeichnet, die den Charakter des Modellhaften bisher nicht verlassen konnten. Es liegt daher nahe zu vermuten, dass die Kriterien der Nachhaltigkeit per Gesetz und „Top-Down“- Planung nur ungenügend in die Realität umgesetzt werden können.

Im ökologischen Bauen wird meist von Maximal-Anforderungen bezüglich des ressourcenschonenden Bauens gesprochen und daran die Forderung geknüpft, das heute technisch Machbare möglichst komplett umzusetzen. Dieser Arbeit liegt die Hypothese zugrunde, dass viele private Bauherren von diesen Maximalforderungen abgeschreckt werden und dem Öko-Bauen dadurch nur geringe Beachtung geschenkt wird. Diese Arbeit basiert auf der Annahme, dass die Umwelt im Sinne der Kriterien des zukunftsfähigen Siedlungsbauens nur dann nachhaltig geplant werden kann, wenn das Ergebnis der Planung von den zukünftigen Bewohnern akzeptiert und verstanden wird.

Da die privaten Bauherren die Haupt-Investoren des Wohnbauens im ländlichen Raum sind, soll diese Personengruppe dahingegen untersucht werden, welche der Öko-Kriterien im Zusammenspiel mit den anderen Faktoren bei einer Bauentscheidung eventuell mehr ins Gewicht fallen als andere. Die Analyse der Einschätzung dieser Personengruppe bezüglich der „Öko-Kriterien“ des Siedlungsbauens verspricht neue Erkenntnisse über den Gestaltungsspielraum für Planer im ländlichen Siedlungswesen und gibt Aufschluss über das heute Machbare im ökologischen Siedlungsbau. Als Ergebnis können zum einen Handlungsempfehlungen für die strategische Entscheidungsfindung im Vorfeld der Festschreibung kommunaler Bauleitpläne erteilt werden bzw. Investoren von Siedlungsplanungsprojekten hinsichtlich der Einbindung ökologischer Aspekte in die Planung beraten werden. Zum anderen soll aufgezeigt werden, wie das Wissen um die Verhaltensstruktur der handelnden Personen dazu benutzt werden kann, positiv auf die Wahrnehmung ökologischer Aspekte des Bauens bei den Bauherren einzuwirken. Diese Arbeit wird im Rahnemn einer Dissertation an der TU München erstellt. Erste Ergebnisse des empirischen Teiles werden für April 2005 erwartet.

2 DAS DISCRETE CHOICE EXPERIMENT (DCE)

Die Entscheidung ob und wie man baut, ist für private Bauherren eine wichtige Lebensentscheidung, die aufgrund ihrer komplexen Inhalte und für Laien kaum überschaubaren Probleme nur sehr schwierig zu treffen ist. Eine empirische Erhebung, die sich zum Ziel setzt, die Parameter der Wahlentscheidung eines Bauherren objektiv zu messen, muss gegenüber den Befragten daher diese Wahlentscheidung möglichst realitätsnah darstellen und die alternativen Wahlmöglichkeiten möglichst anschaulich präsentieren können. Nur dadurch ist gesichert, dass die Ergebnisse einer Befragung den Ergebnissen der tatsächlichen Entscheidungssituation entsprechen, in der sich private Bauherren befinden.

Die empirische Untersuchung bedient sich daher der Methodik des Discrete Choice Experimentes und der Darstellung von alternativen Siedlungsmodellen per 3D-CAD-Layouts innerhalb des Discrete Choice Experimentes. Zur Durchführung der Datenerhebung wird ein Befragungs-Instrument aufgebaut, das neben dem Discrete Choice Experiment auch noch einige allgemeine Fragen zum Thema „Zukunftsfähiger Siedlungsbau“ enthält und auf das mittels einer Internet-basierten Plattform zugegriffen werden kann.

Das DCE kombiniert ein dis-aggregiertes statistisches Modell mit der Analyse-Technik der Discret Choice Models (Random Utility Models). Der Vorteil dieser Vorgehensweise ist, dass die Variablen in der Untersuchung von den Probanden nicht einzeln bewertet werden, sondern dass den Befragten vollständige Alternativen vorgelegt werden, die jeweils eine komplette Alternative darstellen. In diesem Fall bestehen die alternativen Wahlmöglichkeiten aus jeweils kompletten Varianten einer Siedlung, die sich in den wesentlichen „Öko-Merkmalen“ unterscheiden.

Die Ausgangsüberlegung für die Wahl dieser Methode besteht darin, die Entscheidungssituation eines privaten Bauherren möglichst realitätsnah darzustellen. Diese Vorgehensweise ist in der Architektur und im Städtebau tief verwurzelt. Wenn es darum geht, neue Siedlungsplanungen und städtebauliche Lösungskonzepte zu entwerfen, gibt es in der Regel immer mehrere konkurrierende

Lösungsansätze. Im Städtebau wird daher meist in einem Wettbewerbs-Verfahren entschieden, welcher Entwurf zum Tragen kommt. Die Evaluierung von konkurrierenden Lösungsansätzen ist daher integraler Bestandteil des Städtebaus. Dabei werden alternative Konzepte anhand einer Anzahl von Leistungs-Kriterien überprüft.

Für die Evaluierung von Alternativen werden entweder informelle Dsikussionen bzw. Jury-Entscheidungen als methodischer Ansatz gewählt oder formelle, standardisierte Vorgehensweisen. In wissenschaftlichen bzw. standardisierten Ansätzen dominieren die Methoden des „compositional multicriterion evaluation“ (vgl. Dijekstra, J. et al.; 2003; S. 357), d.h. die einzelnen Indikatoren jeder Alternative werden separat behandelt und nicht im Zusammenspiel mit allen anderen Variablen, aus der eine Alternative besteht. Trotz der weiten Verbreitung dieser empirischen Methodik weist sie eine Reihe von Problemen auf, die sich in einer geringen Validität und Reliabilität der Ergebnisse niederschlagen. Das Hauptproblem dabei ist, dass die einzelnen Indikatoren, die den Befragten zur Auswahl gestellt werden, nicht durch ein statistisches Design kontrolliert werden können, so dass die Ergebnisse der Analyse dieser Daten schlecht generalisierbar und keine Rückschlüsse auf die relative Gewichtung der einzelnen Indikatoren möglich sind. Die Indikatoren werden bei der „compositional method“ den Befragten einzeln zur Beurteilung vorgelegt und nicht im Gesamtzusammenhang als Komplett-Alternative. Diese Vorgehensweise entspricht kaum der realen Entscheidungs-Situation, so dass die Befragten große Probleme haben, ihre Präferenzen realitätsgetreu darzulegen (Timmermans, H. J. P.; 1984).

Die „Conjoint Analyse“ und insbesondere das „Discrete Choice Experiment“ löst dieses Problem, in dem den Befragten die Indikatoren in Form von kompletten Alternativen dargestellt werden, die sie als Ganzes bewerten. Der Hauptunterschied zu den „compositional methods“ ist der, dass die Methode de-kompositionell ist, dass die Ergebnisse generalisierbar sind und dass die Alternativen nach einem bestimmten statistischen Design konstruiert werden. In der Analyse können die Teilwert-Nutzen der einzelnen Indikatoren berechnet werden, so dass direkte Rückschlüsse auf die Natur des zugrundeliegenden Wahlentscheidungs-Verhaltens möglich sind.

Die Entscheidung, in welcher Form gebaut werden soll, ist - zumal da viele private Bauherren Laien sind – sehr komplex und beinhaltet das Problem der Entscheidung unter der Vorgabe nicht ausreichender Information. Die Verwendung der Methodik des Discrete Choice Experimentes empfiehlt sich somit aufgrund der besseren Validität und Zuverlässigkeit (vgl. Dijekstra, J. et al.; 2003).

Die individuellen Wahl-Entscheidungen, die im Zusammenhang mit der Bau-Entscheidung stehen, sind zudem von diskreter Natur. Das heißt, es handelt sich in ökonomischem Sinn um Güter, die nur ganzheitlich erhältlich sind bzw. die man entweder kauft oder nicht (vgl. Bignasca, F; 1998). Eine Wohnung kann z.B. nicht halb gekauft werden und ein privater Bauherr hat entweder die Wahl, die Wohnung zu kaufen, oder nicht. Gleiches gilt für die Entscheidung für oder gegen ein Siedlungsplanungskonzept. Daher werden in dieser Arbeit de-kompositionelle Methoden der empirischen Forschung verwendet, insbesondere das Discrete Choice Modell in der Analyse.

Die statistische Form eines Discrete Choice Experimentes gründet auf der Random Utility Theory (vgl. Proenca, I.; 1995; Halperin, W. C. and Gale, N.). Um die Wahlentscheidung der Befragten zu modellieren, wird eine einfache Nutzenfunktion definiert, die aus einer deterministischen und einem stochastischen Element besteht:

$$U_{ni} = V(Z_i \bullet W_{ni} \bullet Y) + \varepsilon_{ni}$$ (vgl. McFadden; 1974 und

In diesem einfachen Fall bedeutet dies, dass der Gesamt-Nutzen des *i*-ten Individuums ausgedrückt werden kann als die Summe aus der „deterministischen Komponente“ V, die das Nutzen-Verhalten eines Individuums i unter Einfluss der determinierenden Variabeln darstellt, und einer „Zufallskomponente“ ϵ. Der Faktor ϵ steht für die unbekannten Faktoren des Wahlentscheidungsverhaltens und die Abweichung des individuellen Verhaltens vom Verhalten des repräsentativen Individuums. Die repräsentative Komponente besteht also aus einem Vektor V, der die Ausprägungen aller deterministischen Variablen der *n*-ten Alternative darstellt und die exogenen Variablen z, die endogenen Attribute der Alternativen W, sowie einen unbekannten Vektor an Parametern Y enthält.

Das Ziel dieser Methode ist es, Aussagen über die Wahrscheinlichkeit zu machen, dass das *i*-te Individuum eine bestimmte Alternative *n* wählt. Das Individuum *i* wählt dann n, wenn der Gesamtnutzen, der mit n assoziiert wird, größer ist als der jeder anderen Alternative:

(vgl. McFadden, D.; 1974)

$$\text{Prob } \{\text{i chosen}\} = \text{prob } \{V_i + \varepsilon_i > V_j + \varepsilon_j \,;\, \forall j \in C\}$$

Die Random Utility Theory hat eine spezifische Auffassung von der Interpretation der Wahlentscheidungen eines Individuums. Demnach wird beim „interpersonal random utility approach“ die Wahlentscheidung als die Wahl eines repräsentativen Individuums der Grundgesamtheit angesehen. Die Abweichungen in den Wahlentscheidungen der Samples vom repräsentativen Individuum werden als Präferenz-Variationen („variations of tastes“) beschrieben, die innerhalb der Grundgesamtheit zufällig verteilt sind. Das heißt, jedes Individuum besitzt eine eigene Nutzen-Funktion, nach der es unter der Voraussetzung absoluter Rationalität als Nutzen-Maximierer handelt. Die Präferenz-Variationen werden zum einen auf beobachtbare, die Wahl-Entscheidung determinierende Faktoren zurückgeführt, auf eine „deterministic component of random utility“. Zum anderen lassen sich die Präferenz-Unterschiede auf nicht-beobachtbare Attribute zurückführen, den „interperson taste-differences“ (vgl. Hensher, D. A. und Louviere, J. J.; 1984).

Als Resultate eines DCE werden „Teilwert-Nutzen“ für jede Ausprägung einer Variable berechnet, so dass Aussagen auf die Bedeutung der unterschiedlichen Variabeln für das Wahlverhalten der Individuen möglich werden.

3 IDENTIFIZIERUNG DER RELEVANTEN ATTRIBUTE UND OPERATIONALISIERUNG

Der Identifizierung der geeigneten Variablen kommt hohe Bedeutung zu, da die endgültige Variablen-Zusammenstellung die Qualität der Arbeit entscheidend beeinflusst. Variablen, die nicht in die empirische Erhebung einfließen, werden nicht erhoben und können somit auch nicht ins Ergebnis der Arbeit einfließen (vgl. Berkhout et al.; 2001).

Variablen sind theoretische Konstrukte und müssen durch Operrationalisierung messbar gemacht werden. Dieser Schritt setzt tiefe Kenntnisse über die Bandbreite der realen Ausprägungen des jeweiligen theoretischen Konstruktes (=Variable) voraus. Die Variablen, die potentiellen Einfluss auf die Gestalt und Ausführung einer Siedlungsplanung haben, sind sehr zahlreich. Bei der Zusammenstellung der für diese Arbeit relevanten Variablen musste daher zunächst eine theoriegeleitete Auswahl erfolgen. Da diese Arbeit die Theorie der Nachhaltigkeit als Leitidee verfolgt, kam sie auch bei der Auswahl der relevanten Variablen zum tragen.

Der Begriff der nachhaltigen Entwicklung hat sich aufgrund des häufigen auch fachfremden Gebrauchs im Laufe der Zeit abgenutzt, so dass seine Bedeutung und konzeptionelle Kraft aufgrund fehlender Inhalts-Definitionen bereits vielfach aufgeweicht worden sind. Das ändert aber nichts an der großen Bedeutung dieses Konzeptes für Arbeiten, in denen Nachhaltigkeit klar definiert und der Begriff detailliert operrationalisiert worden ist. Das erfordert vor allem die genaue Definition von Indikatoren. Die Verwendung des Konzeptes der Nachhaltigkeit erfordert die Integration von drei Dimensionen, die wirtschaftliche Dimension (=Ressourcen-Verfügbarkeit), die ökologische Dimension (=Reduktion der Stoffströme) und die soziale Dimension (=Umweltraum-Konzept). Wird eine dieser Dimensionen bei der Zusammenstellung von Nachhaltigkeits-Indikatoren nicht berücksichtigt, ist das Postulat der ‚Nachhaltigkeit' nicht erfüllt (vgl. Spies-Wallbaum, 2000). Es existiert eine Fülle von Literatur zum Problem der Indikatoren-Auswahl, beispielhaft seien die Folgenden genannt:

- Indikatoren Liste der Enquete-Kommission
- Deutsche Institut für Urbanistik (DIFU): Nachhaltigkeits-Indikatoren der Siedlungsentwicklung auf regionaler/gesamtstädtischer Ebene
- Bundesministerium für Umwelt, Naturschutz und Reaktorsicherheit: CSD-Nachhaltigkeits-Indikatoren in Deutschland

Die relevanten Attribute und Attributs-Ausprägungen sind nicht immer direkt der Literatur zu entnehmen, so dass für die Zusammenstellungen der Ausprägungen zusätzliche Befragungen bei Experten aus dem Planungssektor notwendig wurden. Diese Vorgehensweise entspricht den Anforderungen des Konzeptes der Nachhaltigkeit. Dadurch wird die Akzeptanz und die Validität der gewählten Indikatoren gesichert (vgl. Spies-Wallbaum 2000; Rohn et al., 2001; Dietrichs et al., 2001).

Den partizipativen Planungs-Ansatz kann man auf die Ebene einer Experten-Befragung zur Identifikation von Indikatoren erweitern. Anstelle der Einbeziehung sämtlicher Stakeholder in den Auswahl-Prozess kann man eine gültige Auswahl der Indikatoren auch durch Auswertung der gängigen wissenschaftlichen Meinung treffen, solange diese objektiv nachvollziehbar dargestellt ist (vgl. Dietrichs et al.; S. 49). Ausgehend von diesen Überlegungen stellt sich die Auswahl der Variablen und deren Operationalisierung in dieser Arbeit als Prozess dar. In den Experten-Interviews wurden zusätzlich zu den Informationen über die Variablen-Relevanz auch Vorschläge zur sinnvollen Operrationalisierung gesammelt.

Die auf diese Weise getroffene Auswahl an Attributen stellt sich wie folgt dar:

Tabelle 1: Attribute und Attributs-Ausprägungen in den Choice Sets

CS Teil 1: CAD-Film	Attribute		
	Attribut	Ausprägungen	Kodierung
	Dichte	**Hoch**: 80% RH und DH; 10 % kleine EFH; 10% Geschosswhg. + geringe Parzellengröße **Mittel**: 40% RH und DH; 50% EFH; 10% Geschosswhg.+ mittlere Parzellengröße **Gering**: 100% dichte EFH-Bebauung + große Parzellengröße	0 1 2
	Qualität des Öffentlichen Grün	**Gute Begrünung:** Pro öffentlicher Grünfläche: 2 GB+1 KB **Mittlere Begrünung**: Pro öffentlicher Grünfläche 1 GB+1 KB **Gering**: Pro öffentlicher Grünfläche 1 KB	0 1 2
	Zentrum	**Kein** **Zentrum als Grünfläche ohne Funktion** **Zentrum mit Versorgungsfunktion/Laden**	0 1 2
	Innere Erschließung	**Indiv_Park_KFZ_Str** **3 Sammelparkplätze →** KFZ näher als 50m	0 12
CS Teil 2: Verbale Darstellung	**Attribute**		
	Attribut	Ausprägungen	Kodierung
	Infrastruktur Freizeit	**Kein** **Eine_Infra**: Multifunktionales Spiel-/Bolzplatzgelände **Infra_Nähe** (<1km): Multifunktionales Spiel-/Bolzplatzgelände	0 1 2
	Distanz ÖPNV	**Keine oder sehr seltene Frequenz** **ÖPNV Anschluss 5 –6 mal täglich** **ÖPNV Anschluss 7 - 9 mal täglich**	0 1 2
	Blockheizkraftwerk	**Keine Anlagen BHKW** **Ein BHKW**	0 1
	Anlage zur Grauwasserreinigung	**Keine Anlage zur Grauwasser Aufbereitung** **Eine Anlage zur Grauwassseraufbereitung**	0 1
	Soziale Durchmischung	**Keine Div. Struktur der Wohngrößen Angebote** **Es gibt ein unterschiedliches Wohngrößen Angebot**	0 1
CS Teil 3: Die Variable Kosten			
	Kosten	Die Variable „Kosten" wird den Befragten im Rahmen der Entscheidung gestellt. Die Kosten werden mit den kostentreibenden Variablen und zu einer Aussage im %-Bereich in Relation zum konventionellem Siedlungsbau verknüpft (siehe Beschreibung oben)	

4 IDENTIFIZIERUNG DER GRUNDGESAMTHEIT FÜR DIE EMPIRISCHE ERHEBUNG

Zu Beginn der Bestimmung einer geeigneten Grundgesamtheit für die Befragung wird von der Frage ausgegangen, welches die treibenden Kräfte von „guter“ Planung bzw. aller Veränderungen im ländlichen Raum sind (vgl. Reichenbach-Klinke, M.; in: Bayerische Akademie ländlicher Raum (Hrsg.); 1997). Da die meisten Siedlungen aufgrund privater Investitionen entstehen, liegt der Ansatzpunkt für eine Einflussnahme auf die Siedlungs-Gestalt wohl bei den privaten Bauherren.

Um der Untersuchung weitere Informations-Tiefe zu geben, werden zwei Gruppen von privaten Bauherren in die empirische Untersuchung einbezogen:

Zunächst werden die Personen befragt, die in naher Zukunft privat bauen wollen und solche Personen, die sich nach neuem Wohnraum (auch auf dem Mietmarkt) umsehen: Um Personen, die in naher Zukunft bauen bzw. mieten

wollen, für die empirische Datenerhebung gewinnen zu können, werden Bauträger und Internet-Foren gebeten, eine Email-Einladung an den ihren jeweiligen Email-Verteiler zu verschicken.

Zweitens werden die Personen befragt, die bereits in einer Siedlung wohnen, die nach ökologischen Kriterien gebaut worden ist. Um Probanden aus diesem Personenkreis für die Befragung zu gewinnen, wurden Öko-Siedlungen hinsichtlich der „Nachhaltigkeits-Indikatoren“ untersucht und um die Teilnahme an der Befragung gebeten.

Man betrachtet also die gesellschaftliche Ebene, um den Zusammenhang zwischen der Lebensform der Bewohner und der Gestalt einer Siedlung zu kennen. Anschließend werden die Aussagen der beiden Gruppen abgeglichen, so dass man einen Kriterienkatalog des ökologischen Siedlungsbauens erhalten wird, der das zur Zeit technisch Machbare mit dem gesellschaftspolitisch Machbaren verbindet und darstellt. Dadurch werden Hinweise auf Handlungsfelder identifiziert, die eine wichtige Rolle für die Planung und Realisierung von tatsächlichen Bauprojekten zukunftsfähiger Siedlungen spielen

Der Erfolg einer empirischen Untersuchung, die sich der Methode der Discrete Choice Experimentes bedient, ist unter anderem von einer hohen Zahl an Personen abhängig, die sich bereit erklären, an der Befragung teilzunehmen. Für ein Discret Choice Experiment benötigt man eine hohe Anzahl an Daten (=Wahlentscheidungen), um das statistische Modell schätzen zu können und zu gültigen Resultaten zu gelangen. Aus diesem Grund wurde für diese Studie eine Internet-basierte Befragung konzipiert, da nur über das Internet eine hohe Anzahl an Befragungsteilnehmern zu relativ niedrigen Kosten erreicht werden können.

Grundsätzlich werden Kriterien zur Unterscheidung der Grundgesamtheit ermittelt, um unterschiedliche Präferenz-Niveaus bzw. Trade-Off-Entscheidungen bestimmten Gruppen von untersuchten Personen zuordnen zu können. In den meisten Marktforschungs-Studien werden nur drei Variablen zur Grundgesamtheit erhoben, das Alter der Befragten, das Geschlecht und die Herkunft bzw. der Zielort. Diese drei Kriterien sind die Kern-Variablen jeder empirischen Untersuchung. Zusätzlich zu den oben genannten Kategorien werden in dieser Arbeit noch folgende Kriterien der Grundgesamtheit erhoben:

Ökologische Vorprägung der Probanden

Familiensituation, für die gebaut werden soll (Bauen ist die Vorwegnahme der Zukunft/spiegelt Zukunftsperspektiven wieder). Dadurch wird eine Einordnung der Dichte-Präferenz in Relation zur Haushaltsgröße möglich

Einkommen

5 DIE VISUALISIERUNGEN INNERHALB DES DISCRETE CHOICE EXPERIMENTES

Das Discrete Choice Experiment, das in dieser Arbeit entwickelt wurde, enthält die zur Auswahl gestellten Alternativen als 3D-Darstellungen. Die 3D-Darstellungen werden dabei nicht als Bilder, sondern als Film-Sequenz ausgearbeitet, um dem Betrachter ein Raum-Erlebnis aus der Durchgangsperspektive bieten zu können. Diese Vorgehensweise verspricht beste Resultate in Hinblick auf die Gültigkeit und Zuverlässigkeit der Ergebnisse, der Erreichbarkeit einer ausreichenden Anzahl an Teilnehmern an der Studie und einer schnellen Sammlung und Auswertung der Daten, da die Daten direkt über das Internet-basierte System in eine Datenbank eingelesen werden können. Bei diesen 3D-Visualisierungen handelt es sich nicht um „Virtual Reality“ – Darstellungen (vgl. Hennig, A.; 1997; S. 9), da keine Interaktion des Betrachters mit der Computer-Simulation möglich ist. Vielmehr handelt es sich bei den 3D-Layouts um den visualisierten Teil eines fein-kalibrierten Messinstrumentes, bei dem eine Interaktion des Befragten mit dem Instrument ein Verfälschung der Messergebnisse zur Folge hätte, da jeder Befragte die am Computer erzeugte Realität auf andere Weise erfahren und somit seiner Entscheidung andere Informationen zu Grunde legen würde. Daher entspricht die in dieser Arbeit gewählte Vorgehensweise eher dem Ansatz der „Augemented Reality“, die für gewöhnlich vor allem in der Architektur zur Anwendung kommt (vgl. z.B. Webster et al; 1996).

Typischerweise werden „Discrete Choice Experimente“ so durchgeführt, dass den Befragten je 2-3 Alternativen in Papier-Form auf s.g. „Flash Cards“ gezeigt werden. Die Befragten müssen sich für eine der Alternativen entscheiden und kreuzen diese mit einem Stift an. Die Alternativen werden also meist in verbaler Form dargestellt, Ausnahmen sind aber ebenfalls dokumentiert. Diese Dokumentationen beziehen sich z.B. auf gelungene Darstellungen der Alternativen in Form von Pictogrammen verschiedener Formen von Baulanderschließungen (vgl. Haider, W.; 2002), es sind aber auch bereits erfolgreiche Versuche der drei-dimensionalen Darstellung von Alternativen beschrieben worden, z.B. hinsichtlich der Simulation von Erholungsräumen (z.B. Küstenlandschaften) (vgl. Haider, W. et al. 1998).

Eine einfache verbale Darstellung oder auch eine 2-Dimensionale bildliche Darstellungen der Auswahl-Alternativen werden, wenn es um Fragen des Städtebaus und der Siedlungsplanung geht, dem Problem nicht gerecht.

Will man Evaluierungs-Ergebnisse mit hoher Gültigkeit und Zuverlässigkeit erreichen, müssen den Befragten die Alternativen in Form einer 3-dimensionalen Darstellung präsentiert werden, da die Forschungs-Gegenstände nur als sehr komplexe dreidimensionale Gefüge verstanden werden können.

Durch die dreidimensionale Darstellung erhöht sich der Realismus der hypothetischen Entscheidungs-Situation, in der sich die Befragten befinden (vgl. Klabbers, M. D. et al.; 1996). Ein erfolgreicher Versuch mit einer allerdings recht einfachen Variablen-Zusammenstellung ist bereits dokumentiert worden (vgl. Dijkstra, J. et al. 2003).

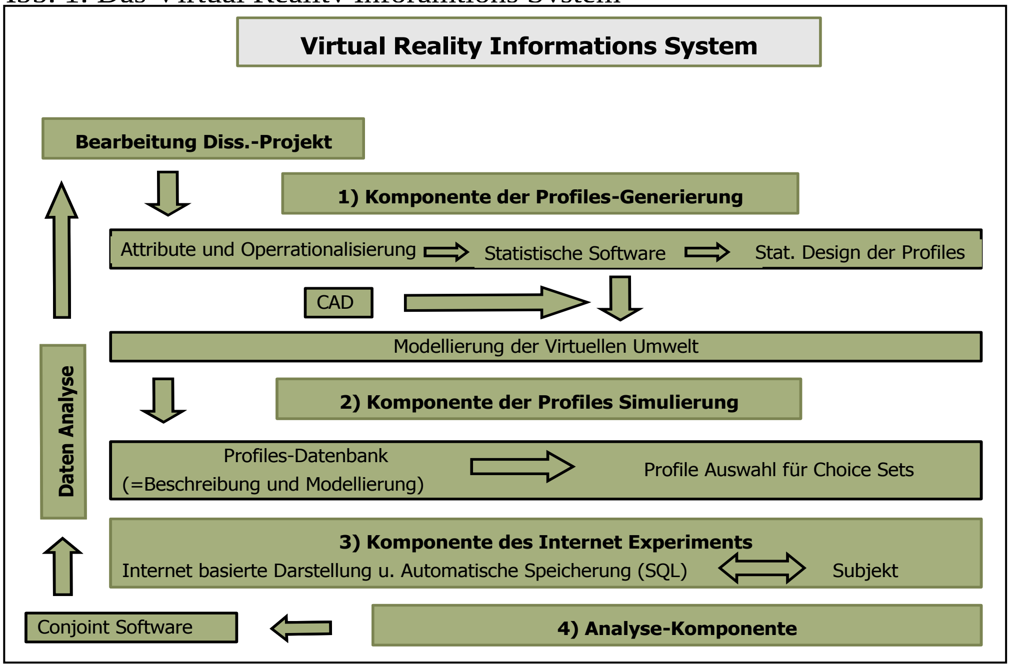
3-dimensionale bzw. Virtual Reality-Darstellungen erlauben es den Befragten, die städtebaulichen Alternativen realitätsnah zu erfahren und danach zu bewerten. Die Entscheidung, zu bauen, ist bei privaten Bauherren meist eine Lebensentscheidung. Da die meisten privaten Bauherren aber als Laien mit einem sehr komplexen Thema konfrontiert werden, sich daher also die gebaute Realität nur eingeschränkt vorstellen können, ist eine Visualisierung der zur Auswahl stehenden Wahl-Möglichkeiten zwingend erforderlich.

5.1 Das Virtual Reality Informations System

Der Informationsfluss, der zur Vorbereitung, Durchführung und Auswertung der empirischen Studie erzeugt wird, ist sehr komplex und erforderte deshalb den Aufbau eines Virtual Reality Informations System. Dieses System ermöglicht es, den Überblick über die Informationsaufbereitung und –auswertung zu behalten und den Prozess möglichst automatisiert zu steuern.

Die Befragten können über einen Internet-Browser auf das Befragungs-Instrument zugreifen. Dieses bettet das DCE in das gesamte Befragungs-Instrument ein, welches neben den Choice Sets einen zusätzlichen allgemeinen Frageteil enthält. Die Daten, die von den Befragten eingegeben werden, werden direkt in eine Datenbank eingespeist.

Abb. 1: Das Virtual Realitv Inforamtions Svstem



Das Virtual Reality Informations System besteht aus folgenden 5 Komponenten:

1) Die Komponente der Profiles-Generierung: Die Attribute für die Zusammensetzung der alternativen Siedlungen werden in einem iterativen Verfahren zusammengestellt und in geeignete Ausprägungen operationalisiert. Die Attribute werden gemäß eines statistischen Design Planes zu Alternativen kombiniert, die jeweils unterschiedliche Formen einer Siedlung darstellen. Diese alternativen Siedlungen werden per CAD-Software als 3D-Layouts visualisiert und dadurch die Umwelt virtuell modelliert.

2) Die Komponente der Profiles-Simulierung: Die Alternativen werden nach einem bestimmten statistischen Design-Plan zusammengestellt. Das Informations-System vergibt in jeder Befragung jeweils unterschiedliche Sets an „Flash-Cards“, so dass jeder Befragte nur 4 Choice Sets mit je 2 Alternativen bewerten muss. Diese Einteilung ist notwendig, um den Zeitaufwand jedes Befragten auf ca. 20 Minuten zu beschränken.

3) Die Komponente des Internet Experimentes: Eine Datenbank ist direkt mit dem web-basierten Befragungsinstrument verknüpft. Sie nimmt die Daten der Befragten auf und stellt sie für die Analyse und Schätzung des MNL-Modelles zur Verfügung.

4) Die Analyse-Komponente: Ist die Befragung abgeschlossen und genügend Daten für die Durchführung der Analyse erhoben worden, werden die Daten mit Hilfe von Statistik-Software analysiert und ausgewertet.

5.2 Aspekte der technischen Umsetzung der Visualisierung der Choice Sets

Die Darstellung der Choice Sets gliedert sich in 2 Einheiten. Zum einen werden die Variablen, die visualisiert werden können, in 3D-CAD-Filmsequenzen bildlich dargestellt. Zum anderen werden in einem zusätzlichen Informationsteil die restlichen Variablen der Choice Sets in verbaler Form dargestellt.

Zunächst wurde in dieser Arbeit versucht, einige Variabeln, die nicht in den CAD-Layouts visualisiert werden konnten, als Detail-Ansichten bildhaft darzustellen. Dazu gehörten die Variablen „Gebäudetyp" (EFH, DH, RH1, RH2), „Größe des privaten Grünbereichs" und „Art der Erschließung der Wohneinheit" (gemeinsame Erschließung, individuell ebenerdig, individuell im Geschoss). Im Zuge der Pre-Test stellte sich heraus, dass diese drei Variablen aufgrund der Präsenz von Gestaltungs-Merkmalen, die nicht Gegenstand der Befragung waren (z.B. gestalterische Details des Gebäudes etc.), überdeckt und daher von den Befragten nicht wahrgenommen wurden. Der Visualisierungsteil gliedert sich daher in zwei Bereiche, dem CAD-Layout und dem Teil einer kurzer Text-Darstellung.

Die Attributsliste gliedert sich wie folgt in einen visualisierten Teil und eine Text-Teil auf:

Abb. 2: Die Attributsaufteilung in den Choice Sets

Die Choice Sets: Visualisierung und Text			
CS Teil 1: CAD-Film		**CS Teil 2: Verbale Darstellung**	
	Attribut		**Attribut**
	1) Dichte		6) Distanz ÖPNV
	2) Qualität Öffentliches Grün		7) Technische Anlagen
	3) Zentrum		8) Soziale Mischung
	4) Innere Erschließung		
	5) Infrastruktur Freizeit		

5.3 Die 3D-CAD-Visualisierungen in den Choice Sets

Um eine hohe Genauigkeit der Untersuchung zu gewährleisten, ist es notwendig, die Visualisierung empirisch exakt steuern zu können. Bei dem Versuch einer Visualisierung über Photographien von bestehenden Siedlungen besteht die Gefahr, dass andere als die zu untersuchenden Parameter die Entscheidung der Befragten so stark beeinflussen, dass keine genaue Messung und Analyse von Instrument- und Zielvariablen möglich ist. Daher werden in dieser Arbeit genau zu quantifizierende Möglichkeiten der Visualisierung über Computer-gestützte Systeme verwendet. Dafür wird auf eine in der Architektur üblichen Verfahrensweise zur Darstellung der gebauten Umwelt zurückgegriffen und CAD-Software verwendet. Mit Hilfe von CAD-Softaware lassen sich auch virtuelle Realitäten darstellen, die dreidimensionale Darstellungen erlauben.

In der Visualisierung sollen Bilder alternativen Siedlungstypen, die den Befragten vorgelegt werden, erzeugt werden. Zunächst kann sich der Befragte anhand einer kurzen Filmsequenz ein Bild von der Siedlung als Ganzes machen. Diese Filmsequenz dauert etwa 10 - 15 Sekunden und vermittelt dem Befragten ein Gefühl für die dargestellten Untersuchungsparameter:

Die Darstellung der Siedlung anhand einer kurzen Filmsequenz ist ein neues Feld der empirischen Forschung. Bisher wurden erst einige Versuche in der Literatur dokumentiert (vgl. z.B. J. Dijkstra et al.; 2003), die in erster Linie mit relativ einfachen Modellen und statischen Visualisierungen gearbeitet haben. Eine dynamische Visualisierung in Form einer Filmsequenz ist bisher nicht dokumentiert.

Die Durchführung der CAD-Arbeiten gestalten sich als relativ komplex. Die größte Herausforderung besteht darin, die Gestaltung so abzustimmen, dass der Betrachter bzw. der Befragte in der Untersuchung nur diejenigen Merkmale der Gestaltung wahrnimmt, die gemessen werden sollen. Die Gestaltung muss aber zugleich so realitätsnah sein, dass eine ausreichende Abbildung der Realität für eine Animation (vgl. Schilcher, M. et al.; 2000) gegeben ist. Dazu ist es notwendig, Gestaltungsmerkmale einfließen zu lassen, die nicht als Messkriterien bzw. Variablen im Choice-Set Konzept vorgesehen sind. Im Rahmen der Vorbereitung der empirischen Studie wurden Pre-Tests mit einer Auswahl an Personen vorgenommen, die den Vorgaben der Definition der Grundgesamtheit entsprechen. Dabei wurden die Choice Sets hinsichtlich der allgemeinen Verständlichkeit und Nachvollziehbarkeit getestet, sowie die Art der Darstellung der visualisierten Parameter und die darin enthaltenen Operationalisierungen hinsichtlich deren Praxis-Tauglichkeit überprüft.

Es ist unumgänglich, mehr als nur die zu messenden Variablen bildlich darzustellen. Wenn man sich nur auf die zu messenden Variabeln beschränken würde, wäre keine bildliche Darstellung bzw. keine vollständige Simulation der Realität mehr möglich. Um trotzdem Messungen der Einflussfaktoren durchführen zu können, werden die Faktoren, die zwar nicht gemessen, aber dennoch zur Darstellung benötigt werden, als Konstanten in das System eingeführt.

Die Varianten, die den Befragten als Alternativen in den Choice Sets vorgelegt werden, basieren daher alle auf einem gleichbleibenden Grundtyp. Dieses Grundmodell aller Siedlungsvarianten geht auf einen Entwurf einer realen Bebauungsplanung zurück, die das Büro AGL in Etting-Polling unter der Leitung von Fr. Prof. Dr. Pröbstl erstellt hat (vgl. AGL/AbtPlan (Hrsg.); 2003). Dieser Entwurf kann als typisch für die Bebauungsplanung in ländlichen Gemeinden Bayerns gelten, was sowohl die Größe des Bebauungsgebietes, den Zuschnitt der Grundstücke als auch die Lage im Raum betrifft und ist somit als Basis für die Siedlungstypen gut geeignet.

Eine weitere Schwierigkeit bei der Arbeit an den CAD-Layouts besteht darin, die Tiefe der Detailstruktur festzulegen. Mit modernen Architektur-Programmen können heute sehr realitätsnahe Simulationen von Gebäuden und auch Stadtmodellen angefertigt werden. Da eine allzu tiefe Detail-Darstellung sehr viel Daten- und einen erheblichen Arbeitsaufwand bedeutet, der weit über die Intention der hier durchgeführten empirischen Untersuchung hinausgeht, musste In der vorliegenden Arbeit eine Abwägung getroffen werden zwischen dem Höchstmaß an vertretbarem Datenaufwandes auf der einen Seite und der Notwendigkeit einer ausreichend ausgestalteten Detaillierung (vgl. Rohrmann, B., Palmer, S. and Bishop, I). Die CAD-3D-Layouts enthalten somit die Variablen, die auf der Detaillierungsstufe LoD 1 – LoD 2 dargestellt werden können. Die Arbeit an den 3D-CAD-Layouts gestaltet sich aufgrund der oben geschilderten Probleme als große Herausforderung.

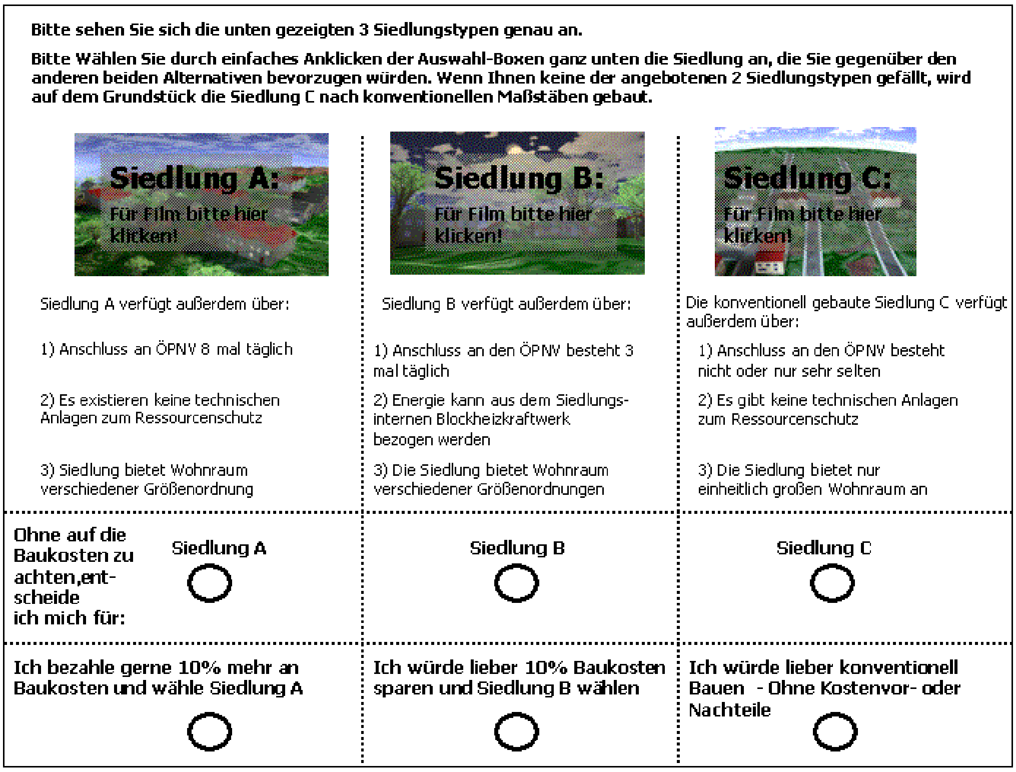
5.4 Das Layout des Internet-Basierten Discrete Chocie Experimentes

Die oben diskutierte Auswahl an Attributen für die Darstellung der Siedlungs-Varianten („Choice-Sets“) müssen in das Befragungs-Instrument integriert werden. Dazu wurde eine graphische Form gewählt, die es den Befragten erlaubt, sehr schnell die Unterschiede zwischen den dargestellten Siedlungs-Alternativen zu erfassen und zu bewerten. Bei der Gestaltung der Choice-Sets muss darauf geachtet werden, den Befragten auch eine „Null-Hypothese“ anzubieten, so dass in der statistischen Analyse der Bezug eines Wertes zur Null-Hypothese hergestellt werden kann.

Insgesamt werden den Befragten je 3 Choice Sets mit jeweils 3 Siedlungsalternativen zur Auswahl gestellt. Ein Befragter muss sich dann entscheiden, ob er Siedlung 1 oder Siedlung 2 als besser einschätzt, bzw. ob er die Siedlung 3 wählt, die den Status Quo im Siedlungsbau darstellt und somit für die Null-Hypothese steht. Der Befragte wird dahingehend instruiert, dass er bei jedem Choice Set so entscheiden soll als gäbe es nur diese 3 Alternativen zur Auswahl.

Ein Choice Set wird innerhalb des Befragungs-Instrumentes wie folgt dargestellt:

Abb. 3: Das Layout der Choice Sets im Befragungs-Instrument



6 AUSBLICK

Als Ergebnis erwartet Verf. die Erstellung eines neuen Beratungsinstrumentes für Kommunen. Diese könnten ihre neuen Siedlungsgebiete durch einen ‚Siedlungspass' zertifizieren lassen, der analog zum Gebäudepass die ökologische Qualität einer Siedlungs-Planung auch nach außen sichtbar macht. Die Arbeit zielt also darauf ab, objektive Kenngrößen der ökologischen Siedlungsplanung zu identifizieren und zugleich deren Bewertung aus Sicht der Bauträger/privaten Bauherren darzustellen, so dass man einen Kriterienkatalog des ökologischen Siedlungsbauens erhalten wird, der das zur Zeit technisch Machbare mit dem gesellschaftspolitisch Machbaren verbindet und darstellt.

Dieses Befragungs-Instrument kann auch im Einzelfall angepasst und zur Entscheidungsfindung vor Ort eingesetzt werden. Es stellt somit ein Variables Instrument da, um ein größeres Maß an ökologischen Faktoren in die Siedlungsplanung im ländlichen Raum einbinden zu können.

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Über die Befindlichkeit einer Großstadt unter dem Aspekt des Durchfilmens

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1 METHODE

„Entlang einer Linie" ist ein <u>Instrumentarium</u> zur Erforschung der Stadt.
Eine künstliche Linie wird so über das zu erforschende Gebiet gelegt, dass die wichtigsten Bereiche miteinbezogen sind. Diese Linie wird mit einer Videokamera abgeschritten. Ist ein Gebäude im Weg, filmt man bis zur Wand. Im Gebäude geht es dann auf der Linie weiter, von der einen Wand zur nächsten. Über einen längeren Zeitraum schreitet man so entlang, bis ans Ende der Linie. Die einzelnen Filmteile werden am Rechner so zusammengeschnitten, dass der Eindruck entsteht man laufe durch Wände. Neben den Videoaufnahmen werden Statistiken und Lageberichte erstellt.
Die Idee ist zum Architekturdiplom 2003 entstanden.
Drei Beschäftigungen führten dazu:

- der Architekturschnitt der die Realität auf eine Zeichnung abstrahiert
- die Beschäftigung mit dem Medium Film
- die Beschäftigung mit 3d CAD Programmen wie 3dmax und cinema 4d.
  Zur Visualisierung eines Architektur Entwurfes legt man einen Spline in den dreidimensionalen Raum. Diesen Spline entlang bewegt sich eine Kamera. Die Kamera macht Filmaufnahmen entlang des Splines. Sie zeigt die Räumlichkeiten.

1.1 <u>Es ist ein Forschungsweg</u> durch öffentliche, halböffentliche und private Räume,

mit besonderem Augenmerk auf die Grenzen.
Situationsbericht: Beliebige Strasse auf der Linie. Links und rechts eine riesige Anhäufung von Steinen. Erste Hürde ist die Tür zum Hof. Unsere Forschungsgruppe klingelt an der Tür, zuerst beim Hauswart und erläutert das Projekt. Wenn wir nicht hereingelassen werden, warten wir, bis jemand den Hof betritt oder verlässt. Der Hof ist die Pufferzone von Öffentlichkeit und Privatheit. Zweites Klingeln an der Wohnungstüre:
„Guten Tag, wir machen ein Videokunstprojekt. Wir haben eine Linie gelegt und gehen entlang dieser Linie mit der Kamera. Sowohl Innen als auch Außen wird gefilmt. Sie liegen auf der Linie und wir würden gerne von der einen Wand zur anderen durch Ihre Wohnung filmen."
Die entscheidende Grenze bildet hier der Bewohner.
Die physische Grenze bildet die Türschwelle.
Erhalten wir die Erlaubnis zum Filmen, so laufen wir im Raum von der einen Wand bis zur anderen, auf der anderen Seite zur nächsten, bis zur letzten der Wohnung. Manchmal können uns die Bewohner noch sagen, was sich dahinter befindet und wie man dort am besten hingelangt.
Verabschiedung. E-mail Austausch. Stiege runter, Stiege rauf. Klingeln. Warten. Klopfen. Erklärung. Linie. Einstellung wählen. Drehen. Wand. Verabschiedung.
Der geschnittene Film zeigt dann das Aneinander von Wohnungen, Höfen, Industrie, Strassen und Flüssen. Er zeigt vor allem die Wände, von denen Vilem Flusser sagt:
„Es ist relativ leicht, sich die Ambivalenz von Wänden im Psychologischen vor Augen zu führen. Eingrenzung und Schutz, Widerstand und Zuflucht, Kerkerzelle und Wohnung, Angst und Geborgenheit, Klaustrophobie und verhütete Agoraphobie: das sind wohl einige der psychologischen Gegensätze, die bei einer Betrachtung von Wänden hervorgerufen werden. Und sie werden sich wahrscheinlich alle auf den Gegensatz `Grab und Gebärmutter` zurückführen lassen." (1)
Die Ambivalenz im Psychologischen könnte man zeitlich aufspalten, denn liest man die Architekturgeschichte, so sind wir im zweiten Jahrtausend nach Christi im embryonalen Zustand angelangt. Vom Grab zur Gebärmutter, von der Höhle zur computergenerierten Scheidewand, vom Loch in der Erde zur speisenden Hülle. In Wien findet man ein verziegeltes Zwischenstadium, welches Flussers ambivalente Spekulation zulässt.

1.2 <u>Es ist ein Querschnitt</u> in mehrfacher Hinsicht:

1.2.1 <u>Ein Schnitt durch den Stadtkörper. Der lineare Schnitt geschieht frontal. Ähnlich einem Bohrer durchkreuzt er verschiedenste Schichten der Großstadt: *Wohnzimmer Wand Flur Wand Bad Wand Strasse Wand Zimmer Wand Küche Wand*</u>

Die Wände werden durchstoßen ohne zerstört zu werden.

1.2.2 <u>Ein Streckendiagramm. Die Fortentwicklung des Filmes entspricht der räumlichen Entwicklung der Stadt. Die Zeit verhält sich linear zum Raum. Zehn Minuten entsprechen ungefähr einem Kilometer. Das entspricht der Schrittgeschwindigkeit von sechs Kilometer pro Stunde.</u>

1.2.3 <u>Eine gesellschaftliche Momentaufnahme von aktuellen Einrichtungszuständen und Verhaltensweisen. Die Verteilung der Stichproben erfolgt linear.</u>

1.3 <u>Es ist ein Film</u> über das Durchschreiten einer Stadt.

Das Drehbuch ist die Linie auf einem Stadtplan. Die Dramaturgie wird erzeugt durch das Geradeausgehen und der damit verbundenen, ständigen Kollision mit der Wand. Dabei wird das Laufen zur Handlung, die Stadt zum Stroposkop, die Wände zum Blitzlicht. Der Betrachter wird nach jedem Aufprall auf die Wand in eine neue Realität versetzt, ähnlich dem wechseln der Programme beim Fernsehen.

Szene: Zwei chinesische Musikstudentinnen sitzen am Holztisch und sprechen Chinesisch. Die Kamera geht vorbei durch die offene Tür auf das Waschbecken zu.

`Zap`.

Szene: Ein junger Mann spielt rauchend Cello. Bücher sind überall im Raum verteilt. Ein zweiter junger Mann kommt hinzu. Die Kamera geht an ihm vorbei, auf ein Regal zu.

`Zap`.

Szene: Ein großes Bild. Immernoch hört man das Cello vom Raum davor.

`Zap`

Der Drücker der Fernbedienung ist die Wand.

Konstant bleibt das Geradeausgehen, die stete Bewegung nach vorne. Ähnlich dem Umschalten auf Lichtgeschwindigkeit in diversen Science-Fiction Utopien zieht der Betrachter nicht an hellen Lichtpunkten, sondern Geschirrspülern, Sofagruppen und Badaccessoires vorbei. Der Betrachter taucht nicht nur ein in die verschiedenen Milieus, er taucht sogar hindurch.

Die Ethnografie von Robert Ezra Park wird erweitert um den Aspekt der Bewegung: Go straight through the district, get the feeling, become acquainted with people.

2 LAGEBERICHT

2.1 Halle

In Halle wurde die Linie von Westen Richtung Osten gezogen:

Beginnend in Nietleben am Rande von Neustadt. Ein Mann mit Baseballkappe und Sonnenbrille führt uns durch seine komplett tapezierte Wohnung. Er baut gerade eine Badewanne ein, obwohl der Block in den nächsten Wochen abgerissen wird. Doch hat die alte Wohnung eine Badewanne so hat er Anspruch auf eine neue Wohnung mit Badewanne. Parallel zur Magistrale geht es über gestampfte Flächen durch zwei weitere eng dimensionierte Behälter mit sanitären Anlagen und Küchenzeile. Es folgen leere Wohnungen, die Zeugnis von 20 Prozent Leerstand geben. In der teils renovierten Mitte von Neustadt angelangt kommen wir nicht mehr durch die Blocks. Die Leute verstehen den Sinn des Projektes nicht. Ausweichmanöver. Fünf prächtige Scheiben, das Aushängebild für Abriss Ost werden teils durchquert. Durch ein Punkthochhaus führt der Weg über die Freizeitzone Saaleaue mit Tennis- und Fußballplätzen ins Stadtinnere.

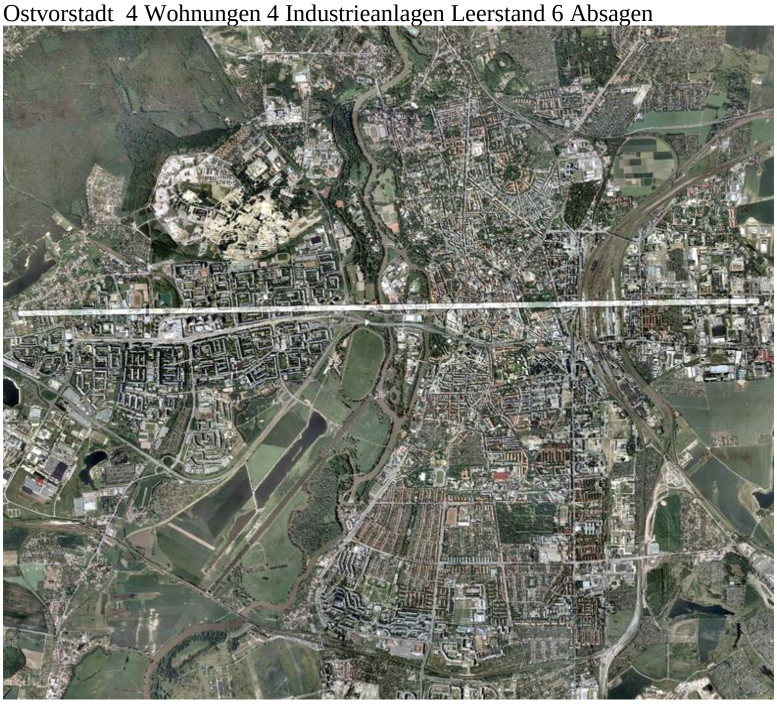
Knapp vorbei am Göbelbrunnen geht es durch Ankleidegeschäfte, eine Schule, in verschiedene Altbauwohnungen mit hohen Decken und Parkettböden. Sind die Menschen in den 70ern aus der sich zersetzenden Innenstadt nach Neustadt gezogen, so ist jetzt die Umkehrung der Fall. Die frisch renovierte Innenstadt saugt. Es folgt die Marienbibliothek – Deutschlands ältester und größte evangelische Kirchenbibliothek bevor wir im Dunstkreis der altehrwürdigen Marienkirche durch die Wohnung des Pfarrers und seines Nachbarn kommen. Am Rande des Marktplatzes folgen Geschäfte, eine Baustelle und ein Frauenarzt bis ins Justizgebäude von 1905 mit einem höchst eindrucksvollen Treppenhaus als steile, gewölbte Kuppelhalle in monumentaler Übersteigerung. Über den Hansering verlassen wir die Innenstadt. Ein noch nicht renoviertes Gebäude beinhaltet das Kino La Bim sowie Proberäume für Bands im Keller. Es folgt der Stadtgottesacker – der Friedhof . Ein riesiges Areal von Gleisanlagen bildet den Auftakt zum Osten, der für uns der interessanteste Teil der Stadt war. Er ist durchmischt mit Wohnungen, Schrebergärten, Industrie, Geschäften und Volksschulen. Dazwischen gibt es immer wieder Brachland und zerfallene Anlagen. Der Osten ist urban und ländlich zugleich, ist konzentriert und weitläufig, geordnet und vielfältig, reif und jugendlich.

Statistik der Forschungsreise

Neustadt 5 Wohnungen 16 Absagen

Altstadt 7 Wohnungen 12 Geschäfte 1 Bibliothek 1 Landesgericht 2 Büros 1 Frauenarzt 1 Kino 8 Absagen

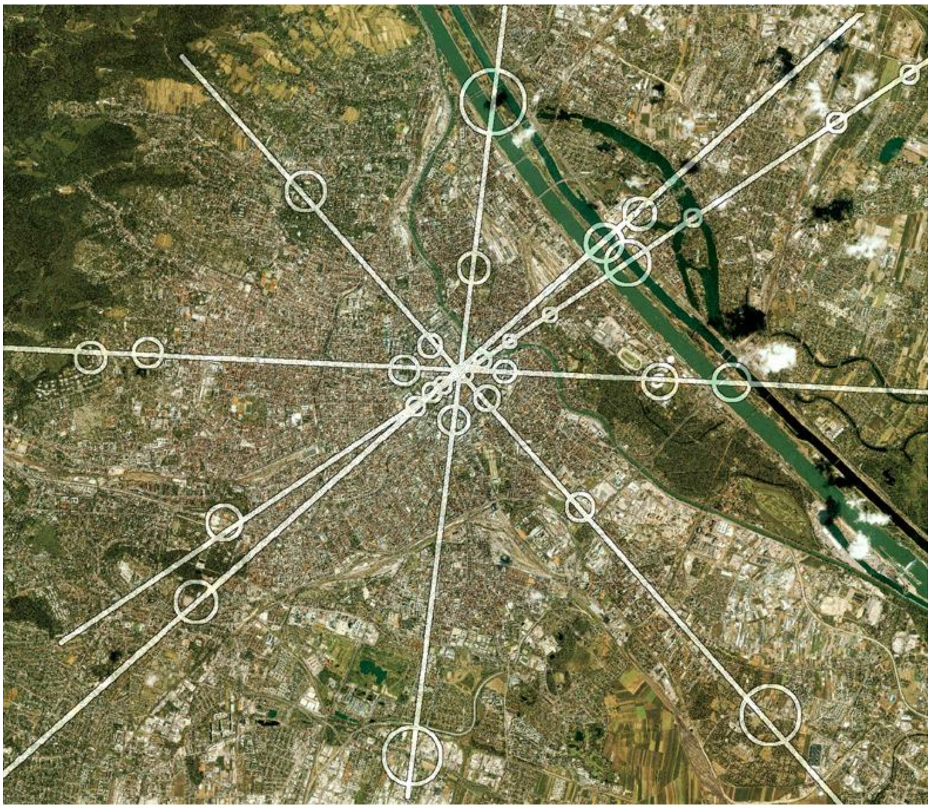
Ostvorstadt 4 Wohnungen 4 Industrieanlagen Leerstand 6 Absagen



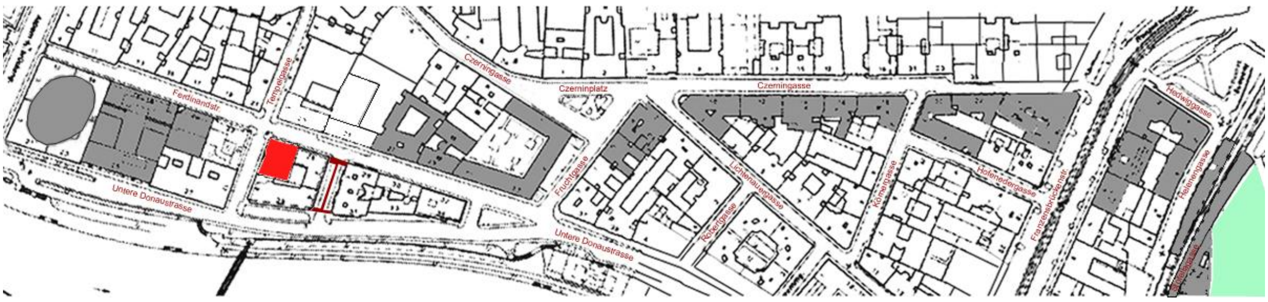
Luftbild Halle mit der Linie

2.2 Wien

Die Lage der Linie wurde im Institut Wiener Kreis ermittelt.
Die Linie auf 1.54 Uhr führt durch Schönbrunn über die Mariahilfer Einkaufsstrasse durch das MQ, das Kunsthistorische Museum, die Burg, durch das historische Zentrum den Stephansdom, durch den zweiten Bezirk, über den Prater, über die Donau, durch Kaisermühlen, erneut über die Donau mit dem Strandbad Gänshäufel, über die Äcker von Kagran.
Zur Alternative standen noch andere Linien:
Linie auf 12.14 Uhr durch die Donau, den Augarten, den Stephansdom, den Karlsplatz und den Obst- und Gemüsegroßmarkt.
Linie auf 1.36 Uhr parallel zur historischen Achse durch die UNO city, den Stephansdom, die Burg, die Maria Theresien Kasernen.
Linie auf 3.06 Uhr durch die Donau, das Stadion, die Angewandte, den Stepahansdom, das Parlament, das Wilhelminenspital.
Linie auf 4.36 Uhr über den Zentralfriedhof, den Zentralviehmarkt, den Stadtpark, den Stephansdom, die Türkenschanze.



Luftbild Wien mit den Linien



Ausschnitt der Linie auf 1.54 Uhr (zweiter Bezirk). Die Linie dehnt sich in der Praxis zu einem raumbringenden Korridor aus.

Es folgt der dazugehörige Ausschnitt aus der Berichterstattung.
(Im CORP - Vortrag wird an dessen Stelle der dazugehörige Ausschnitt aus dem Film gezeigt)

Versicherung U, Montag 02.08.2004
Eröffnungstag des neuen Glashochhauses. Menschen in Anzügen. Restaurant. Wand. Tiefgarage. Hof. Garage. Strasse.

Synagoge, 25.07.2004, 08.09.04, 15.09.04
Die Synagoge erscheint wie ein normales Mietshaus. Das einzig Ungewöhnliche sind die großen Betonklötze, die anstatt parkender Autos am Straßenrand stehen. Läuten an der Tür. Bedenken wegen der Sicherheit. Es bedarf einer Erlaubnis von der israelischen Kultusgemeinde. Warten. Es Bedarf eines Ansprechpartners in der Synagoge. R geht zur Synagoge und wird zur Sicherheit im Block

nebenan verwiesen. Dort schickt man ihn zur israelischen Kultusgemeinde. Am Mittwoch darauf klingelt R. wieder an der Synagoge. Die Tür wird geöffnet. R. geht rein und filmt. Wand. Durchgang. Wand. Die Verwaltung des Österreichischen Turnerbundes.

Ferdinandstraße, 18.07.04, 28.07.04, 25.08.04
An der Ferdinandstrasse liegt das Elektrogeschäft E K. Durch einen Flur kommt man zur Hinterhofwohnung, dem Atelier C T. T malt Ölgemälde nach Fotografien von Bettina Rheims, er wohnt im Atelier, hat oben auf der Galerie sein Bett stehen und malt unten bei offenem Fenster. Durch den Hof geht es in die Wohnung von Herrn T, der gemütlich sein Wurstbrot verzehrt. Wand. Eine Dreier WG, es wird Englisch gesprochen, nach ca. 10 Minuten dann deutsch. Es sind Deutsche, zwei sind anwesend, ein Student, der sich in eine Engländerin verliebt hat und ein Schriftsteller, der im Wettbüro arbeitet. Drei Wände. Der Hauswart danach hat zwei Töchter, die eine setzt sich nur gegen eine Belohnung auf die Couch. Wand. Großer Innenhof. Wand. Wohnung von Herrn A P dessen Wägelchen vor dem Haus steht. Er hat ein künstliches Bein und fährt daher mit dem blauen Wägelchen durch die Stadt.

Fruchtgasse 19.07.04
Über die Fruchtgasse geht es in das Gasthaus A W mit Clubraum im hinteren Teil. Der Besitzer Wilhelm trägt einen Kaiser Franz Josef-Bart und ist dem Projekt gegenüber sehr aufgeschlossen. Die Gäste spielen Schafskopf. Wand. Hinterhof mit Getränkepaletten. Wand. Naturkostladen N N. Der Besitzer erklärt uns, dass wir die historische Achse durch das ehemalige Moor mit unserer Linie knapp verfehlen. Wand. Frau mit Papageien.

Lichtenauerstrasse - Czerningasse 23.07.04, 09.09.04, 25.08.04
Im Hochparterre gab es leerstehende Büroflächen zu mieten. Der Makler verlangt 60 Euro plus MwSt. für das Durchfilmen. Ablehnung. Darüber A S, der an Jean Paul Belmondo in den mittleren Jahren erinnert. Gesprächig. Er vertröstet R. auf den nächsten Tag, da er unter die Dusche möchte. Der Sohn spielt Klavier. Wand. G S war auf Geschäftsreise in Moskau und zeigt ein Stück Plexiglas, in welches der Kreml eingelasert ist. Wand. A M liegt lesend im Bett. Wand. G M, am Laptop sitzend, Rap hörend. Schrank. Wand. Chinesische Musikstudentinnen. Bad. Wand. I H ist der Mitbewohner des Cellisten, beide rauchend. Sie geben uns Tips zur Videotechnik, wir mögen das Ganze zum Schluss doch fazen lassen. Wand. 3 Punks, die eigentlich niemand in die Wohnung lassen, weil dort geraucht und getrunken wird, die uns aber nach hartnäckigem Überreden reinlassen, immer interessierter werden (das junge Mädchen findet es echt cool und strahlt, Ihr Freund schnorrt mich noch um einen Euro für ein Bier an, den ich ihm gebe) und uns schon auf die Nachbarin vorwarnen, die natürlich nicht aufmacht, uns aber dazu bewegen die Frau anzusprechen, die gerade die Treppen hochkommt und uns nach einigen vertrauensschaffenden Maßnahmen, wie das Aufzeigen des Nachgehens einer ordentlichen Architektentätigkeit im 2. Bezirk, kurz in Ihre Wohnung mit dem blauen Bad lässt. Wand. Familie W.

Sozialbau 19.07.04, 21.08.04 07.09.04
Den Sozialbau haben wir anfangs übersehen. Erst am Mittwoch den 18.08.04 klingeln wir dort an. Maglovski, Magister Spitaler, Grzybowski, Bezucha, Manhardt, Trnka, Herzberger, Neumann, Jacoba, Nummer 7, Nummer 5 und Nummer 1 lassen uns nicht in die Wohnung. Lange Absage vom Schriftsteller E B. Er hat abends eine Lesung und hat deswegen keine Zeit, erzählt uns aber ausführlich, dass er keine Kriminalromane und keine Handys mag und wie schwierig der Buchmarkt ist. Weitere 4 Absagen über dem Hof am Ende des Sozialbaus.
Frau F versteht nicht ganz was wir wollen und lässt uns rein, doch ihre Wohnung möchte sie nicht gefilmt haben. Guter filmischer Übergang zum jungen Liebespärchen S und S. Wand. Herr G hat einen Gipsfuß. Seine Frau schläft gerade noch, wir mögen in einer Stunde wiederkommen; er möchte nicht mit aufs Bild. Wand. F G spricht nur türkisch. M ruft C T seinen türkischen Arbeitskollegen an und übergibt das Telefon an Frau G, sie wird überzeugt. Flur. Musiksolistin. Wand.
Frau L . Sie ist gerade am Putzen, wir sollen eine halbe Stunde später wieder kommen. Sie hat für uns ein Bild mit einem japanischen Spruch bereitgestellt:“ Lauf Schnecke den Fujiama hoch, aber langsam, langsam“ (Isa). Sie läuft für uns auf dem Home-Trainer. Hof. Junge WG**.** T A zündet eine Kerze an, seine Freundin schaut zu, Beat-Musik, alles vor dem mit Perlmutt-Effekt beklebten Mehrzweckschrank. Wand. F Club. Einer der Übenden – Hände werden übereinandergekreuzt – möchte nicht gefilmt werden. Dafür stellt sich der Trainer in Pose. Der Mann, der an der Wand steht, steht - von meinem Eintreten bis zu meinem Austreten – genauso an der Wand und regt sich nicht. Herr W ist Pianist und kocht gerade. Seine Kinder hüpfen für uns auf dem Bett. Wand. Frau ? lächelt die ganze Zeit. Ihre Tochter springt Trampolin und lacht ebenfalls. Der Sohn ist etwas krank und schaut Olympia.

Franzensbrückenstraße Sonntag 19.07.04, 28.07.04
Von der Franzensbrückenstraße gehen wir ins T A Pizza. Wand. Gasse. In der Straßenbahnarkade hat Herr B eine Schreinerei mit zwei Ebenen. Die Maschinen sind lauter als die darüberhinwegdonnernden Züge.

Stoffelagasse. 19.07.04
Ein Fahrradraum mit Mülltonnen, Benzinkanister, Lassi-Puzzle und großen Teddybären. Im Treppenaufgang spielen Kinder. M. läuft durch das Flurfenster an den Kindern vorbei, schlägt sich den Kopf an. R schlägt sich danach im Videowahn den Kopf an, ihm wird schwarz vor Augen. Köpfe schauen aus den Fenstern der oberen Geschosse. Nach und nach kommt die ganze Familie aus dem Haus, sie scheinen den ganzen Block (70m lang) zu bewohnen.

Auf unserem Weg durch Wien haben wir bisher (Stand 20. Dezember 2004) durchschritten:
27 öffentliche Einrichtungen wie Schulen, Freibäder, Polizeistationen, Kirchen, Museen.
91 Geschäfte, dazu zählen Läden, Restaurants, Pensionen, Arztpraxen, Büros.
125 Wohnungen
demgegenüber stehen 152 Absagen von Bewohnern

3 EINGRIFF

Unterschiedliche historische Gegebenheiten haben zu verschiedenen geometrischen Mustern im Grundriss der Stadt geführt. So etwa die Sternstadt der Renaissance mit einer Reihe zahnförmig vorspringender Bastionen, um ein Flankenfeuer auf die Angreifer zu ermöglichen. Technische Innovationen haben diese Strukturen aufgebrochen, das signifikanteste Beispiel ist die Eisenbahn, die eine Schneise möglichst tief in das Stadtinnere gezogen hat. Unser medialer Eingriff führt zu einer neuen Stadt in der Stadt. Eine lineare Stadt, ein künstlich erzeugtes Produkt aus bestehenden Nachbarschaften. Ebenso wie in der traditionellen Stadt gibt es unterschiedliche räumliche Funktionen, Distanzen und Formen. Die Nachbarschaft ist ein Hauptbestandteil von „Entlang einer Linie." Wir sind auf zwei Arten von Nachbarschaft gestoßen. Die eine ist, man kennt seine Nachbarn nicht, ist aber interessiert, wie diese hausen. Die andere ist, man kennt seine Nachbarn und empfiehlt uns weiter oder lieber nicht.
Dazu das Handbuch der Soziologie:

„Nachbarschaft ist nicht denkbar ohne ein naturales Element – die physische Nähe. Auch sie verliert wesentlich an Bedeutung, wenn sie nicht gleichzeitig durch funktionale Beziehungen bestätigt wird." (2)

Und Pierre Bourdieu:

„Tatsächlich steht einem nichts ferner und ist nichts weniger tolerierbarer als Menschen, die sozial fern stehen, aber mit denen man in räumlichen Kontakt kommt." (3)

Herr F in der Arminenstrasse ruft seine Nachbarin an, die etwas ältere Frau G. Diese hat uns vorher abgewiesen. Er erläutert ihr das Projekt am Telefon. Daraufhin lässt sie uns filmen. „I wußt net dass es ein Filmprojekt isch und sie wisse ja, da klingeln soviel Leut. In der Englertstrasse sind die Nachbarn schon zusammen in der ersten Wohnung. Wir bekommen Wein und selbstgezüchtete Tomaten. Zusammen mit den Nachbarn gehen wir zum nächsten Nachbar, der irgendwie schon von uns erfahren hat und zuerst meint: „Keiner filmt durch meine Wohnung." Doch Frau W. meint es wäre ganz schmerzlos und überredet den Herrn doch mitzumachen.

Drei Vorschläge zur Förderung der Nachbarschaft:

Öffnen der Wände mit kleinen Fenstern

schafft eine direkte Verbindung zum Nachbarn. Empfehlenswert anzubringen in den Aufenthaltszonen oder Fluren in einer Höhe vom Nabel bis zum Kopf. Fördert die Kommunikation und die Anzahl der flüchtigen Begegnungen mit dem direkten Nachbarn. Dabei kann man das Fenster kurzerhand mit einem roten Vorhang versehen auch für Puppentheater nutzen. Auf beiden Seiten sollten Rollos angebracht sein, so dass man sich dem Einblick auch entziehen kann.

Übergreifen, Eingreifen von Elementen

Frau W. wollte ein Blumenbild einer ihr bekannten Künstlerin mit dem Video - Beamer an die Wand beamen. Doch dazu war der Raum zu eng, das Bild war zu klein, da der Beamer nicht die notwendige Distanz zur Wand hatte. Da sie sich gut mit ihrem Nachbarn verstand, vereinbarten sie einen nicht gewidmeten Kleinstraumtausch von etwa einem Zehntel Kubikmeter. Eine große Öffnung wurde geschaffen, die in zwei Hälften unterteilt wurde. In beiderlei Räume ragt nun eine Kiste von zwei Fuß Länge und einem Fuß an Höhe. Frau W hat ihren Beamer untergebracht, der Nachbar hat eine Lampe eingebaut.

Besiedelung von Zwischenräumen

Vor allem in der Nähe von Diskotheken ist es notwendig Nischenräume in Schlafräume umzuwandeln. So ersparen sich die Diskobesucher nach dem Feiern einen oftmals langwierigen Heimweg. Für die Schlafzellen eignen sich besonders Hinterhofflure, Brandwände oder kleinere Baulücken. Die Zubauten sollten einfach sein - beschichtete Dämmplatten tun es - und verstehen sich temporär. In Zukunft hat jeder nicht nur eine Wohnung in der Stadt sondern mehrere verteilte Räume, die man unterschiedlich nutzt. Dabei wird die Nachbarschaft zuerst nicht gefördert. Im Gegenteil entsteht am Anfang eine Aufweichung der Nachbarschaften durch die innerstädtischen Bewegungen. Im zweiten Schritt werden sich aber durch die flexiblen Umzüge neue fruchtbare Nachbarschaften etablieren.

Alle drei Vorschläge sind im vorhandenen Gefüge ohne großen Aufwand zu installieren. Durch die Eingriffe wird der soziale Raum (die Interaktion von Menschen) im physischen Raum gestärkt.

LITERATUR

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2) Handbuch der Soziologie, Werner Ziegenfuss, Stuttgart 1956
3) Stadt-Räume – Die Zukunft des Städtischen, Martin Wentz, Campus Verlag 1996

Privatisierung und soziale Kontrolle öffentlicher Räume in „sicheren Städten“

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1 EINLEITUNG

”Amerikanische Verhältnisse” sind wohl das, was jeder Kommunalpolitiker seiner Stadt am wenigsten wünscht. Auch wenn nicht immer deutlich wird, was damit gemeint ist, so werden darunter doch häufig hohe Kriminalitätsraten, Angst machende Zuwanderer, ‚not-to-go-areas‘, Ghetto- und Slumbildung und das Verschwinden des öffentlichen Raumes verstanden. Die ”Unregierbarkeit der Städte” – die der SPD-Politiker Hans Ulrich Klose (1975, 1989) bereits zweimal für deutsche Verhältnisse konstatiert hatte – scheint für amerikanische Städte jedoch vorüber zu sein. Man spricht in den USA von einem ‚metropolitan revival‘. In die ehemaligen ‚blights‘ der Innenstädte kehren Investitionen, Kaufkraft und gut situierte Bewohner zurück.

Saubere Innenstädte, nette Flaniermeilen, Kultur-Events, Erlebnis-Restaurants, Urban Entertainment Centres und Cineplexxe können als Teil einer rigiden Ausgrenzungspolitik gegenüber allem, was den Vorstellungen der aufstrebenden städtischen Dienstleistungsklasse nicht entspricht (vgl. Werheim 1999), betrachtet werden. Ein wichtiges diskursives Element dieser Strategie besteht darin, die wachsende Armutsbevölkerung nicht nur zu diskreditieren, sondern sie als Schuldige ihrer eigenen sozialen Situation einzuordnen. Die ”Kultur der Armut”, also die Einstellung und die Verhaltensweisen der Armutsbevölkerung, stelle sie außerhalb der gesellschaftlich akzeptierten Normen: Arbeitsunwillligkeit, das sich Arrangieren mit den Leistungen des Sozialstaates, Geburt unehelicher Kinder, Drogenmissbrauch und Neigung zur Kriminalität. Wichtig wurde es in ”gute” und ”schlechte” Armen zu teilen, indem die ”wirklich Bedürftigen” definiert werden, für welche die Sozialstaatlichkeit weiterhin Gültigkeit hat, denn der Wohlfahrtsstaat (selbst der schlanke amerikanische) ist außer finanziellen Atem geraten. Er wandelte sich daher in Amerika zum ”strafenden Staat”, indem er die Folgen des eigenen Handelns kriminalisiert (vgl. Wacquant 1997).

Die ‚zero tolerance‘-Strategie – etwa auch in der BRD gefeiert und kopiert – beinhaltet das Einschreiten der Polizei bei Bagatell-Delikten (die früher im Rahmen sozialer Kontrolle zwischen Menschen geregelt wurden), Razzien und Aktionismus sowie die Vertreibung nicht genehmer sozialer Gruppen aus dem öffentlichen Raum (zum Begriff „soziale Kontrolle“ vgl. Peters 2000). Wichtiger Baustein war der ”Krieg gegen die Drogen”, der sich als Krieg gegen farbige Dealer und Besitzer von Drogen herausstellte. Zusätzlich wurde die Justiz zunehmend unter die Zielsetzung von Strafe und Sühne gestellt, beispielsweise durch das ‚Three strikes and your´re out‘-Prinzip, was beinhaltet, dass nach dem dritten Vergehen der gleichen Art (auch Schwarzfahren, Übertreten der nächtlichen Ausgangssperre o.ä.) eine lebenslange Haftstrafe verordnet werden kann, und durch die Fixierung von Haftstrafen – ohne dass in einer Verhandlung die Umstände der Tat abgewogen werden können.

Gerade die ‚Zero tolerance‘-Strategien haben zu einer ”Säuberung” des öffentlichen Raumes und zu einer Kriminalisierung insbesondere der Schwarzen im Alter von unter 30 Jahren geführt[78]. „In Städten wie Los Angeles zeigt sich das hässliche Gesicht der Postmoderne und verschmelzen Stadtplanung, Architektur und Polizeiapparat wie noch nie zuvor tendenziell zu einer einzigen umfassenden Sicherheitsmobilisierung” (Davis 1995: 260) – der Geograph Neil Smith (1996) spricht über Polizeimaßnahmen zur ”Säuberung des öffentlichen Raumes” im Zusammenhang mit der Durchsetzung der Gentrifizierung attraktiver innenstadtnaher Standorte von einer ”revanchistischen Stadt”. Ursache der Zuspitzung der sozialen Konflikte ist die Zunahme der Erosion der Einstellungen und Verhaltensweisen der bürgerlich weißen Mittelschicht in den Stadtteilen mit hohen Konzentrationen sozialer Problematik. Die räumliche Konzentration von arm und reich erleichtert die Strategien der kommunalen Kriminalprävention (‚community policing‘ resp. ‚problem-oriented policing‘), bei der die staatliche Polizei durch private Sicherheitsdienste und ”aufmerksame Bürger” unterstützt werden (vgl. Lehne 1998).

Neben der Säuberung der Innenstädte gehört das ‚Urban Empowerment Zones‘-Programm zum Repertoire gegenwärtiger amerikanischer Stadtpolitik. Dieses Programm soll dem ‚empowerment‘ von Bewohnerinnen und Bewohnern von extremen Armutsquartieren dienen – de facto bringt es jedoch weder die Armen aus ihrer prekären ökonomischen und sozialen Situation, noch wird der Abstand zu den Mittelschicht-Quartieren verringert (Heinrich 1998). Marcuse (1997) spricht von einer ‚acceptance of the permanence of the ghettos‘.

Doch auch die deutschen Städte können hier mithalten. Nahezu in jeder deutschen Großstadt wurde eine Diskussion um die ”Säuberung” des innenstadtnahen öffentlichen Raumes geführt und im Zuge einer populistischen Debatte meist zu Gunsten des ungetrübten Einkaufserlebnisses, des Umsatzes des Einzelhandels, des Investments in neue, postmoderne Gebäude oder der Bühnen der Lebensstilisierung der neuen aufstrebenden Dienstleistungsklasse geführt (vgl. Dangschat 1997). Auch in deutschen Städten werden Stadtlandschaften oder öffentliche Räume verstärkt gemanagt, separiert und kontrolliert. Die Innenministerkonferenz hat – zurückgehend auf einen Vorschlag des damaligen Innenministers M. Kanther – am 2.2.1998 für alle Länder die Etablierung eines ”Sicherheitsnetzes” für die Cities der Großstädte beschlossen, welches auf das ”gestörte Sicherheitsempfinden” in der Bevölkerung reagiere. „Kernpunkt der Arbeit ist eine entschlossene Verfolgung aller Delikte einschließlich solcher der Alltagskriminalität, die die Bürger besonders bedrücken (z.B. Sachbeschädigung, Schmierereien, Randale in Verkehrsmitteln etc.)” (Diemer 1999: 30).

Die Instrumentalisierung des Sicherheitsdiskurses bestimmt inzwischen etwa in vielen deutschen Städten die offiziellen Vorstellungen sozialer Integration. Überwiegend geschieht dieses als ein sich demokratisch legitimierender sozialer

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[78] Der Kriminologe Christian Pfeiffer: ”Ohne dass die Kriminalität wesentlich angestiegen ist, wurde (in den USA, die Autoren) die Zahl der Gefängniszellen seit 1982 von 400.000 auf 1,6 Millionen vervierfacht. Gegenwärtig sitzen in den USA 1,7 Millionen Menschen in überfüllten Strafanstalten; das sind pro 100.000 Einwohner 650; in Europa sind es zwischen 50 und 100", aus Körber-Stiftung (Hrsg.), Wachsende Ungleichheiten – neue Spaltungen?, Bergedorfer Gesprächskreis, Protokoll 112, S.60

Schließungsprozess einer bestimmten, bürgerlichen sozialen Gruppe gegen alles Fremde (Migranten, Bettler, Punks und andere anti-bürgerliche Lebensstile). Die Zahl der Bettlerverordnungen, Erlässe (die Obdachlose aus den öffentlichen Räumen verschwinden lassen sollen) und der Einsätze von Sondergruppen (die vehement gegen Jugendgruppen oder gegen die Drogenszene vorgehen sollen) nehmen allerorten zu. „In zahlreichen Städten ist Sicherheit zum neuen Dispositiv eines Konsenses der städtischen Mittelschicht geworden: Frankfurt, Düsseldorf, Wiesbaden, Darmstadt, Freiburg, München und viele andere mehr” (Noller 1999: 164). Vor allem farbige Ausländer erscheinen dabei als zentrale Sicherheitsbedrohung, wobei sie immer wieder als Tatverdächtige herhalten müssen[79]. Auf diese Weise werden die neuen Sicherheitsvorkehrungen durch die Herausbildung neuer Feindbilder legitimiert.

In dem vorliegenden Artikel werden diese Phänomene jedoch nur knapp beschrieben (vgl. dazu Dangschat 1995, Eick 1998, Keil & Ronneberger 1995). Die Kriminalisierung sozialer Gruppen und die ”Säuberung” des öffentlichen Raumes werden in diesem Beitrag einerseits als Motor, andererseits als spezifische Erscheinungsform eines forcierten Modernisierungsprozesses angesehen. Der restrukturierte innerstädtische Raum wird ebenso wie der Diskurs über den ”Sicherheitsstaat” und die ”bedrohte innere Sicherheit” als eine interessengeleitete soziale Konstruktion verstanden, die wiederum auf eine spezifische, im Wandel befindliche Gesellschaftsformation (sog. Postfordismus) zurückzuführen ist.

Ein Teil dieser Gesellschaftsformation umfasst das Verhältnis zwischen Staat und Bürger und das Verhältnis zwischen ”Privatheit” und ”Öffentlichkeit”. Es sind überwiegend neo-liberale Wirtschaftsideologien, die aus der Globalisierung abgeleitete Sachzwang-Logik, die These der Individualisierung sozialer Beziehungen und von Biographien sowie die Kommerzialisierung und Privatisierung des öffentlichen Raumes, welche als neue Linie gesellschaftlicher (Des-)Integration die gesellschaftlichen Verhältnisse prägen sollen, wobei sich über das ”Herstellen von Sicherheit” eine neue institutionelle Kontrolle des öffentlichen Raumes abzeichnet.

2 DAS VERÄNDERTE VERHÄLTNIS VON ”PRIVATHEIT” UND ”ÖFFENTLICHKEIT” - FLEXIBILISIERTE REGULATION IM ”NEUEN SICHERHEITSSTAAT”

Das ”goldene Zeitalter des Fordismus”, das durch eine tayloristisch organisierte Massenproduktion und eine über die Sicherungen des Wohlfahrtsstaates abgestützte Massenkonsumtion gekennzeichnet war, ist einem grundlegenden Wandel unterworfen („Post-Fordismus“, vgl. Amin 1994). Der Fordismus war eine räumlich und zeitlich in spezifischer Weise geprägte Gesellschaftsformation, der ein bestimmtes makroökonomisches Design und eine dieser entsprechende Form der Integration der Staatsbürger in die Gesellschaft und lokale Gemeinschaft zugrunde lag. Diese umfasst vor allem bestimmte kollektiv geteilte Werte, Normen und Institutionen (vgl. Lipietz 1998). Über die zentrale Regulierungsinstanz ”Staat” und seine Apparate wurden einerseits das Verhältnis des Bürgers zu seinem Staat, das Verhältnis von Öffentlichkeit zu Privatheit, und andererseits auftretende soziale Konflikte und politische Opposition über den sozialen Konsens geregelt (beispielsweise die Einbindung der Arbeiterschaft in die Sozialpartnerschaft). Der Staat war sowohl Sicherungsstaat (als Überwachungsstaat) mit einer ausufernden Bürokratie, als auch Wohlfahrtsstaat, der die Vermeidung sozialer Risiken zu einem öffentlichen Anliegen machte (Hirsch 1996).

Mit der Krise des Fordismus, die in vielen Ländern Anfang der 70er Jahre einsetzte, sind Veränderungen auf und zwischen allen staatlichen Ebenen (lokal, regional, national) festzustellen, wobei allerdings vor allem der nationale Wohlfahrtsstaat als früherer Garant für Sicherheit in Richtung eines ”nationalen Wettbewerbsstaates” restrukturiert wird. Eine neue Qualität von Staatlichkeit setzt sich hierbei durch, die vor allem eine aktive Umsetzung von Standortpolitik zum Ziel hat. Bestehende Ordnungsvorstellungen und die Wahrnehmung der Entwicklung von Gesellschaft, die in der (fordistischen) Regulationsweise subsumiert wurden, werden immer fragwürdiger. „Der Übergang vom fordistischen Sicherheits- zum nationalen Wettbewerbsstaat, vom Modell Deutschland zur Deutschland GmbH, vollzieht sich in einem komplexen Verhältnis von Kontinuitäten und Brüchen” (Hirsch 1996: 116). Ein wichtiges Element des zunehmend international geführten Wettbewerbes ist das gemeinsame Interesse der Gebietskörperschaften und der Investoren an einer zunehmenden Externalisierung der sozialen und ökologischen Kosten.

Die Restrukturierung des Staates, die sich auch in einem politisch inszenierten Sicherheitsdiskurs, in der Konstruktion von Feindbildern und der Verdrängung von Marginalisierten als Elemente einer sich verändernden Regulationsweise sozialer Probleme zeigt, setzt Mittel zur Kontrolle sozialer Konflikte voraus, die immer mehr autoritär und ausgrenzend sind und neue ideologische Werte produzieren, um so den Zusammenhalt der Konsum- und letztendlich Kontrollgesellschaft zu sichern. Der Zusammenhang zwischen Sozialer Ungleichheit, Marginalisierung und Kriminalität wird dabei ideologisch benutzt.

Ein weiterer Ausdruck veränderter Staatlichkeit sind zunehmende und intensivierte Privatisierungsprozesse. ”Privatisierung” verweist auf die Grundfeste der bürgerlichen Gesellschaft, die sich im Besitz von Privateigentum ausdrückt und im Kapitalismus seine ökonomische Form gefunden hat. Die Sozial- und Systemintegration der Bürger wird in zunehmender Weise ideologisiert, um Privatisierungsstrategien in nahezu allen lebensweltlichen Sphären durchzusetzen. Der schrittweise Rückzug des Staates aus seiner sozialen Verantwortlichkeit führt auch zu einer Privatisierung sozialer Gefährdungen. In der Tat, muss jeder Mensch mehr denn je selbst darauf achten, dass er sich gegen die Risiken und Gefahren des Lebens absichert (vgl. Butterwegge, Hickel & Ptak 1998: 102).

Der Begriff ”öffentlich” wird in diesem diskursiven Prozess im Gegensatz zu ”privat” negativ bewertet, da ”öffentlich” zumeist mit ”staatlich-zentralistisch” und seit Beginn der 70er Jahre mit ”defizitär” und ”defizient” gleichgesetzt wird. Die Idee des urbanen öffentlichen Raumes wird zwar positiv als egalitärer physischer und geistiger Raum für alle reflektiert (Demirovic 1992), der postmoderne Diskurs des ‚anything goes‘ legitimiert jedoch auch die Privatisierung und Ästhetisierung des Raumes (s.u.). Da der öffentliche Raum eine politische und soziale Konstruktion von Machtverhältnissen darstellt, werden immer mehr Privatisierungen durchgesetzt, welche sozial ausgrenzend wirken und auf diese Weise die Urbanität nicht wiederherstellen, sondern verhindern (Feldtkeller 1994).

79 In diesem Zusammenhang ist die semantische Konstruktion der Ausländer- resp. Jugendkriminalität von Bedeutung, weil sie den unter dieser Überschrift angezeigten Verhaltensweisen einen gemeinsamen Ursachenfaktor unterstellt und zugleich ein nicht überwindbares Zuweisungs- und Diskriminierungsmerkmal schafft.

Im Rahmen der Restrukturierung des lokalen Staates kommt es vielerorts zu einer Veränderung und Privatisierung des öffentlichen Raumes. Um an Attraktivität für internationales Kapital (Investitionen in Bürogebäude, Entertainment-Center, Hotels und Einkaufspassagen etc.) zu gewinnen, geht es den Stadtverwaltungen immer mehr darum, das ”Gesicht” ihrer Stadt im Sinne einer neuen, flexiblen Kapitalakkumulation zu verändern (vgl. Krätke 1990) , wobei die Idee der ”Sichtbarkeit” und die Bedeutung der Oberfläche vor allem in der Architektur und Städtebau-Debatte innerhalb der Postmoderne hervorgehoben wird (Harvey 1990). In diesem Zusammenhang geht es um die Definition der Signifikation des öffentlichen Raumes und damit um

- die Frage der Hegemonie im Raum (vor allem als kulturelle Hegemonie), die sich

- geistig (als Repräsentation einer bestimmten normativen Ordnungsvorstellung) und

- physisch (als Inbesitznahme von Orten)

ausdrückt (vgl. Zukin 1995).

Öffentliche Räume werden zu privatisierten Konsumräumen und werden als solche von einer Architektur dominiert, die diese Veränderungen aufgrund ihres prägnanten Einsatzes von expressiven Stilmitteln und Ornamenten als Mittel der Lebensstilisierung symbolisieren. Hauptverwaltungen, Banken und Versicherung bedienten sich etwa auch postmoderner Architektur und ihrer Zeichensprache, da gleichzeitig über den Einsatz von ”bodenständigen Materialien" (wie Stein oder Marmor) Sicherheit oder Vertrauenswürdigkeit symbolisiert wird und über die Möglichkeit der ”Plünderung” der Geschichte und des Zitieren von alten Baustilen (Säulenhallen, Portale) Dominanz, Erhabenheit und Stärke vermittelt werden kann.

Dass Städtebau und Architektur auch psychische Barrieren aufbauen kann, wird von vielen Architekten nicht gesehen oder verdrängt, von Investoren oder Developern jedoch angestrebt. Es wird dazu auf der einen Seite ein individualistisches Design und teure Materialien verwendet, auf der anderen Seite wird Sicherheitstechnik eingebaut sowie ausgeklügelte Zuwegungen durch Schranken, Zäune oder trennende Wände errichtet. Das Innere der Gebäude wird meist von der ”feindlichen und bedrohlichen” Außenwelt durch hohe Mauern oder kalte Fassaden (verspiegeltes Glas) abgetrennt. Soziale Exklusion erfolgt hier ganz ausdrücklich mit ästhetischen Mitteln.

Mit der Tertiärisierung der Stadt und der immer räumlich weiteren Dominanz von Konsumkulturen verändert sich die ästhetische Ausstattung öffentlicher Räume. „Ästhetisierung soll heißen, dass in kommerziellen und öffentlichen Räumen der Städte das Schöne und Gestylte vordringt, hyperästhetische Erlebnis- und Unterhaltungsräume entstehen und soziale Beziehungen über Formen ästhetischer Selbstdarstellung und die Inszenierung der Lebensstile wahrgenommen werden” (Noller 1999: 135).

3 VOM ”VERLÄNGERTEN ARM” ZUM MANAGEMENT DER SOZIALEN KONFLIKTE: DIE TRANSFORMATION DES ”LOKALEN STAATES”

Seit den 70er Jahren sind ökonomische und soziale Restrukturierungsprozesse vor allem in den großen Städten zu beobachten, welche sich überwiegend darin manifestieren, dass Privatisierungen von ehemals öffentlichen Institutionen und Betrieben durchgeführt und Deregulierungsmaßnahmen in ehemals geschützten Reproduktionsbereichen wie dem Arbeits- und Wohnungsmarkt eingeleitet werden. Damit zusammenhängend verändern sich sowohl die strategische Bedeutung der Stadt, als auch das Selbstverständnis des administrativ-politischen Apparates: „Städte können als konkurrierende Einheiten innerhalb der wirtschaftlichen Entwicklungsdynamik begriffen werden, die sich unter Konkurrenzdruck zunehmend wie privatwirtschaftliche Unternehmen verhalten. Der ”lokale” Staat wird heute nicht mehr nur ressortgebunden verwaltet, vielmehr sollen Wachstums- und Umstrukturierungsprozesse von der Stadtverwaltung und -politik aktiv initiiert werden” (Krätke 1995: 246).

Zentraler Anknüpfungspunkt ist die Idee der Anwendung „unternehmerischer“ Strategien innerhalb des politisch-administrativen Systems. Dies wird mit den Begriffen ‚urban management‘, ‚entrepreneurial city‘ und ‚urban governance‘ (vgl. Jessop 1994) umschrieben. Der ”lokale Staat” ist demnach wie ein Unternehmen zu führen, wobei mit Konzepten des ‚city marketing‘ gearbeitet wird und die öffentliche Verwaltung Managementfähigkeiten entwickeln soll, damit sie flexibler und effektiver auf die wechselnden Anforderungen einer globalisierten Ökonomie reagieren kann. Vor allem der momentan vielfach diskutierte Begriff „Governance“ beinhaltet eine grundlegende Veränderung des Staatsverständnisses. Im Übergang von „government“ zu „governance“ wird die Rolle des Staates in Bezug auf die Steuerung gesellschaftlicher und räumlicher Entwicklung sowie in Bezug auf die Koordination politischer Entscheidungsprozesse neudefiniert (Pierre 2000, Benz 2004). Zunehmende vertikale und horizontale Integration des Politikmachens, Öffnung des politisch-administrativen Systems für Akteure aus unterschiedlichen gesellschaftlichen Bereichen, sowie das Regieren über Netzwerke sind zentrale, allgemeine Kennzeichen dieses neuen Staatsverständnisses.

Dabei sind folgende Elemente einer Umstrukturierung des ”lokalen Staates” auszumachen:

> - Der ”lokale Staat” als ursprünglich wichtigster Ort der Versorgung der Bevölkerung mit Gütern des kollektiven Konsums (Castells 1978) ändert seine Strategien: Er lagert einige Dienstleistungen aus, er dereguliert den Bereich des kollektiven Konsums und er entwickelt flexiblere Formen der Bereitstellung öffentlicher Güter (wie Gesundheit, Bildung, Umwelt und Sicherheit). Diese Umstrukturierungen innerhalb des ”lokalen Staates” dienen wiederum der Herstellung von Wettbewerbsfähigkeit und der Anziehung von internationalem Konsum- und Finanzkapital. Die alten korporatistischen Kommunikationssysteme (überbürokratisiert, zentralistisch, ‚top-down‘) zwischen der öffentlichen Verwaltung und den Bürgern verwandeln sich in eine Anbieter-Nachfrager- oder Unternehmer-Kunden-Beziehung, wobei auf mehreren Ebenen und in vielfältigeren Gremien verhandelt wird (Mayer 1996). „Der Prozess der ‚Entbehördlichung‘ und ‚Verbetrieblichung‘ der Kommunalverwaltung wird ... im Zusammenhang damit gesehen, dass kommunal zu erbringende Leistungen zu Produkten und Bürger zu Kunden werden” (Heinelt & Mayer 1997: 18). Festzustellen ist eine Institutionalisierung neuer Verhandlungs- und Entscheidungssysteme, wobei verschiedene Kooperationsformen mit dem privaten Sektor an Bedeutung gewinnen und mehr private Akteure in die deutlich pluralistischeren und horizontalen Entscheidungsprozesse eingebunden sind.

- Die „'unternehmerisch' konzipierte regionale Standortpolitik und Wirtschaftsförderung stützt sich bevorzugt auf neue, para-staatliche Organisationsformen: immer häufiger wird lokale und regionale Politik mittels privatrechtlich organisierter Gesellschaften und Entwicklungsträger betrieben" (Krätke 1995: 246). Solche Entwicklungsträger, die vor allem in der Stadtplanung aufzufinden sind, sollen das lokale Wachstums- und Entwicklungspotential über die enge Kooperation zwischen "lokalem Staat" und regionaler Ökonomie fördern sowie den Standort an sich für Anlage von internationalem Kapital attraktiver machen (public-private partnerships). Dies können stadteigene GmbHs, städtische Beteiligungen an privaten Firmen sein, eine Verflechtung über Vorstände und Aufsichtsräte oder aber sich auf eine projektbezogene Zusammenarbeit beschränken. Aber auch die vermehrte Einbeziehung von immer mehr privaten Akteuren in den Entscheidungsprozeß (etwa über Bürgerbeteiligungsverfahren) ist Bestandteil des Regulationsmodus, mit Hilfe dessen die Legitimationskrise des lokalen Staates bekämpft werden soll (Hamedinger 1999).

- In ihrer Konkurrenz um die Ansiedlung von Verwaltung und Direktionszentralen von Großunternehmungen fühlen sich die Städte gezwungen, Infrastrukturen und Flächen bereitzustellen sowie "weiche Standortfaktoren" (etwa kulturelle Ereignisse, Events, Festivals) zu entwickeln (Häußermann & Siebel 1987: 124). Kulturpolitik als zentraler Standortfaktor wird somit als neuer Motor für die Stabilisierung der lokalen Ökonomie und für die Schaffung von neuen Images genutzt. In diesem Rahmen müssen für die Selbstdarstellung dieser Großunternehmen (und ihrem Management) "repräsentative Lagen" innerhalb der Stadt mit entsprechender städtebaulicher und architektonischer Gestaltung hergerichtet werden.

- Die initiierten Deregulierungs- und Flexibilisierungsbemühungen sind mit zunehmender sozialer Polarisierung und einer weiteren, tieferen Spaltung der städtischen Gesellschaft verbunden. Vor allem die Deregulierung des Arbeits- und Wohnungsmarktes führt zu einer von Polarisierung gekennzeichneten Beschäftigungsstruktur und zu einer verstärkten räumlichen Konzentration von Armut. Die Produktion von Räumen, in welche Arme und von der städtischen Gesellschaft Marginalisierte abgeschoben werden, folgt einer Modernisierungslogik, die Armut und staatliche Restrukturierungen wie die Privatisierung von Sicherheit in einen Zusammenhang bringt. „Soweit diese Verschränkung von Sicherheit und Sauberkeit mit der räumlichen Konzentration von Armen in der Öffentlichkeit und in öffentlichen Räumen einhergeht, werden diese in Berlin (und anderen deutschen Großstädten, die Autoren) ordnungspolitischer Gegenstand und Ziel repressiver Aktivität" (Eick 1998: 96) . Privatisierungen öffentlicher Güter wie Sicherheit werden durchgeführt, indem der "lokale Staat" auf sein Gewaltmonopol verzichtet (verzichten muss) und vermehrt private Sicherheitstruppen einsetzen lässt, um die Ordnung und Sauberkeit der Straßen zu gewährleisten. Die Privatisierungsstrategien von Stadt und Gesellschaft umfasst die Privatisierung öffentlicher Sicherheit, was sich dann in der Privatisierung öffentlicher Räume widerspiegelt.

Bei der Transformation des "lokalen Staates" handelt es sich also nicht um eine stärkere Demokratisierung im Sinne der Herstellung von mehr Öffentlichkeit im politischen und planerischen Entscheidungsprozeß, sondern die Strategie der Privatisierung dient der Durchsetzung der Interessen einer lokalen Wachstumskoalition. Die Reproduktion lokaler Machtkoalitionen hat sich als Tatsache nicht verändert, sie funktioniert jetzt allerdings wesentlich subtiler über die konsensuale Einbeziehung der vormaligen Elemente der Zivilgesellschaft (beispielsweise von NGOs oder intermediären Organisationen in der Stadtplanung).

Vielmehr ist die Auslagerung von ehemaligen Aufgaben des "lokalen Staates" und die damit verbundene Privatisierung von öffentlichen Gütern als Entdemokratisierung zu betrachten. In der Tat haben sich die privaten Sicherheitsdienstleister oder etwa auch die als public-private partnerships organisierten Stadtentwicklungsunternehmen nicht der Öffentlichkeit und dem Gebot der "Transparenz" zu stellen. Von demokratischer Kontrolle kann keine Rede sein. Der "lokale Staat" zieht sich dabei allerdings nur auf den ersten Blick zurück, denn er bleibt der entscheidende Akteur in der Kooperation mit seinen neuen privaten Akteuren in der Stadt. Obgleich es so scheint, dass durch vielfältige Privatisierungsstrategien das staatliche Gewaltmonopol (vor allem im Sicherheitsbereich) ausgehöhlt wird, erfolgen staatlich initiierte Re-Regulierungen mit dem Ziel, den "erweiterten Staat" zu stabilisieren. Im Sinne dieser Machtsicherungsstrategien ist der seit etwa fünfzehn Jahren initiierte und inszenierte (Verun-)Sicherheitsdiskurs zu sehen. Darin geht es auch nicht um die Analyse und Bekämpfung der Ursachen von Kriminalität in den Städten, sondern um die Möglichkeit, Kontrollmechanismen im Namen der Unrechtsbekämpfung auszuweiten (etwa im Zusammenhang mit dem teilweisen Verbot von Demonstrationen in New York; vgl. Marcuse 2003). Demokratiepolitische Errungenschaften werden in diesem Zusammenhang leicht übergangen. „Vielmehr bestimmen politisch perzipierte Kontrollerfordernisse, die durch wachsende Spannungen zwischen sozialen, ökonomischen, ethnischen Gruppen in der Stadt entstehen, die Wahl der sicherheitspolitischen Maßnahmen. Kriminalitätskontrolle ist folglich ein Mittel, um Unzufriedenheit und Widerstand zu unterdrücken" (Nissen 2003: 11).

4 AUFRÜSTUNG UND IDEOLOGISIERUNG: DER "KONSTRUIERTE" SICHERHEITSDISKURS

Die Furcht vor organisierter Kriminalität, Aggression und Gewalt und der Kriminalitätsentwicklung steht in Ost und West noch vor der Arbeitslosigkeit und der Sorge um den Umweltschutz an erster Stelle der Problemlisten – Tendenz steigend (vgl. Reuband 1996). Die Ursache hierfür ist jedoch nicht eine zunehmende Kriminalität – die ist eher rückläufig (Ruth 1999) –, sondern die Beunruhigung ist auch und großenteils das Ergebnis der Bemühungen der Instanzen, die die Innere Sicherheit erhalten sollen. Angestiegen ist nämlich nicht die Rate der personalen Kriminalitätsfurcht (das sich selbst Bedroht-Fühlen), sondern die der sozialen Kriminalitätsfurcht (das Gefühl, dass die Gesellschaft als Ganze bedroht sei) hat beträchtlich zugenommen (Reuband 1996). „Die ‚Verbrechensfurcht' ist nach den Kampagnen der 90er Jahre angestiegen, nicht vorher" (Cremer-Schäfer 1999: 13).

Die Bedeutung der Konjunktur des Begriffes "Innere Sicherheit" vermittelt sich insbesondere dann, wenn man erkennt, dass es sich hierbei um eine sozial konstruierte Selbstbeschreibung in der Gesellschaft handelt. „Man kann die verschiedenen Formen ‚abweichenden Verhaltens' als Ausdruck illegitimer gesellschaftlicher Machtverhältnisse begreifen, sie auf einen Zerfall ethisch-religiöser Wertorientierungen zurückführen, oder sie eben als Ausdruck der Gefährdung der Inneren Sicherheit interpretieren. In jedem Fall wird durch die unterschiedlichen Diagnosen eine andere ‚Therapie' nahegelegt" (Kreissl 1998: 155). Der Begriff Innere

Sicherheit thematisiert und fokussiert „ein eher diffuses Unbehagen. Er bezeichnet entgegen der durch die Wortwahl nahegelegten Bedeutung, einen Zustand der Unsicherheit" (Kreissl 1998: 157).

Ruth (1998) sieht drei Institutionen, die maßgeblich den Diskurs über die "Produktion der Inneren Sicherheit" bestimmen:

„Zur ersten Gruppe der Starregisseure der Inszenierung ‚Innere Sicherheit' zählen die Regierenden" (Ruth 1998: 13). Insbesondere in der Vorbereitung der Asyldebatte in der BRD wurden Ausländer wiederholt als bedrohlich dargestellt, die "das Boot ist voll-These" auch von gemäßigteren Politikern bemüht und die Angst vor der "Überfremdung" geschürt. Gerade das Feld der "Inneren Sicherheit" bietet in der Auseinandersetzung der Parteien die Chance zur populistischen Dramatisierung. Durch diesen institutionalisierten Rassismus fühlen sich soziale Gruppen legitimiert, ihrerseits ausländerfeindlich zu reagieren.

Zur zweiten Gruppe zählen nach Peters (1998: 15) die "etablierten Massenmedien", die trotz der Abnahme der Gewaltkriminalität in sehr viel umfangreicherer Weise über Gewaltereignisse berichten. Hohe Einschaltquoten und steigende Auflagenzahlen bestätigen die Eigentümer und Chefredakteure in ihrem Vorgehen. So stehen sie einerseits den Politikern zur Verfügung, wenn jene "unnachsichtige Härte" fordern (gegen vorher diskriminierte Randgruppen der Ausländer, Jugendlichen, Drogenkonsumenten etc.). Gleichzeitig verfolgen sie ein eigenständiges Interesse, den Fremden als "Feind" (der Inneren Sicherheit, des Wohlergehens, des Wohlstandes) anzusehen.

Cremer-Schäfer (1999: 13) fügt mit den "Sprecherinnen und Sprechern der Polizei" eine dritte Gruppe an, die von ihr im Rahmen "dieses ideologischen Diskurses" als "primäre Definiererinnen und Definierer von Bedrohungslagen und gesellschaftlichen Strukturdefekten" angesehen werden. Insbesondere werde „durch Reden über ‚Kriminalität' und über ‚Gewalt' verhandelt und bestimmt, welche gesellschaftlichen Gruppen Probleme machen, wie darauf reagiert werden kann und welche Grenzen von Integration und Ausschließung gelten".

So mancher Kommunalpolitiker neigt also dazu, aus parteipolitischen Gründen das Sicherheitsthema zu forcieren und auf spezifische soziale Gruppen zu beziehen. „Die eine – wie der Stuttgarter Oberbürgermeister Schuster begründen Ideen von der ‚Modellstadt für mehr Sicherheit'. Thomas Schäuble, Innenminister von Baden-Württemberg, sucht nach Möglichkeiten, die der Polizei künftig ein ‚schärferes Durchgreifen gegen Bettler und Punker' erlauben. Mittlerweile weitverbreitetes Vorbild ist das amerikanische ‚community policing' (frei übersetzt: Nachbarschaftspolizei), was in der Praxis die vollständige Verpolizeilichung des öffentlichen Raumes bedeutet...."(Simon 2001: 23). Die Asyldebatte in der BRD wurde etwa auch mit der forcierten Angst vor Drogenhandel und -konsum verbunden, die Öffnung Mittel- und Osteuropas wurde von einer zunehmenden Angst vor organisierter Kriminalität ("Russen-Mafia") oder Eigentumsdelikten (gegenüber den Polen und Rumänen) begleitet. Die dritte "Feindgruppe" sind Arme, Bettler und Obdachlose, bei denen der Unterschied zwischen Präsenz im öffentlichem Raum, aggressivem Betteln und Diebstahl kaum noch gemacht wird. Der Sicherheitsdiskurs ist im Zusammenhang mit der Suche nach neuen Identitätsbildern zu sehen, wobei immer mehr innere und äußere Feinde erzeugt werden (Mafia, Asylanten, Bettler). „Deutlich ist nur, dass kriminelle Bedrohungen medial und politisch systematisch produziert, aufgebaut und eingesetzt werden" (Hirsch 1996: 158).

Das gesteigerte und seitens der Politik suggerierte Sicherheitsbedürfnis trifft dabei auf ein wirkliches Bedürfnis nach Sicherheit und Identität für den Bürger in der postmodernen, unübersichtlichen und schnelllebigen Zeit und auf das wahre Bedürfnis des in die Krise geratenen Staates nach neuer Legitimität. Gleichzeitig ist momentan ein sinkendes Toleranzniveau gegenüber sozialen Randgruppen zu beobachten, was - alles zusammen - die Grundlage für eine florierende Sicherheitsindustrie darstellt. Allerdings ist auf folgendes hinzuweisen: „Die urbane Sicherheitsdebatte wird ganz wesentlich von einem Phänomen dominiert, das als ‚subjektives Sicherheitsgefühl' oder ‚Kriminalitätsangst' umschrieben wird. Es handelt sich dabei um ein hybrides Konstrukt, welches von der polizeilich ausgewiesenen Kriminalitätsentwicklung deutlich zu trennen ist" (Beste 2000: 31).

Sicherheit wird in diesen neuen privaten Sicherheitsunternehmungen, die rund um die Dienstleistungsbereiche entstehen – einem der am stärksten wachsenden Dienstleistungssektoren in Berlin – als Ware behandelt, die in einer freiheitlichen Gesellschaft von jedem gekauft werden kann (Nogala 1998). Vor allem hier können auch ‚public-private-partnerships' zum Tragen kommen, die den Handlungsspielraum des "lokalen Staates" wieder erweitern sollen. So arbeiten etwa die Berliner Verkehrsbetriebe (BVG) mit dem privaten Sicherheitsdienst IHS zusammen, die dann gemeinsam die Sicherung ihrer Räume besorgen sollen. Auch die Deutsche Bahn AG wird im Zuge ihrer Privatisierung zu einem Verkäufer von Innenstadträumen und zu einem zentralen Akteur in der Sicherheitspolitik.

Die sich entwickelnde Sicherheitsindustrie ist ein gutes Beispiel einer Dienstleistungsökonomie, die sich im Wesentlichen auf schlecht bezahlte Jobs stützt und zumeist prekäre Arbeitsverhältnisse anbietet und damit soziale Polarisierung forciert.

Die "Nachfrage" nach Sicherheit als Ware ist - aufgrund der oben beschriebenen Entwicklungen - enorm gestiegen. Die Sicherheitsbranche erfuhr dadurch ein schnelles Wachstum, was sich etwa in der Entwicklung der Beschäftigtenzahlen dokumentieren lässt: „Seit 1980 hat sich die offizielle Beschäftigtenzahl bis heute allein für die alten Bundesländer knapp verdreifacht (von ca. 30.000 im Jahre 1980 auf geschätzte 81.500 in 1998; Quelle BDWS)" (Nogala 1998: 136).

Strukturelle Kennzeichen dieser Branche sind:

- Niedrige Qualifikation der Angestellten, die sich weniger aus den Bereichen der Polizei oder etwa der Bundeswehr rekrutieren, sondern aus den Bereichen Handwerk und Bau (Langzeitarbeitslose und sog. "gescheiterte Existenzen" sind hier verstärkt vorzufinden).
- Aufgrund des enormen Kostendrucks, der durch eine scharfe Konkurrenzsituation entstanden ist, werden Sicherheitsvorschriften vernachlässigt.
- Sicherheitsunternehmungen bieten zumeist mehrere Dienstleistungen an (wie etwa auch Gebäudereinigung, Hostessenservice etc.).

- Die Angestellten werden nur mäßig ausgebildet und sind damit in der Ausübung ihrer Tätigkeiten ständig überfordert. Das liegt auch daran, dass es kein spezielle sicherheitsgewerbliche Ausbildung gibt und eine entsprechende Ausbildung den Unternehmern zu teuer kommt.

- Insgesamt kann von sehr schlechten Arbeitsbedingungen ausgegangen werden. Die Angestellten werden schlecht bezahlt; außerdem werden sie in prekäre Arbeitsverhältnisse gezwängt, damit sie flexibel und auftragsbezogen verwendet werden können.

- Es gibt Tendenzen in Richtung Marktkonzentration, Subunternehmertum und Zeit- und Leiharbeitsfirmen (Beste 1998).

- Hauptauftraggeber sind Kommunen, das produzierende und das Dienstleistungsgewerbe.

Diese privaten Sicherheitsdienstleister scheinen das Bild der öffentlichen Räume bald gänzlich zu kontrollieren. Damit erledigen sie staatliche Aufgaben der Herstellung von Sicherheit und Ordnung. „Bereits 5% aller Beschäftigten sind in öffentlichen Räumen tätig, andere Quellen sprechen von über 13%. Es liegt im ökonomischen Interesse der Branche, öffentlichen zu privaten Raum zu definieren, ihn also dem Hausrecht zugänglich zu machen” (Eick 1998: 103). Diese Sicherheitsdienste nehmen Einfluss auf die Definition von Sicherheitsproblemen und entsprechenden Problemgruppen und nehmen an Besprechungen von in der Verwaltung angesiedelten Gremien zum Thema Sicherheitspolitik teil, was aus demokratiepolitischer Sicht bedenklich erscheint.

5 DIE “TRANSFORMATION” ÖFFENTLICHER RÄUME

Im Zusammenhang mit den bereits erwähnten sozialen und ökonomischen Restrukturierungsprozessen in Städten und den “inszenierten” Sicherheitsdiskursen können folgende Aspekte der Transformation öffentlicher Räume festgehalten werden:

Öffentliche Räume werden zu privatrechtlich sanktionierbaren Enklaven des gehobenen Konsums, deren Nutzung durch eine an Militärdiktion erinnernde Rhetorik (Vertreibung, Säuberung, Sicherung) und durch Verhaltensgebote ausgefochten wird. Der ungestörte Konsum muss gesichert bleiben, da dieser als eine wichtige ökonomische und normative Grundlage für den ”lokalen Staat” angesehen wird. Beispielhaft sind Shopping Malls als ”postmoderne Konsumräume” mit ihren festungsartigen Strukturen, die in deutschen Städten immer mehr an Bedeutung gewinnen. Die schnelle Entwicklung der ”Überwachungsinstrumente” wie Kameras, Monitore, Lichtschranken oder Bewegungsmelder ermöglicht eine immer subtilere Kontrolle des öffentlichen Raumes (Weichert 1998). Genau an diesen ”Marktplätzen” verschwindet die Unterscheidung zwischen Privatheit und Öffentlichkeit, da hier der Marktplatz – ursprünglich Ort des Meinungsaustausches und der politischen Repräsentation – als privatisierter Raum erscheint. Die alte Vorstellung eines öffentlichen Platzes, welcher der Treffpunkt vieler sozialer Gruppen darstellen und dem Austausch von Meinungen als Forum dienen soll, wird durch den Schritt in die Privatisierung erstens durch die Herstellung und zweitens durch die Kontrolle dieses Raumes unmöglich (Feldtkeller 1994).

Die Kontrolle dieser öffentlichen Konsumräume dient dem Gefühl der persönlichen Sicherheit. Hier wird Sicherheit gegenüber ”bedrohlichen Elementen” der Gesellschaft gefordert. Nicht ökonomische Umstrukturierungen und damit einhergehende verschärfte soziale Polarisierungen werden für das gestiegene “Unsicherheitsgefühl” verantwortlich gemacht, sondern die Marginalisierten selbst. Der in uns allen vorhandene latente Rassismus, der sich aus der Angst vor dem Fremden und Unkontrollierbaren nährt, findet über diesen Weg ein entsprechendes Ventil. Die jeweilige Gesellschaft muss Wege finden, diese Ängste zu kanalisieren. Diese Funktion wurde früher durch die Kontroll- und Überwachungsinstanz ”Staat” wahrgenommen: „Nationale Gesellschaften haben immer auf Fremde und Armut entweder in Form von Bedrohung und Ausgrenzung oder eines Abfederns der Einkommensunterschiede (Almosen, Obdach, Sozialhilfe) oder durch beides zugleich reagiert” (Dangschat 1997: 6). Im umstrukturierten Staat erfolgt dies heute stärker über Netzwerke und Kooperationen („Sicherheitspartnerschaften“); es entsteht ein neuer Steuerungsstil in Bezug auf die Regulierung von sozialen Verhalten in öffentlichen Räumen (vgl. Schubert 2000).

Im Rahmen der Sicherung öffentlicher Räume geht es auch um die Sicherheit des privaten Eigentums. Dafür wird eine ”Politik der Lebensstile” betrieben, die es ermöglicht, über die Verfügbarmachung eines öffentlichen Raumes Distinktionsgewinne für die Personen zu erzielen, die sich einen ”luxuriösen” Lebensstil leisten können. Innerhalb des städtischen Raumes dienen dann diese öffentlichen Räume den Zielen, „... die eigene soziale Position abzusichern oder auszubauen und die ‚Hegemonie über die Köpfe‘” (Dangschat 1995) zu gewinnen. Der öffentliche Raum kann nur von denen beherrscht werden, die Kapital besitzen und damit auch die Möglichkeit haben, andere von diesem Raum physisch und damit auch sozial auszugrenzen. Um dies zu bewerkstelligen, bedienen sie sich einer bestimmten Rhetorik, rechtlichen Bestimmungen (Verbote) und einer entsprechenden Ästhetisierung (Architektur), deren Codes unmissverständlich die ”Kapitallosen”[80] exkludieren. „Tatsächlich setzen bestimmte Räume, allen voran die am meisten abgeschotteten und erlauchtesten, nicht nur ein bestimmtes Niveau ökonomischen und kulturellen Kapitals voraus, sondern erfordern auch soziales Kapital. Sie verleihen soziales und symbolisches Kapital durch den ihnen eigenen ‚Club-Effekt‘, basierend auf der dauerhaften Ansammlung (in schicken Wohnvierteln oder in Luxusresidenzen) von Personen und Dingen, denen es gemein ist, nicht gemein zu sein” (Bourdieu 1997: 166). Die Umfunktionierung von Innenstädten zu Konsumzonen und die Privatisierung öffentlicher Räume, die rigiden Sicherheitskontrollen ausgesetzt sind, dient dazu, das an solchen Orten zusammenkommende ökonomische, soziale, kulturelle und symbolische Kapital der Menschen zu maximieren.

Im Zusammenhang mit der Kontrolle öffentlicher Räume geht es vor allem um die Definitionsmacht von Raum und die Hegemonie im Raum, die soziale Ausschließung mit sich bringen muss. „Denn es geht ja nicht um nur um die Platitüde, dass Reiche ihre Sicherheit bezahlen können, und Arme nicht. Vielmehr geht es in erster Linie um die Verfügungsgewalt über öffentliche Räume und damit um die Strukturplanung und Stadtpolitik in einem ganz unmittelbaren Sinn“ (Beste & Braun 1995: 61).

[80] Damit ist im bourdieuschen Sinne nicht nur der Mangel an Geld gemeint, sondern auch an Artikulationsfähigkeit, Definitions- und Durchsetzungsmacht, sowie eine geringe Kompetenz im Spiel der konsumorientierten Lebensstile.

6 FAZIT

Die Hegemonie im und über den Raum wird von den bereits erwähnten Wachstumskoalitionen getragen, wobei sich die Wirkungsweise der Macht qualitativ verändert hat. Bis in die 70er Jahre hinein, war das Machtzentrum klar zu verorten: Der ”lokale Staat” dominierte Entscheidungen über den öffentlichen Raum. Jetzt, bewirkt durch die vielfältigeren und differenzierteren Machtkoalitionen, wird es schwieriger, einen zentralen Akteur auszumachen. Diese neue ”Raum-Macht” manifestiert sich auch nicht mehr in großen und klaren Planungen, die Räume für bestimmte Funktionen zurecht schneidert und damit eine Form von Raumkontrolle erringt. Vielmehr erscheint das Planen fragmentierter und schwieriger und die Wirkungsweise der Kontrollinstrumente erscheint auch auf den ersten Blick subtiler und weniger sichtbar (Videokameras, Architektur). Macht, die in den öffentlichen Raum wirkt, versteckt sich in den Strukturen und bekommt einen unpersönlichen Charakter. Dies sind Phänomene der Macht, die Michel Foucault im Zusammenhang mit dem ”Benthamschen Panopticum” (Foucault 1977) als absolutes Kontroll- und Disziplinierungsgebäude schon beschrieben hat.

Diese Prozessen sind Teil einer Veränderung der hegemonialen Struktur in Folge der Überwindung des krisenhaften Fordismus. Sie ist gegenwärtig in nahezu allen Großstädten der Welt - variiert durch lokale ökonomische, kulturelle und soziale Faktoren - zu beobachten. Neu für europäische Städte ist, dass ein wesentlicher Bestandteil der ”Integrationsmaschine Stadt“ - der freie Zugang zum öffentlichen Raum, der die Urbanität der europäischen Stadt ausmacht - aus sehr einseitigen und kurzfristigen Interessen preisgegeben wird. Namens einer ”neuen Urbanität“ werden zentrale Teilgebiete von Städten architektonisch und stadtplanerisch umgestaltet. Ausgrenzungen über Ästhetik, Funktionalität, Eigentumsrecht, Sicherheitstechnik und die Art der Ausübung staatlichen Gewaltmonopols durch die Polizei oder dessen Übertragung an private Firmen sorgen für eine Trennung der Lebensräume in der modernen Großstadt (”aus den Augen, aus dem Sinn“). Urbanität löst sich infolgedessen in eine Reihe von fragmentierten Territorien auf, wobei die einzelnen Fragmente voneinander festungsartig, wie abgeschirmte Zitadellen (vgl. Christopherson 1994) ausgeprägt werden.

Die Räume der Verlierer der Umstrukturierungen werden hingegen mit spezifischen 'empowerment'-Programmen bedacht - was bisweilen offen ”Bekämpfung sozialer Brennpunkte“ (was eine ”Feuerwehrpolitik“ legitimiert) oder euphemistischer ”Maßnahmen in Gebieten mit besonderem Erneuerungsbedarf“ genannt wird. Hier werden neue Strategien der Sozialpolitik und Sozialarbeit sowie der Stadterneuerung territorial zusammengeführt, zumindest, um die Lebensbedingungen ”vor Ort“ für die im Arbeitsmarkt ausgegrenzten und/oder wegen ihres fehlenden kulturellen Kapitals Diskriminierten zu verbessern (Alisch & Dangschat 1998). Dass auch dieses Bestandteil einer neuen Regulationsweise ist, mit der die soziale Bewegungen und Akteure des kritischen und linken Flügels mittels Arbeit in intermediären Organisationen oder in Formen neuer Zivilgesellschaft in eine Strategie der Herstellung und Sicherung des sozialen Friedens eingebunden werden sollen, ist offensichtlich (Alisch 1998). Armutsbekämpfung dient in der Regel nicht den Armen - die Entwicklung in den USA machen das sehr deutlich -, sondern sie dient der Beruhigung der Bürgerlichkeit, die sich den Genuss des Wohlstandszuwachses nicht trüben lassen möchte. Armut wird jedoch als Voraussetzung und Folge von Wettbewerbsfähigkeit und von Wachstumsraten produziert - sie ist nicht peinliche oder überraschende Begleiterscheinung der gegenwärtigen Umstrukturierung (vgl. Dangschat 1999).

Deshalb gehört auch die Schuldzuweisung gegenüber denen, die am meisten unter den Umstrukturierungen zu leiden haben, sowie eine breit angelegte Ideologisierung von Individualisierung und Privatisierung zum Programm des nationalen und ”lokalen“ Staates. Die Beschreibung der Marginalisierten als ”Gefahrenherd“ (”sozialer Brennpunkt“) schafft die Legitimation auch für die vom Abstieg bedrohten Kleinbürger, Sondergesetze und Verordnungen sowie neue Formen der Zuständigkeiten zu erlassen, und dennoch nicht die demokratische Legitimation zu verlieren. Schließlich haben die Kommunalpolitiker, so lange es Stadtteile gibt, in denen die bauliche und infrastrukturelle Versorgung ebenso am unteren Rand der Hierarchie liegt, wie die soziale Stellung der Bewohner, die in kommunalen Parlamenten kaum repräsentiert sind (weil die Bürger kein Wahlrecht haben, dieser Art von Demokratie nicht vertrauen oder eine Partei wählen, die keinen Einfluss auf die Kommunalpolitik nehmen kann), leichtes Spiel, soziale Ausgrenzung gerade über die Territorialität zu inszenieren.

Eine anzustrebende Lösung des Problems ist, die Zunahme sozialer Ungleichheit zu beenden Respektive sie zurückzuführen, zumal sich jede Form sozialer Ungleichheit auch im Raum niederschlägt. Auch wenn man von einem weitgehenden Konsens bezüglich dieser Aussage ausgehen kann, bedeutet dies noch lange nicht, dass es auch erreicht werden kann oder gar soll. Erstens fehlt es an eindeutigen und widerspruchsfreien politischen Zielsetzungen. So wird Armut und Ausgrenzung als Bestandteil der Wettbewerbsorientierung von Stadtregionen, von Firmen, Interessensverbänden und sozialen Gruppen systematisch, wenn auch nicht immer absichtsvoll erzeugt. Dennoch wird immer deutlicher, dass Armut auf lokaler Ebene kaum zu verhindern ist, weil die Arbeitsmarktentwicklung, die Sozialpolitik und die demographischen Strukturen sich weitgehend der kommunalen Steuerung entziehen. Die Verantwortung liegt demgegenüber eher im Umgang mit sozialen Gruppen, die an den Rand gedrängt werden. Hier gilt es, andere Strategien und Verhaltensweisen als bisher zu verfolgen. Neue Verhandlungs- und Kooperationssysteme, die immer mehr städtische Akteure involvieren, müssen hierarchische und zentralisierte Muster staatlichen Vorgehens ersetzen.

Für die Stadt gilt es zu bedenken, dass “sozialer Frieden” ein erfolgsversprechender Standortfaktor sein kann, in den es sich lohnt, zu investieren. Insofern ist es notwendig, neben der Schaffung von strahlenden Konsumräumen, auch soziale Stadtentwicklung zu betreiben, die sich an den Bedürfnissen der Bewohnerschaft und deren Beteiligung orientiert. Die Stadt muss dabei jenen zur Seite stehen, die nicht über das notwendige Kapital verfügen, um in der Auseinandersetzung um die Aneignung öffentlicher Räume bestehen zu können. Vor allem der Stadtplanung kommt vermehrt die Aufgabe zu, sich nicht zu sehr von kurzfristigen Kapitalinteressen leiten zu lassen, sondern gleichzeitig städtische Teilräume für unterschiedliche soziale Gruppen offen zu lassen. Denn gerade die Vielfalt an Nutzungen von öffentlichen Räumen durch verschiedene soziale Gruppen entspricht einem Ideal von Urbanität, das auf Heterogenität, Lebendigkeit, Offenheit und Integration setzt. Seitens der Stadt gilt es, dem “ausschließenden” Sicherheitsdiskurs ein Ende zu setzen und statt dessen Initiativen zu fördern und Potentiale zu finden, die ein friedliches Leben “nebeneinander” und “miteinander” ermöglichen.

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Ein standortgewichteter Durchgrünungsgrad zur Bewertung der Wohnqualität in Salzburg

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ABSTRACT

Grünflächen in Städten sind aus ökologischen und klimatischen Gründen von erheblicher Bedeutung und zusätzlich bei den Bewohnern durch die individuelle Wahrnehmung einen großen Stellenwert ein. In der vom Magistrat Salzburg in Auftrag gegebenen und hier vorgestellten Studie wurde eine computergestützte Methode zur Erfassung von Grünflächen in der Stadt Salzburg und darüber hinaus ein standortgewichteter ein Indikator zur Bewertung der Grünqualität entwickelt und für ein erstes Testgebiet berechnet. Die Ergebnisse der ersten Phase des Projekts beziehen sich auf eine Testfläche von 30ha im Süden der Stadt (Umgebung der Naturwissenschaftlichen Fakultät der Universität Salzburg). Der anfängliche aus Luftbildern gewonnene einfache Grüngrad pro Rasterzelle wurde in weiterer Folge durch zwei zusätzliche Faktoren gewichtet, a) die Flächenanteile der Mehrfamilienhäuser und b) die minimalen Gebäudedistanzen. Die Ergebnisse der Vorstudie zeigen, dass eine Kombination dieser Faktoren einem realistischen Grüneindruck aus Sicht der Bewohner näher kommt.

1 HINTERGRUND

Erhalt, Ausbau und Pflege von Grünflächen in Städten ist insbesondere aus stadtökologischen und stadtklimatischen Gründen von entscheidender Bedeutung. Darüber hinaus stellen Grünflächen einen wichtigen Standortfaktor für das individulle Wohlempfinden und zur Sicherung der Lebensqualität dar und sind auch in ökonomischer Hinsicht von Bedeutung (Grunert, 2001). Die Erfassung von Grünflächen fließt teilweise in die Qualitätsziele und Handlungsziele der lokalen Agenda 21 mit ein, wie das Beispiel des Arbeitsentwurfs für die Berliner Lokale Agenda 21 zeigt. Darin sind Richtwerte für wohnungsnahes Grün (6m²/EW) bzw. siedlungsnahes Grün (7m²/EW) festgeschrieben. Eine Erhöhung des Grüngrads um 10% bis zum Jahre 2002 ist angestrebt, wo diese Richtwerte nicht erreicht werden. Die Handlungsziele der Berliner Lokalen Agenda 21 sehen eine Umwidmung von Bauflächen vor, die wegen veränderter Bevölkerungs- oder Gewerbesituation nicht mehr gebraucht werden. Diese Umwidmung ist auch eine wesentliche partizipative Massnahme zur Einbindung der lokal ansässigen Bewohnerschaft.

Bisherige Studien zur Quantifizierung des städtischen Grüngrads (siehe z.B. Stadtentwicklungskonzept Graz) haben bei der Ermittlung des Grünraums die zugrunde liegenden Grünflächen in relativ groben Maßstabsbereichen mithilfe multispektraler Klassifikation von Fernerkundungsdaten abgeleitet. Vom Zentrum für GeoInformatik der Universität Salzburg (Z_GIS) soll für das Magistrat der Stadt Salzburg eine automatisierte computergestützte Methode entwickelt werden, um den Durchgrünungsgrad in einer kombinierten Herangehensweise auf Basis von höchstauflösenden Fernerkundungsdaten und zu ermitteln. Damit wird dem Bedarf der Stadtplanung an Unterlagen zum Durchgrünungsgrad als wesentlichem Indikator der Wohnstandort-Qualität Rechnung getragen. Das endgültige Set der Grünklassen soll einerseits Klassen beinhalten, die durch spektrale und strukturelle Charakteristika definiert sind und andererseits die Wahrnehmung von Grünflächen von Seiten der Bewohner widerspiegeln. Ein und dieselbe Grünfläche kann je nach Arrangement der umliegenden Häuser unterschiedlich wahrgenommen und bewertet werden. Zum Beispiel wird ein Baum oder eine Grünfläche zwischen einem Einfamilienhaus und einem mehrstöckigem Wohnblock von den Bewohnern des jeweiligen Gebäudekomplexes unterschiedlich bewertet. Durch die jeweiligen Perspektiven und Abstände zur Grünfläche variiert die Wahrnehmung des Grüneindrucks.

Die Gesamtstudie zur Ermittlung des Durchgrünungsgrads in Salzburg erfolgt in einem 2-stufigen Projektverlauf. Die Vorstudie (Phase I), deren Ergebnisse hier vorgestellt werden, basiert auf einzelnen Farb-Orthofotos im Süden der Stadt, wobei vor allem methodische Fragen im Vordergrund stehen. Auf Basis der Vorstudie sollte die Methodik und deren Übertragbarkeit auf das gesamte Stadtgebiet hinsichtlich Genauigkeit, Transparenz, Durchführbarkeit und Aufwand getestet werden. Für die anschließende Hauptstudie (Phase II) wird eine Ausweitung auf das von einer Satellitenszene abgedeckte Stadtgebiet (ca. 13*13km) und eine Anwendung der Methodik auf höchstauflösende Satellitendaten angestrebt.

2 METHODIK

2.1 Datenmaterial und Georeferenzierung

Die Farborthophotos 4430-482 (Naturwissenschaftliche Fakultät der Universität Salzburg) und 4430-483 (Teile des Stadtteils Nonntal) mit einer Bodenauflösung von 0.1m wurden auf Basis des digitalen Katasters georeferenziert. Das Bild 4430-482 diente als Datengrundlage für die Entwicklung der Methode, 4430-483 wurde zum Testen der Übertragbarkeit der Klassifikation verwendet. Die Orthophotos wurden für die anschließende Bildsegmentierung mit dem digitalen Kataster kombiniert.

2.2 Bildklassifizierung

Der Prozess der semi-automatisierten Klassifikation ist in vier Teilschritte gegliedert: (1) die Erstellung eines (vorläufigen) ‚Kognitionsnetzwerks' (vgl. Abb. 1), das als konzeptioneller Rahmen für die folgenden Schritte dient; (2) Segmentierung, (3) Klassendefinition und (4) Klassifikation. Der Schritt der Erstellung des Kognitionsnetzwerks erfolgte über eine empirische Voruntersuchung des Bildmaterials und enthält vor allem deskriptive Klassenbeschreibungen, die auf spektrale Unterschiede beruhen. Bei der Segmentierung der Rohdaten wird ausgehend von Bildpunkten mit Hilfe eines multiskalaren Segmentierungsverfahrens ein hierarchisches Netz von Bildobjekten erzeugt. Die Parametrisierung ist so zu wählen, dass die generierten Bildobjekte möglichst gut mit real existierenden geographischen Gegebenheiten übereinstimmen, wobei entstehende

Bildsegmente nicht a priori mit den Objekten der auf der Erdoberfläche wie Gebäude, Bäume, Wasser sowie sämtliche Bodenbedeckungen gleichzusetzen sind. Die Segmentierung der Orthofotos erfolgte in drei Auflösungsebenen, wobei in der höchsten Ebene homogene Bereiche durch ein verändertes Segmentierungsverfahren noch einmal stärker zusammengefasst wurden. Die Klassifizierung erfolgte auf dem zweiten Segmentierungslevel, um eine Übersegmentierung, aber auch eine zu starke Zusammenfassung von Objekten verschiedener Klassen zu vermeiden.

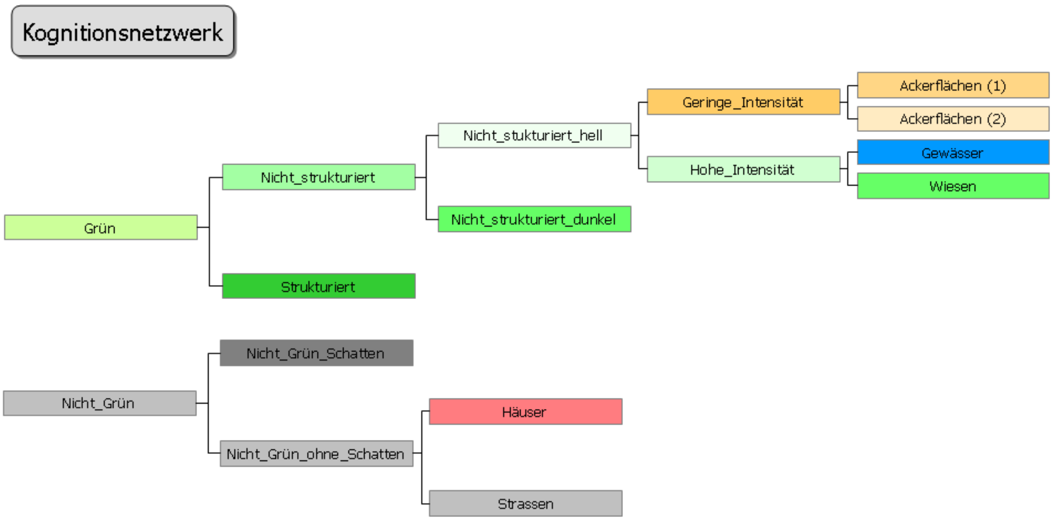

Abb. 1: Kognitionsnetzwerk

Die objekt-basierte Klassifikation des Orthophotos 4430-482 erfolgte in mehreren Schritten:

Basierend auf dem Kognitionsnetzwerk wurde das Luftbild in die zwei generischen Klassen *Grün* und *Nicht_Grün* mithilfe der Ratio (Verhältnis) aus grünem Kanal und der Gesamthelligkeit klassifiziert. Alle Bildobjekte, die einen Ratio-Wert größer als 0.36 aufweisen, erhalten für dieses Merkmal einen Fuzzy-Wert von 1 (= volle Zugehörigkeit), während Bildobjekten mit einem Mittelwert von 0.35 der fuzzy-Wert von 0 (= keine Zugehörigkeit) zugewiesen wird. Bildobjekte, die einen Wert in der dazwischen liegenden Wertespanne von 0.35 bis 0.36 besitzen, wird entsprechend dem Funktionsverlauf ein Fuzzy-Wert zwischen 0 und 1 zugewiesen.

Anschließend wurden innerhalb der Klasse Nicht_Grün die Schattenflächen ausgewiesen. Dies erfolgte über die Information der Helligkeit (Brightness) aller Kanäle. Die entstandenen Klassen *Nicht_Grün* und *Nicht_Grün_Schatten* bieten somit eine zusätzliche Unterscheidung.

Zur weiteren Unterscheidung der Oberklassen *Grün* wurden homogene hellgrüne Flächen (Wiesen), strukturierte Flächen (Sträucher, Bäume) sowie homogene Flächen mit geringer Reflexionsintensität (Ackerflächen) unterschieden.

Im nächsten Schritt wurde eine Untergliederung zwischen strukturierten und weniger strukturierten Flächen vollzogen. Dies diente zur Unterscheidung von Bäumen, Hecken, Sträuchern und flachem Bewuchs wie Wiesen und Feldern. Die Standardabweichung des zweiten Kanals lieferte dabei die besten Trennergebnisse.

Entsprechend der Klasse *Nicht_Grün_Schatten* wurde eine Klassifizierung der Schattenflächen der Klasse *Nicht_Strukturiert* durchgeführt. Wie im ersten Fall diente dazu die Helligkeit der Kanäle, um die Klassen *Nicht_Strukturiert_hell* und *Nicht_Strukturiert_dunkel* zu generieren.

Im weiteren Arbeitsverlauf wird laut Klassenhierarchie zwischen Flächen mit geringer und hoher Intensität unterschieden. Der Ratio aus blauem Kanal und der Gesamthelligkeit war in diesem Fall für die Klassentrennung besonders geeignet. Innerhalb der Klasse *Geringe_Intensität* werden über den Mittelwert des zweiten Kanals verschiedene Ackerflächen detektiert. In Ergänzung dazu wird für die Klasse *Hohe_Intensität* die Standardabweichung des ersten Kanals genützt, um Wasser mit einer niedrigeren Standardabweichung von Wiesen zu trennen.

Neben der Klassifizierung verschiedener begrünter Flächen wurde im Anschluss die Klasse *Nicht_Grün* weiter unterteilt. Dies erfolgt über die Einbeziehung des Katasters in die Klassen *Häuser* und *Strassen*.

Eine statistische Überprüfung der Genauigkeit der Klassifikationsgüte (*accuracy assessment*) ergab insgesamt eine hohe Klassifikationsgüte in den Grünklassen und den versiegelten Flächen (> 80), bestätigte jedoch die Unsicherheit der Zuteilung in den Schattenflächen (< 65%). Dies ist vor allem auf die fehlende Infrarotinformation der Orthofotos zurückzuführen, was eine mögliche Ratiobildung zur Schatteneliminierung verhindert.

2.3 Standortbezogene Gewichtung der Rasterzellen

Die Ergebnisse der Klassifikation wurden aggregiert und auf ein regelmäßiges Zellraster (Vorstudie: 100*100m) bezogen. Für eine zusätzliche standortbezogene Gewichtung der Grünanteile in den jeweiligen Rasterzellen wurden folgende weitere Faktoren herangezogen:

der Flächenanteil der Mehrfamilienhäuser P_M in einer Rasterzelle;

die durchschnittlichen Distanzen der Gebäude $D_{M1 \rightarrow M2}$ und $D_{E \rightarrow M}$ zueinander.

Der Flächenanteil wurde durch Verschneidung der Rasterzellgrenzen mit den Gebäudegrundflächen aus dem Kataster ermittelt. Aufgrund der Zellgröße von 100*100m konnte der errechnete Anteil direkt einer Skala von 0 bis 100 zugeteilt werden. Aufgrund der negativen Aussage im Vergleich zum Gründgrad (je mehr Verbauung, desto schlechter), wurde dieser Faktor invertiert. Die Berücksichtigung der durchschnittlichen Distanzen der Gebäude zueinander wird der Tatsache gerecht, dass der Grüneindruck wesentlich von der Lage und Nähe benachbarter Gebäude abhängt (vgl. Abb. 2).

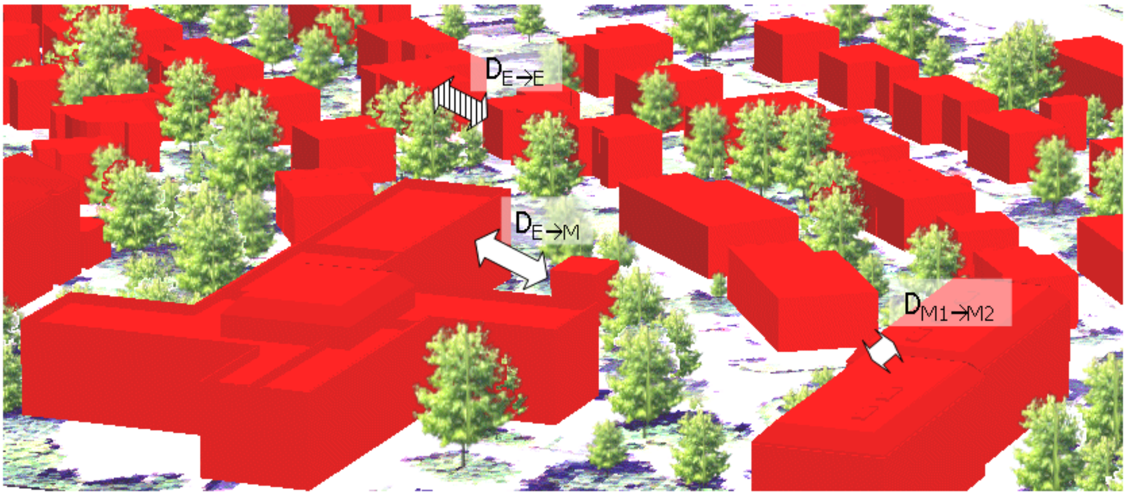

Abb. 2: Gebäudekonstellation, die die Wahrnehmung von Grünflächen beeinträchtigen können

Hierbei sind mehrere Konstellationen denkbar, wobei in der vorliegenden Anwendung nur zwei davon berücksichtigt wurden: die Distanz von einem Mehrfamilienhaus M (mehr als ein Obergeschoß) zu einem anderen Mehrfamilienhaus ($D_{M1 \rightarrow M2}$), und die Distanz von einem Einfamilienhaus E zu einem Mehrfamilienhaus ($D_{E \rightarrow M}$). Die Konstellationen E→E bzw. M→E soll im Rahmen dieser Studie keine Beeinträchtigung der Wohnqualität darstellen. Die unterschiedlichen Wertebereiche der drei zusätzlichen Faktoren wurden auf eine Skala zwischen 0 und 100 standardisiert. Dabei wurde für die Distanz ein Maximalwert von 200m angenommen, jenseits dessen die Beeinträchtigung vernachlässigt werden kann (Wert 100). Eine qualitative Kategorisierung in vier Güteklassen erfolgte zunächst getrennt. Die Kombination zu einem gewichteten Wert für die Grünqualität wurde anschließend durch Berechnung eines gewichteten Mittels erzielt. In die Berechnung ging bei den Distanzfaktoren der jeweilige Minimumwert $D_{M1 \rightarrow M2}$ *min* $D_{E \rightarrow M}$ pro Rasterzelle ein (vgl. Tab. 1).

	Wertstufe	Klassengrenzen	Gewichtung
Gründgrad			**60**
1	Wenig durchgrünt	< 0.25	
2	Ausreichend durchgrünt	0.25 – 0.5	
3	Erheblich durchgrünt	0.5 – 0.75	
4	Stark durchgrünt	0.75 – 1	
Flächenanteil Mehrfamilienhaus			**20**
1	Dicht bestanden	0.25 – 1	
2	Mittel bestanden	0.1 – 0.25	
3	Locker bestanden	0 – 0.1	
Distanzen			**20**
1	Starke Beeinträchtigung	0 – 0.1	
2	Mittlere Beeinträchtigung	0.1 – 0.25	
3	Schwache Beeinträchtigung	0.25 – 1	
Gewichtete Grünqualität			
1	Niedrige Grünqualität	< 0.25	
2	Mittlere Grünqualität	0.25 – 0.5	
3	Hohe Grünqualität	0.5 – 0.75	
4	Höchste Grünqualität	0.75 – 1	

Tab. 1: Qualitative Kategorisierung der standardisierten Faktoren und der gewichteten Grünqualität

3 ERGEBNISSE

Die Verteilung der zwei grundlegenden Oberklassen Grün und Nicht-Grün bezogen auf die 1ha großen Rasterzellen im Bereich des Orthofotos 4330-482 ist in Abbildung 3 dargestellt. Dieses Endergebnis war nur durch eine semantische Kombination der Unterklassen in mehren Schritten zu erreichen; die Trennbarkeit der Klassen über spektrale Eigenschaften allein ist, wie oben skizziert, nicht möglich.

Abb. 3: Grünanteil auf Basis der Klassifikation innerhalb der 1ha-Rasterzellen

Abbildung 4 zeigt die Verteilung der beiden Faktoren P_M und $D_{M1\rightarrow M2}$ *min* $D_{E\rightarrow M}$ in den Rasterzellen 1-30 im Bereich des Orthofotos 4330-482. In Abbildung 5 ist die Kategorisierung der gewichteten Grünqualität wiedergegeben.

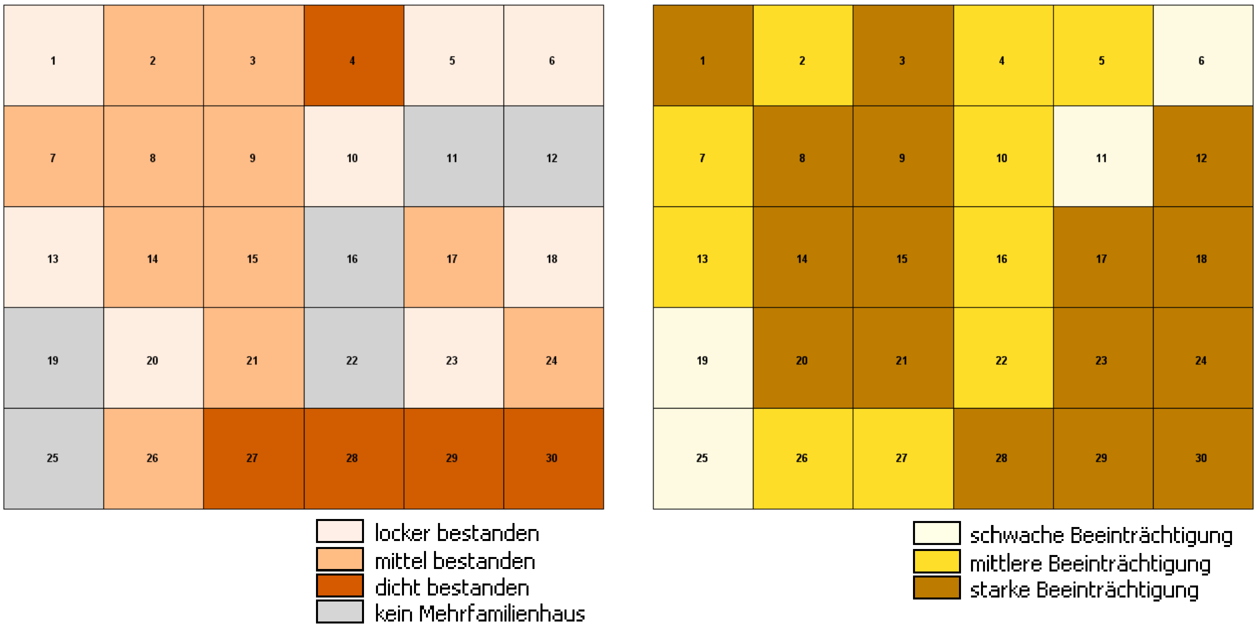

Abb. 4: Die Verteilung der Faktoren P_M und $D_{M1\rightarrow M2}$ *min* $D_{E\rightarrow M}$

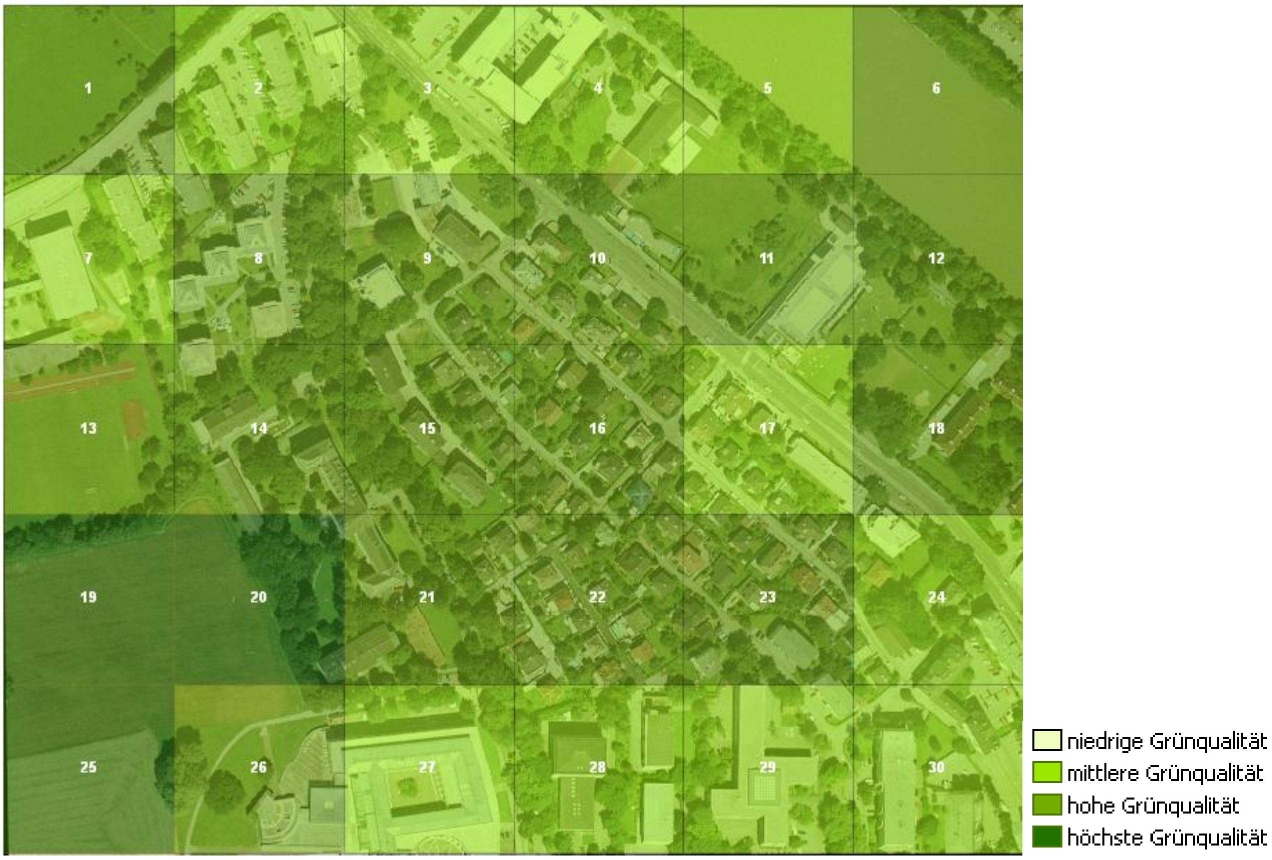

Abb. 5: Verteilung und Kategorisierung der gewichteten Grünqualität. (Die unterste Klasse tritt in diesem Fall nicht auf)

4 DISKUSSION

Der Beitrag hat gezeigt, dass durch die Einbeziehung von standortbezogenen Faktoren die Bedeutung von Grünflächen innerhalb einer Stadt nicht nur aus der Vogelperspektive, sondern auch aus dem üblichen Blickwinkel der Bewohner beurteilt und bewertet werden kann. Durch die zusätzliche Gewichtung wird der Durchgrünungsgrad etwas ausgeglichener eingeschätzt, hohe Grüngrade werden durch die Berücksichtigung der zusätzlichen Faktoren etwas relativiert. Die gesamte Qualität einer Rasterzelle (‚Grünqualität') kann sich im Vergleich zu dem reinen Grüngrad erhöhen, wenn die anderen Faktoren in Relation positiver bewertet sind. Die höchste Kategorie erreichen beispielsweise nur noch drei statt ursprünglich fünf Rasterzellen. Die beiden niedrigen Qualitätsstufen sind etwas schwächer besetzt. Dafür ist jedoch die vornehmlich mit Einfamilienhäusern bestandene Mitte des Untersuchungsgebiets einheitlicher mit der Kategorie hohe Grünqualität abgebildet (vgl. Diagramm in Abbildung 6).

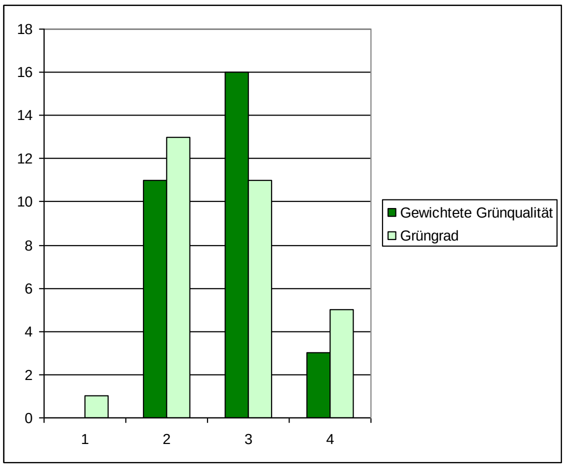

Abb. 6: Vergleichende Darstellung der Anzahl der Rasterzellen in den einzelnen Kategorien (eine Rasterzelle entspricht 1ha)

Die Ausweitung auf ein größeres Gebiet ist aufgrund der zufrieden stellenden Ergebnisse beim Testen der Klassifikationsübertragbarkeit prinzipiell möglich, wenn auch wegen der geringen spektralen Auflösung der Orthofotos die Klassen beschränkt bleiben. Durch das Mosaiken der einzelnen Orthofotos (80-100 Einzelbilder) kann auch die Klassifikationsstabilität beeinträchtigt werden. Für die Hauptstudie (Phase II) ist vorgesehen, höchstauflösende Satellitendaten zu beziehen. Die Auswertung wird nach einem erweiterten Klassifikationsschlüssel von spektralen und semantisch-strukturellen Grünklassen erfolgen. Hierfür ist auch eine begleitende sozialgeographische Studie zur Erfassung der individuellen Durchgrünungswahrnehmung geplant. Diese soll auf Basis von Fragebögen die Bedeutung von z. B. vertikalen Häuserflächen, Häuserhöhen, durchschnittlichen Baumhöhen und Ausdehnung von Grünflächen erheben. Um dann den individuellen Eindruck in der Berechnung des Durchgrünungsgrads einfließen zu lassen, sind verschiedene fortgeschrittene Ansätze möglich. Diverse Visualisierungstechniken dienen dazu, Informationen über die Gebäudehöhen mit den spektral-semantischen Klassifikationsergebnissen in 3D zu kombinieren. Die räumliche Verteilung der endgültigen Klassen wird letztendlich zur Bestimmung des Durchgrünungsgrad in der Stadt Salzburg herangezogen. Der berechnete Indikator wird einen wesentlichen Teil zur Bewertung der Wohnstandortsqualität beitragen.

5 DANKSAGUNG

Diese Studie wurde im Rahmen eines Projekts zwischen dem Magistrat Salzburg und Zentrum für Geoinformatik und dem Research Studio iSpace durchgeführt. Wir danken Herrn Mag. Josef Reithofer vom Magistrat Salzburg und Herrn Mag. Thomas Prinz von iSpace für ihr Entgegenkommen und die außerordentlich gute Zusammenarbeit.

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MAKE.IT
Multimodales Alternatives Konzept für verbesserte Erreichbarkeit durch Informations-Technologie

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1 EINLEITUNG

Die Motorisierung breiter Bevölkerungsschichten und die Individualisierung der Lebensgewohnheiten führten in den vergangenen Jahrzehnten im Öffentlichen Verkehr zu einem ständigen Rückgang der Fahrgastzahlen. Mit der Einrichtung von Verkehrsverbünden gelang es zwar zum Teil, die Fahrgastzahlen zu erhöhen, überproportionale Steigerungen der Fahrleistung sowie Ab- und Durchtarifierungsverluste führten aber zum massiven Anwachsen der von der Öffentlichen Hand zu tragenden Kosten.

Die Grenzen der Finanzierbarkeit des öffentlichen Verkehrs rücken damit in greifbare Nähe. Die Bereitschaft zur weiteren Steigerung der Ausgaben für den Öffentlichen Verkehr ist angesichts überforderter öffentlicher Budgets daher nicht mehr gegeben, zumal die erhoffte Trendumkehr der Entwicklung des Modal Split nicht eingetroffen ist. In Zusammenhang mit der Deckelung der Ausgaben für den Öffentlichen Verkehr werden vielfach Linienstilllegungen angedacht und zum Teil auch durchgeführt. Speziell peripher gelegene, dispers besiedelte Regionen verlieren damit ihren Zugang zum Öffentlichen Verkehr, womit ihre Bevölkerung für jegliche Mobilität auf den privaten PKW angewiesen ist.

Im Spannungsfeld der berechtigten Forderung nach einem vernünftigen Verhältnis von Kosten und Nutzen und dem Wunsch, eine Grundversorgung auch in peripheren Gebieten bereitzustellen entstanden in den letzten Jahren Überlegungen für eine Neuorganisation des Öffentlichen Verkehrs in ländlichen Gebieten. In einem vom ITF geförderten Projekt wurde von den Firmen Siemens und IPE unter dem Titel ***MAKE.IT*** ein Konzept für eine völlige Umgestaltung des ländlichen ÖV und ein Prototyp für das dafür erforderliche technische System entwickelt.

MAKE.IT ermöglicht durch eine Restrukturierung des Öffentlichen Linienverkehrs, bedarfsgesteuerte Flächenerschließung und sein innovatives Buchungs-, Informations- und Hintergrundsystem eine wesentliche Attraktivierung des Öffentlichen Verkehrs im ländlichen Raum bei einer deutlichen Verbesserung der Kostenstruktur.

Im Auftrag der Burgenländischen Landesregierung wird ***MAKE.IT*** unter dem Dachprojekt „Pilotprojekte für nachhaltig umweltverträglichen Verkehr in Sensiblen Gebieten“ in der zum UNESCO Weltkulturerbe erklärten Region Neusiedler See erstmals in der Praxis eingesetzt werden.

2 AUSGANGSLAGE

2.1 Der Öffentliche Verkehr im ländlichen Raum

Im Gegensatz zu den Ballungsräumen, wo auf Grund der Kapazitätsengpässe im Individualverkehr der Öffentliche Verkehr außer Streit steht, werden speziell in peripheren, dispers besiedelten Räumen auf Grund des geringen Fahrgastaufkommens zunehmend Kurse und ganze Linien eingestellt, da ihre Finanzierung auf Grund der extremen Unwirtschaftlichkeit angesichts angespannter öffentlicher Haushalte nicht mehr möglich erscheint. Oft ist somit keine flächendeckende Grundversorgung mit Öffentlichem Verkehr mehr gegeben, womit Menschen ohne eigenen PKW gänzlich von Mobilität ausgeschlossen werden.

Der Öffentliche Verkehr im ländlichen Raum erfüllt 2 verkehrliche Funktionen:

die Flächenerschließung

den schnellen Transport entlang von Hauptverkehrsachsen

Derzeit ist eine exakte Zuordnung einer einzelnen Buslinie zu einer der beiden Funktionen oft unmöglich, da abhängig vom Streckenabschnitt unterschiedliche Funktionen wahrgenommen werden. Die Vermengung der Funktionen führt zu den heute üblichen langen Reisezeiten, die einen entscheidenden Konkurrenznachteil des Öffentlichen Verkehrs bedeuten.

In dem Bestreben, möglichst viele Orte durch direkte Buslinien zu verbinden, kommt es darüber hinaus zu unwirtschaftlichen Mehrfachbedienungen auf den Hauptverkehrsachsen, sowie zu dem heute charakteristischen unübersichtlichen und oft wenig logischen Liniennetz (vgl. Abbildung 1). Auf Umsteigemöglichkeiten zwischen den Linien wird in der Fahrplangestaltung derzeit kaum Rücksicht genommen.

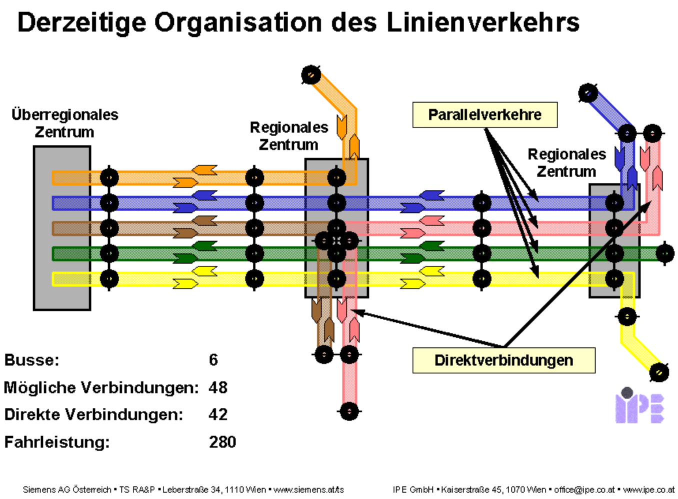

Abb.1: Derzeitige Organisation des Linienverkehrs (Quelle: IPE))

2.2 Der ländliche ÖV im Berufsverkehr

Ist ein entsprechendes Angebot vorhanden, ist der Öffentliche Verkehr im ländlichen Raum im Berufsverkehr entgegen der landläufigen Meinung durchaus konkurrenzfähig, wie ein Vergleich des Modal Split des Berufsverkehrs mit Ziel Wien und dem mit anderen Zielen zeigt.

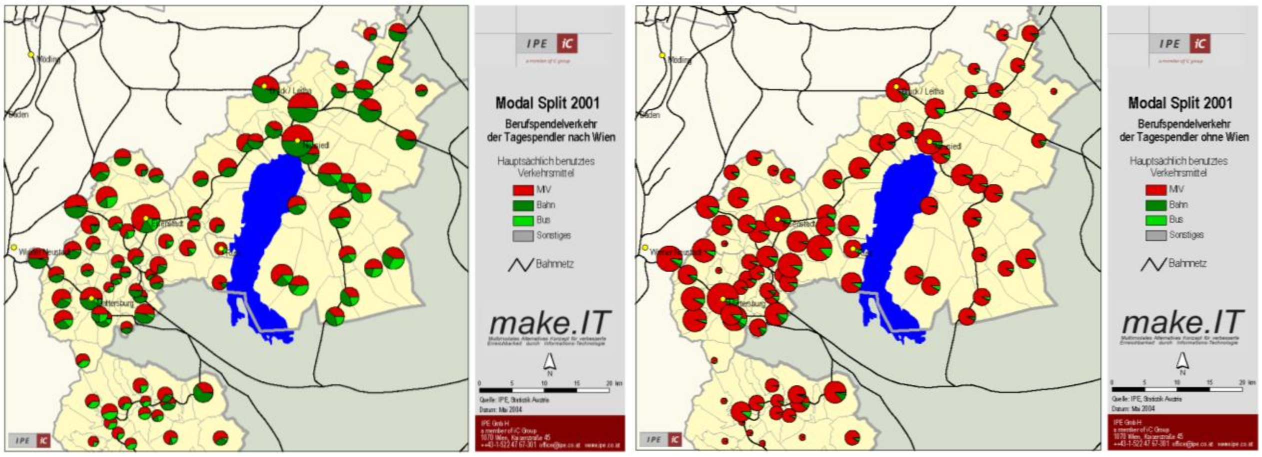

Abb.2: Modal Split des Burgenländischen Berufsverkehrs (Quelle: Statistik Austria, IPE))

Abbildung 2 zeigt deutlich, wie entlang der Bahnachse des Seewinkels, die attraktive Verbindungen nach Wien bietet, der Anteil des Öffentlichen Verkehrs ungewöhnlich hoch ist, während in Bereichen schlechterer Anbindung nach Wien der MIV dominiert. Für Verbindungen zu anderen Zielen bestehen keine attraktiven ÖV-Verbindungen – mit entsprechenden Auswirkungen auf den Modal Split.

2.3 Der ländliche ÖV im sonstigen werktäglichen Verkehr

Ist im Berufsverkehr der Anteil des Öffentlichen Verkehrs, in Abhängigkeit des Angebots, noch relativ hoch, so wird der sogenannte „sonstige werktägliche Verkehr", also etwa der Einkaufs- oder Freizeitverkehr heute praktisch ausschließlich mit dem privaten PKW abgewickelt. Die Nutzung des Öffentlichen Verkehrs beschränkt sich demnach im Wesentlichen auf hochgradig ritualisierte Fahrten, die täglich zur selben Zeit von der selben Einstiegs- zur selben Ausstiegshaltestelle führen.

Im kaum ritualisierten sonstigen werktäglichen Verkehr stößt selbst der an sich routinierte ÖV-Nutzer auf vielfältige Zugangshürden:

Die Linienstruktur des Öffentlichen Verkehr im ländlichen Raum ist oft unklar und für den gelegentlichen Nutzer kaum durchschaubar. Kurse ein und der selben Linie fahren völlig unterschiedliche Strecken, unterschiedliche Linien fahren parallel, eine Vielzahl von Saisonierungen und Abweichungen vom Regelfahrplan erschweren die spontane Nutzung, etc.

Die Fahrpläne sind, teils wegen der unklaren Linienstruktur, teils auch wegen der kundenfremden Gestaltung schwer lesbar.

Eine Abstimmung der Fahrpläne um ein Umsteigen zwischen den Linien zu ermöglichen, findet oft nicht statt.

Der sonstige werktägliche Verkehr macht immerhin etwa 60% (!!!) des täglichen Verkehrsaufkommens aus. Ein großer Teil dieses Verkehrs wird von nicht mehr im Berufsleben stehenden Personen verursacht, deren Zahl in den nächsten Jahren erheblich zunehmen wird. Zudem ist in dieser Bevölkerungsgruppe die Motorisierungsentwicklung enorm hoch. Maßnahmen, die den Öffentlichen Verkehr für diese Bevölkerungsgruppe attraktiver gestalten, kommen daher große Bedeutung zu.

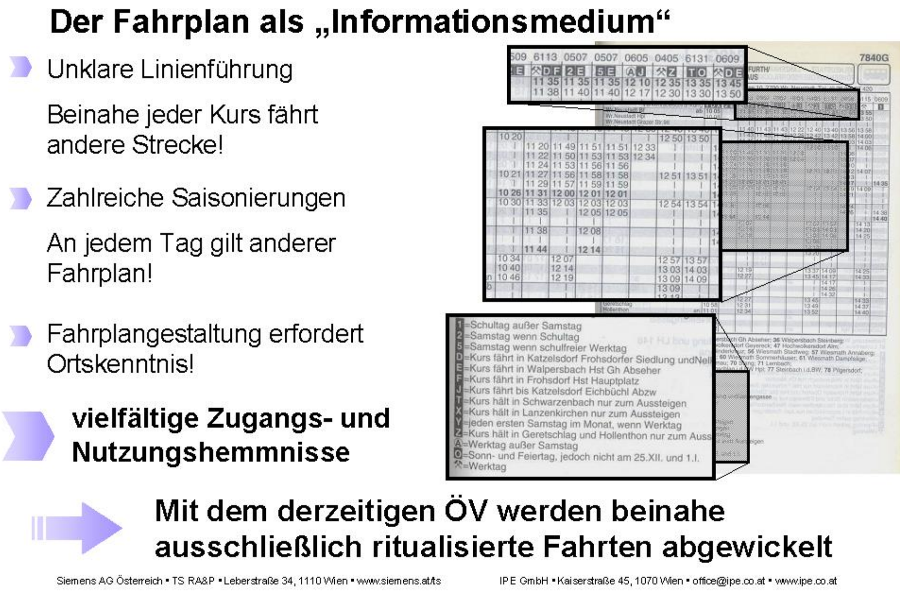

Abb.3: Der Fahrplan als „Informationsmedium“ (Quelle: IPE))

2.4 Die Wirtschaftlichkeit des ÖV

Mit der Einrichtung von Verkehrsverbünden und anderen Maßnahmen wird seit einigen Jahren das Ziel einer Trendwende in der Entwicklung des Modal Split verfolgt. Den in Teilbereichen durchaus erreichten Steigerungen der Fahrgastzahlen standen jedoch oft unverhältnismäßig hohe Angebotsausweitungen und damit Kostensteigerungen gegenüber. Die angesichts des finanziellen Aufwandes eher bescheidenen Zuwächse an Fahrgästen lassen schwere Zweifel aufkommen, ob der Öffentliche Verkehr in der derzeitigen Organisationsform überhaupt attraktiviert werden kann. Eine nachhaltige Sicherstellung eines flächendeckenden ÖV-Systems und erst recht jede Angebotsverbesserung setzt eine deutliche Verbesserung der Wirtschaftlichkeit voraus, die jedoch nur durch eine weitgehende Reorganisation erreicht werden kann.

Die Wirtschaftlichkeit des Öffentlichen Verkehrs ist je nach verkehrlicher Funktion durchaus unterschiedlich. Während das Fahrgastaufkommen entlang der Hauptverkehrsachsen und damit der Kostendeckungsgrad relativ hoch ist, ist dieser für die Flächenerschließung mit Linienbussen in dispers besiedelten Schwachlasträumen äußerst gering, da die Kosten für Fahrzeuge und Fahrer auch anfallen, wenn gerade kein Bedarf besteht oder das System still steht. Die Flächenerschließung ist jedoch nicht nur verkehrspolitisch wünschenswert, sondern auch wirtschaftlich notwendig, da ein erheblicher Teil der Fahrgäste nicht unmittelbar an den Hauptstrecken wohnt, sondern diesen zur Erzielung einer hohen Auslastung erst durch ein Flächenerschließungssystem zugeführt werden muss. Es gilt daher ein System zu finden, das die erforderliche Flächenerschließung und Alimentierung der Hauptstrecken kostengünstiger ermöglicht als ein Betrieb mit Linienbussen. In erster Linie sind hier die hohen Kosten für das Vorhalten von Transportkapazitäten in den Griff zu bekommen, denen zumeist kein entsprechender Bedarf gegenüber steht.

3 DAS VERKEHRSKONZEPT *MAKE.IT*

Das Verkehrskonzept ***MAKE.IT*** verfolgt folgende Ziele:

Attraktivierung des Öffentlichen Verkehrs für den Berufsverkehr durch Verkürzung der Reisezeiten

Sicherstellung einer flächendeckenden Bedienung

Verbesserung der Kostenstruktur ohne Verschlechterungen des Angebots

Öffnung des ÖV für nicht ritualisierte Fahrten durch ein einfach zu bedienendes Informations- und Buchungssystem

Die Eckpunkte des Verkehrskonzepts ***MAKE.IT*** sind:

Entlang der Hauptverkehrsachsen werden – wo keine Bahn vorhanden ist – Buslinien als Schnellverkehre und im Taktverkehr geführt.

Die Knoten der Hauptsverkehrsachsen sind als symmetrische Taktknoten ausgebildet, d.h. dass das direkte Umsteigen von jeder Fahrtrichtung in jede andere Fahrtrichtung möglich ist. Um das zu ermöglichen müssen die Fahrzeiten zwischen den Knoten jeweils 30 Minuten oder ein Vielfaches davon betragen.

Schwachlasträume zwischen den Hauptverkehrsachsen werden mit einem bedarfsgesteuerten Zubringersystem erschlossen, das die Fahrgäste zur nächsten bedienten ÖV-Haltestelle bringt bzw. sie von dort abholt. Wo ausreichend Bedarf besteht, erfolgt die Flächenerschließung durch Zubringerlinien.

Nach dem Konzept ***MAKE.IT*** wird der Öffentliche Verkehr zu einem Gesamtsystem umgestaltet, das einerseits nachhaltig wirtschaftlich tragfähig und andererseits in Punkto Flexibilität und Geschwindigkeit mit dem privaten PKW konkurrenzfähig ist.

3.1 Das Knotenpunktkonzept

Rückgrat des Verkehrskonzepts von ***MAKE.IT*** ist ein System von beschleunigten Buslinien entlang der Hauptverkehrsachsen. Diese werden in den regionalen Zentren in Form symmetrischer Taktknoten verknüpft, so dass das problemlose Umsteigen zu jeder Linie und in jede Richtung möglich ist (vg. Abbildung 4 und Abbildung 1).

Durch die Umsteigemöglichkeit kann auf die vielfältigen Direktverbindungen des gegenwärtigen Systems verzichtet werden, wodurch die teuren Parallelverkehre und Mehrfachbedienungen entfallen. Ein solches System ermöglicht bei einer Erhöhung der Zahl der möglichen Verbindungen eine Reduktion der Fahrleistung und somit der Kosten. Der Taktverkehr erhöht darüber hinaus die Transparenz das Systems für den Fahrgast, so dass der Öffentliche Verkehr auch für nicht regelmäßige Fahrten leichter nutzbar wird. Die Alimentation der Schnelllinien mit Fahrgästen erfolgt über Zubringerlinien bzw. ein bedarfsgesteuertes System.

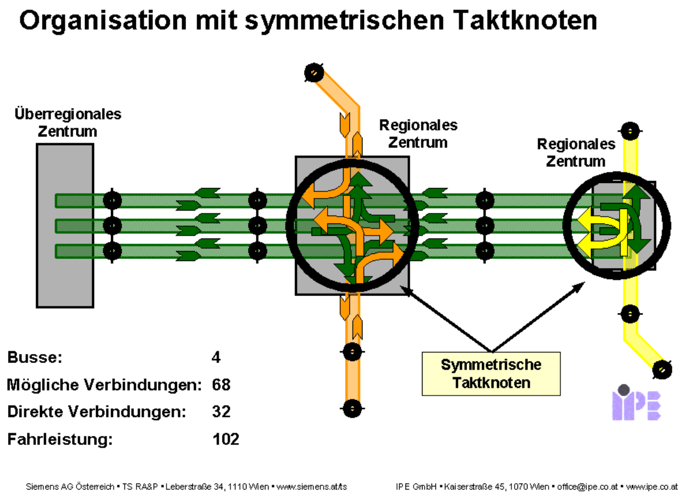

Abb.4: Organisation des ÖV mit symmetrischen Taktknoten (Quelle: IPE))

3.2 Das bedarfsgesteuerte Flächenerschließungssystem

Im zumeist dünn besiedelten Raum zwischen den Hauptverkehrsachsen ist eine liniengebundene Erschließung oft unwirtschaftlich und in dispers besiedelten Gebieten auch wenig sinnvoll. ***MAKE.IT*** sieht deshalb zur Flächenerschließung ein bedarfsgesteuertes Zubringersystem zu den Haltestellen des Linienverkehrs entlang der Hauptverkehrsachsen vor. Im Gegensatz zum jetzigen System fallen beim bedarfsgesteuerten System nur Kosten an, wenn tatsächlich Transportbedarf besteht, Stillstandskosten gibt es nicht. Schwachlasträume und -zeiten können demnach erheblich billiger versorgt werden als bisher.

Als Zubringer können unterschiedlichste Betriebsformen wie gewerbliche Taxis, Bürgerbusse, Gemeindetaxis o.Ä. herangezogen werden. Wo der ÖV-Bedarf auch abseits der Hauptverkehrsachsen so hoch ist, dass er mit Linienbussen wirtschaftlicher abgewickelt werden kann als mit bedarfsgesteuertem Verkehr, werden Zubringerlinien zu den Schnellverkehren entlang der Achsen eingerichtet.

Das Endergebnis der Umgestaltung des Öffentlichen Verkehrs ist ein differenziertes System aus getakteten Schnellverkehren entlang der Achsen und einer adäquaten Flächenerschließung, die Abhängigkeit vom Bedarf in Form von Zubringerlinien oder bedarfsgesteuerten Zubringerverkehren abgewickelt wird (vgl. Abbildung 5)

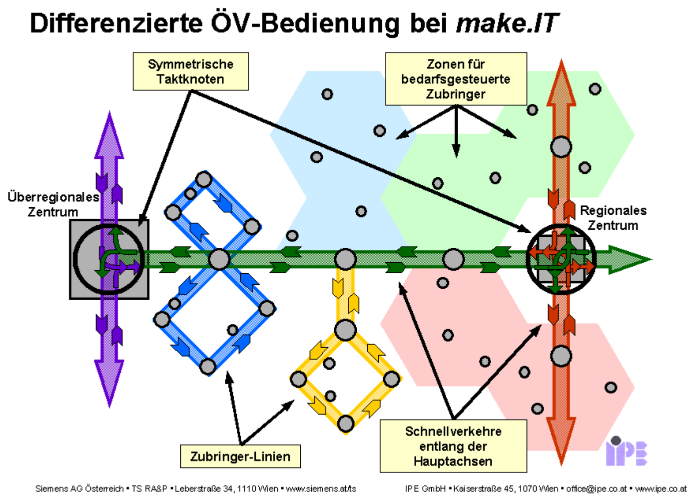

Abb.5: Differenzierte ÖV-Bedienung bei ***MAKE.IT*** (Quelle: IPE))

4 DAS TECHNISCHE SYSTEM MAKE.IT

Die Organisation des Bedarfsverkehrs, die Sicherung der Taktknoten und der Informationsbedarf der Fahrgäste erfordern ein technisches System.

Der bedarfsgesteuerte Zubringerverkehr benötigt ein System zur Bestellung, zur Vermittlung und zur Dokumentation der Fahrten.

Zusätzlich stellt ***MAKE.IT*** ein System zur Information der Fahrgäste bereit, sodass intermodale Wegeketten problemlos und ohne Fahrplankenntnis geplant werden können.

Die Lage der Fahrzeuge im Fahrplan ist bekannt, sodass im Verspätungsfall eingegriffen werden kann.

Im Pilotbetrieb gibt es eine zentrale Anlaufstelle in Form einer Kundenservicezentrale mit Call-Center, welche dem Fahrgast des öffentlichen Verkehrs eine Plattform für die Planung von intermodalen "Tür zu Tür"- Routen und deren Bestellung bietet. Eine intermodale Route kann im Pilotgebiet aus Bahnen, Bussen und bedarfsgesteuerten Verkehrsmitteln (Anschlussfahrzeugen AFZ), die nur am Anfang und am Ende einer Route vorkommen dürfen, bestehen.

4.1 Kundenservicezentrale

Überblick über die geforderte Funktionalität

Die Kundenservicezentrale ermittelt über den intermodalen ÖV Routenplaner die möglichen bzw. die optimale Fahrtroute und organisiert bei einer Fahrtenbestellung die notwendigen Anschlussfahrzeuge. Ob eine AFZ zu einer bestimmten Uhrzeit zu einer Haltestelle angeboten wird, wird durch den intermodalen ÖV Routenplaner bestimmt. Die AFZ Lenker können sich bei der Kundenservicezentrale registrieren und ihre Dienste im Rahmen von ***MAKE.IT*** anbieten. Die AFZ Lenker werden mit GPRS fähigen Interaktionsgeräten (Zubringerendgerät mit einer Zubringeranwendung) ausgerüstet. Ziel der Kundenservicezentrale ist es, nach Möglichkeit die Bestellungen der AFZ zusammenzufassen, und somit eine größtmögliche Wirtschaftlichkeit des bedarfsgesteuerten Verkehrs zu garantieren. Über die Schnittstelle zum Modul Verkehrskontrollzentrale werden grobe Abweichungen vom Soll-Fahrplan in die Kundenservicezentrale übertragen und dort nach Relevanz ausgewertet. Die Daten möglicher Fahrplanabweichungen stehen somit dem AFZ und dem Fahrgast zur Abfrage zur Verfügung. Die Benachrichtigung von Fahrplanabweichungen erfolgt durch die Kundenservicezentrale nach Möglichkeit beim Fahrgast über SMS, bei einer Haltestelle über eine Haltestellenanzeige und beim AFZ über das Zubringerendgerät.

Einbettung in das Projektumfeld MAKE.IT

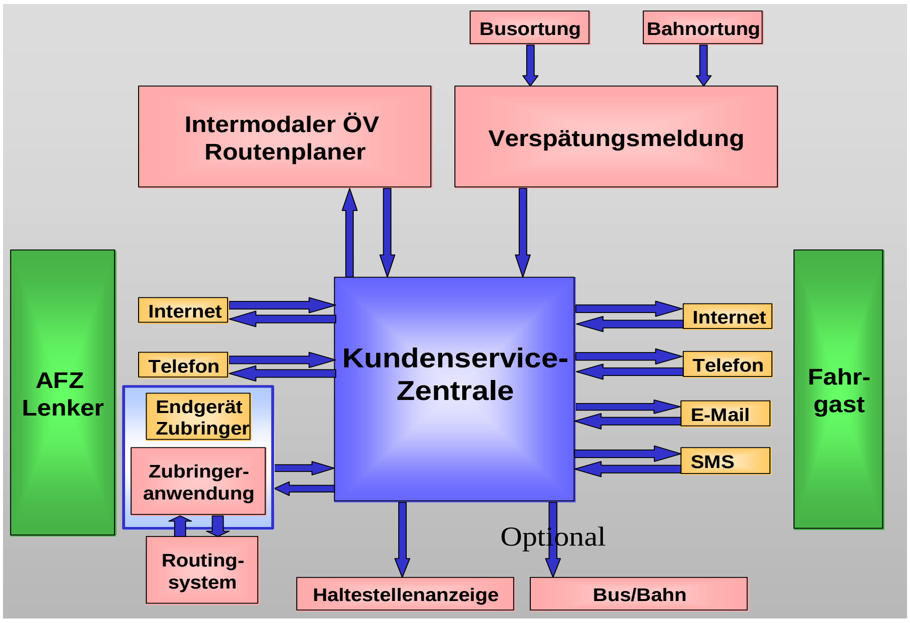

Abb. 6: Einbettung der Kundenservicezentrale in das Gesamtprojekt ***MAKE.IT***

Der Fahrgast kann über die Kundenservicezentrale Informationen (vor allem Informationen über Fahrtrouten) abfragen und nach erfolgter Registrierung Bestellungen für Fahrtrouten absetzen. Dem Fahrgast ist der Zugang zur Kundenservicezentrale über folgende Medien gegeben: Internet, Telefon (Call Center), Email und SMS.

Die Kundenservicezentrale ermittelt die möglichen Fahrtrouten über eine Abfrage beim intermodalen ÖV Routenplaner und gibt die Daten der ermittelten Fahrtrouten an den Fahrgast weiter. Wünscht der Fahrgast eine Bestellung der Fahrtroute, so wird ein Auftrag an einen verfügbaren AFZ Lenker generiert und an die Zubringeranwendung versendet. Wird der Auftrag von einem AFZ Lenker angenommen, so wird eine Bestätigung der Bestellung an den Fahrgast gesendet.

Weiters bietet die Kundenservicezentrale auch für den AFZ Lenker ein Internetportal, wo jeder Lenker seine gesammelten Fahraufträge (Journal) ansehen und seine Fahrzeugdaten erfassen kann.

Die Fahrzeuge des Linienverkehrs überwachen autonom ihre Abweichungen vom Soll-Fahrplan. Grobe Abweichungen vom Soll-Fahrplan werden der Kundenservicezentrale übermittelt. Bei der Kundenservicezentrale können die Abweichungen vom Soll-Fahrplan abgefragt werden. Die Abweichungen werden den betroffenen AFZ Lenker und Fahrgästen zugestellt. Ebenso kann eine Abweichung an eine Haltestellenanzeige gesendet werden.

Prozesse der Kundenservicezentrale

Die Hauptaufgabe der Kundenservicezentrale ist es, den Fahrgast über die Leistungen von ***MAKE.IT*** zu informieren, seine Fahrtaufträge zu erfassen, mögliche und optimale Fahrtrouten zu berechnen und bestellte Fahrtaufträge zu bearbeiten. Dieser Bereich wird in der Kundenservicezentrale als Fahrgastebene bezeichnet. Es wird ein Call Center eingerichtet, welcher über Internet, Email, SMS, Fax und Telefon erreichbar ist.

Ein weiterer Bereich der Kundenservicezentrale ist die Vermittlungsebene. Hauptaufgabe dieses Bereichs ist es für die Beauftragung der Anschlussfahrzeuge zu sorgen. Dazu müssen je Zone die verfügbaren AFZ Lenker und ihre Fahrzeuge verwaltet werden. Da von der Zubringeranwendung je Auftrag die geleisteten Kilometer gemeldet werden, ist es auch Aufgabe der Vermittlungsebene für das Clearing benötigte Daten in einem Report aufzubereiten.

Fahrgastebene

Die Kundenservicezentrale bietet dem Fahrgast ein Internetportal an. Das Internetportal gliedert sich in einen allgemein zugänglichen Bereich, wo der Fahrgast sich (anonym) über das Projekt Make.IT informieren und intermodale ÖV Routen abfragen kann. Der anonyme Fahrgast hat nicht die Möglichkeit sich vordefinierte Fahrtrouten zu speichern.

Möchte ein Fahrgast sich in der Kundenservicezentrale registrieren, so wird sein Fahrgastprofil gespeichert und es wird ihm eine Benutzerkennung und ein Passwort zugewiesen. Als registrierten Benutzer ist es dem Fahrgast möglich, eine abgefragte Route unter einem selbst zu vergebenden Namen als vordefinierte Route abzuspeichern (Bsp. Arzt, Kino, ...). Die Start- und Zielpunkt der Fahrt müssen somit nicht jedes Mal neuerlich eingetragen werden, sondern werden automatisch geladen. Vordefinierte Routen können später abgefragt und bestellt werden. Der registrierte Fahrgast hat die Möglichkeit unter seiner Benutzerkennung in seine Routenabfragen einzusehen und kann jederzeit sein persönliches Profil abfragen und modifizieren. Der registrierte Fahrgast hat die Möglichkeit sich Verspätungen gegenüber dem Soll-Fahrplan per SMS zustellen zu lassen (Minimalanforderung SMS-fähiges Telefon).

Abb. 7: Fahrgastprofil

Fahrtrouten abfragen und bestellen

Die Abfrage einer Fahrtroute kann von einem anonymen sowie von einem registrierten Fahrgast durchgeführt werden. Für die Abfrage einer Fahrtroute stehen in der Kundenservicezentrale zwei Dialoge zur Verfügung. Die einfache Fahrtroutenabfrage und die erweiterte Fahrtroutenabfrage. Der Startpunkt und Zielpunkt der Fahrtroute kann eine Adresse, Haltestelle oder ein wichtiger Punkt sein. Wird vom Fahrgast keine gewünschte Abfahrtzeit bzw. Ankunftszeit und Datum erfasst, so wird der eheste Fahrtantritt angenommen.

Im Dialog Routenanfrage werden die Eingaben des Fahrgastes gegenüber den internen Listen der Adressen, Haltstellen und wichtiger Punkte evaluiert. So kann sichergestellt werden, dass nur mit einer gültigen Eingabe eine Routenabfrage durchgeführt wird.

In der erweiterten Routenabfrage hat der Fahrgast zusätzlich die Möglichkeit sein bevorzugtes Verkehrsmittel auszuwählen, sich nur Direktverbindungen anzeigen zu lassen und / oder die maximale Reisedauer zu begrenzen. Über die Option „über“ hat der Fahrgast die Möglichkeit die Haltestelle auszuwählen über die die gewünschte Fahrtroute geführt werden soll.

Nachdem alle Daten für die Abfrage erfasst wurden, wird durch den Fahrgast die Routenabfrage gestartet. Das Ergebnis der Abfrage kann eine einzelne Route sein oder eine begrenzte Anzahl von alternativen Fahrtrouten. Die Fahrtrouten werden dem Fahrgast in Listenform angezeigt. Für jede Route können die Routendetails (die einzelnen Routenabschnitte) angezeigt werden.

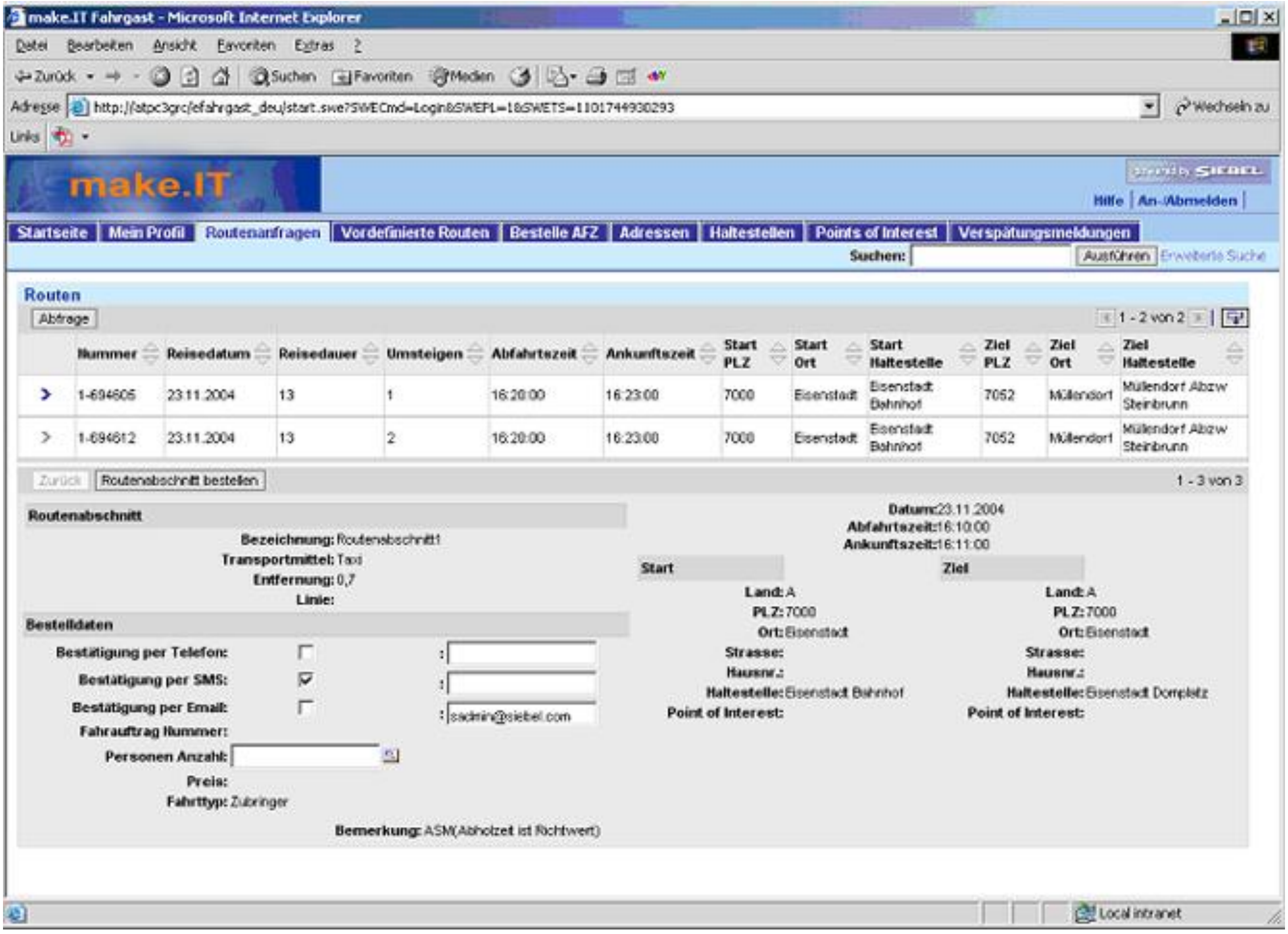

Abb. 8: Routenabfragen

Über einen Button löst der Fahrgast die Bestellung eines AFZ Abholers oder AFZ Zubringers aus. Bei positiver Abwicklung der Bestellung wird dies dem Fahrgast über das gewünschte Medium (mittels SMS, Email, Telefon) mitgeteilt. Ebenso wird die voraussichtliche Abholzeit dem Fahrgast bekannt gegeben. Die Bestätigung kann auch negativ sein, falls innerhalb einer bestimmten Zeitspanne kein Zubringerdienst organisiert werden konnte.

Information über Fahrplanabweichung

Bekommt die Kundenservicezentrale eine Information über eine Abweichung vom Soll-Fahrplan, so leitet die Kundenservicezentrale die Information an die betroffenen Fahrgäste, AFZ Lenkern, und Haltestellenanzeigen weiter. Dies dient zur Information und hat keine planungstechnische Auswirkungen.

Vermittlungsebene

Die Vermittlungsebene hat die Aufgabe die Verwaltung der AFZ Unternehmen, der AFZ Lenker und Anschlussfahrzeuge durchzuführen und die Auftragsabwicklung mit den Anschlussfahrzeugen zu koordinieren.

Das Ziel ist, dass aus den Bestellungen in der Fahrgastebene Aufträge für die vermittelbaren Anschlussfahrzeuge generiert werden und dort wo es möglich ist eine Zusammenfassung von mehreren Bestellungen zu einem Auftrag (Sammelauftrag) zu machen. Die Wirtschaftlichkeit der AFZ Betriebs soll durch diese Zusammenfassung optimiert werden.

Die verwendeten Funktionen sind angepasst an die eines modernen Call Centers, die Anforderungen eines Fahrgastes im öffentlichen Verkehr und die Anforderungen der Zubringer.

4.2 Zubringeranwendung

Die Zubringerapplikation selbst besteht wiederum aus 3 Prozessen.

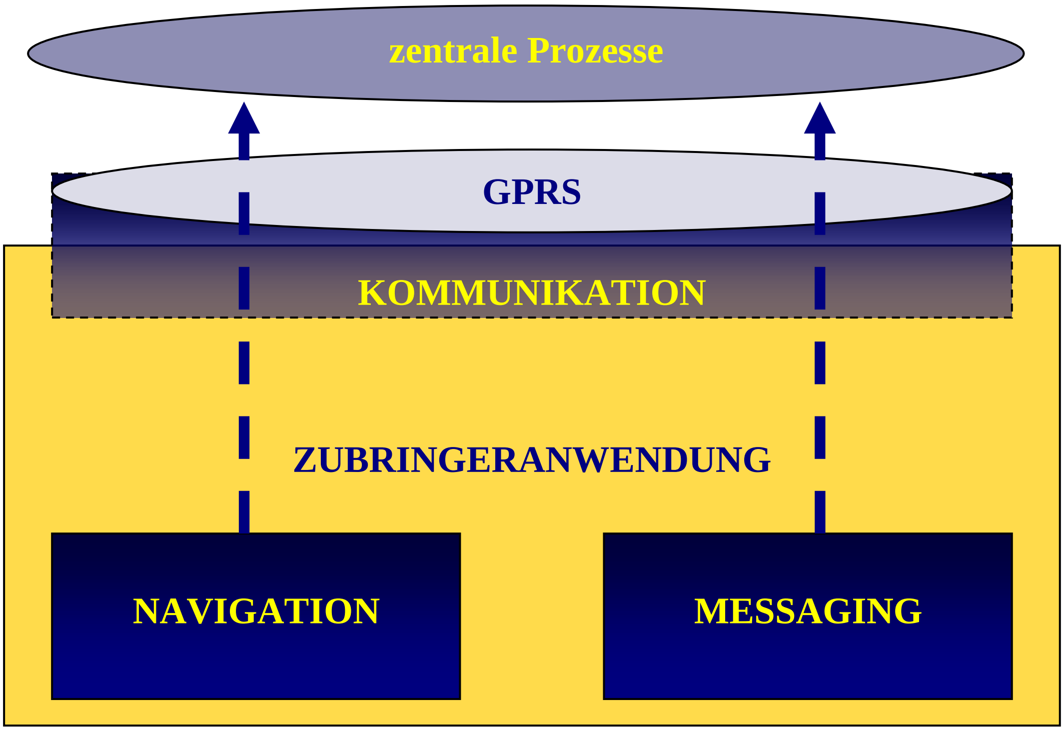

Abb. 9: Prozesse der Zubringerapplikation

Kommunikationsprozess

Einige lokale Prozesse am Terminal erfordern – zumindest temporär – die Datenkommunikation mit den zentralen Prozessen. Die einzelnen Applikationen werden so ausgelegt, dass Kommunikationsgeschwindigkeiten wie sie mit der GPRS Übertragungstechnologie (ca. 20-30kbps) erreichbar sind, ausreichen.

Im Zuge einer universellen Anwendbarkeit der Lösung sollten am Terminal Technologien zum Einsatz kommen, die eine permanente Datenverbindung zur Zentrale nicht voraussetzen. Daher muss bei der Erstellung der Applikation besonderes Augenmerk darauf geworfen werden, dass nicht davon ausgegangen werden kann, dass in jedem Einsatzgebiet eine flächendeckende Verfügbarkeit der Datenkommunikation vorliegt.

Messaging Prozess

Durch die Kommunikation mit den zentralen Systemen besteht ein weitreichender Datenaustausch mit der Terminalapplikation. Im Hinblick auf die Verkehrssicherheit ist es sehr wichtig, dass die Kommunikation mit dem Fahrer, also der Messaging Prozess per se, aus einfachen und klaren Anweisungen zu einem Auftrag bzw. einer Fahrt besteht, die möglichst wenige Interaktionen des Fahrers voraussetzt.

Generell sollte sich die Kommunikation in den meisten Fällen auf das Bestätigen einer Meldung aus der KSZ, wie z.B. die Annahme eines Auftrages oder das Rückmelden an die Zentrale, dass ein Auftrag abgeschlossen ist, beschränken.

Die Basisapplikation am Terminal sollte zumindest den Austausch folgender Kommunikationselemente unterstützen:

Annahme/Ablehnen eines Auftrages
Beenden eines Auftrages
Liste der absolvierten Aufträge
Liste der offenen Aufträge
Auswählen der Details zu einem Auftrag
Auswählen der Details zu einer Fahrt

Rückmeldung der Zone, die vom Lenker bedient wird
Rückmeldung eines Bereitschaftsstatus
Übernahme des Fahrpreises
Verspätungsmeldung des Zubringers
Rückmeldung des Fahrzeugtyps
Rückmeldung der Lenkeridentifikation
Anzeige von Verspätungsmeldungen des öffentlichen Verkehrsmittels

Zusätzlich dazu sollte das System in der Lage sein folgende optionale Funktionen zu unterstützen, die vielleicht zu einem späteren Zeitpunkt zum Einsatz kommen könnten:

Drucken und Ausgabe einer Rechnung
Rückmeldung der Aufnahme eines Fahrgastes
Stornieren einer Fahrt eines Auftrages durch die Zentrale
Stornieren einer Fahrt eines Auftrages durch den Fahrer
Erfassen der exakten Fahrtroute und der gefahrenen Geschwindigkeiten

Navigationsprozess

Für den nicht ortskundigen Fahrer muss die Möglichkeit vorgesehen werden am Terminal die zu fahrenden Routen zu berechnen bzw. anschließend den Lenker durch optische und akustische Anweisungen zu den Fahrzielen zu leiten. Voraussetzung dafür ist eine Übermittlung der GPS Koordinaten der Zieladresse an die Terminalanwendung.

Falls ein Auftrag aus mehreren Fahrten besteht ist davon auszugehen, dass die Fahrziele durch ein Routenoptimierungssystem in einer routenoptimierten Reihenfolge vorliegen. Minimalanforderung ist, dass der Fahrer selbst die Entscheidung treffen können muss, in welcher Reihenfolge die einzelnen Fahrziele angefahren werden.

Für den Fall, dass die Route vom Fahrer während der Fahrt geändert wird (z.B. Umleitung), muss in angemessener Zeit, ohne die Intervention des Fahrers, eine alternative Route berechnet und angezeigt werden.

Die Navigationsapplikation am Terminal sollte daher die folgenden Kommunikationsschnittstellen zum Fahrer aufweisen:

Automatische Übernahme des Fahrzieles aus der Zentrale
Automatische Übernahme des aktuellen Fahrzeugstandortes für den Start der Navigation
Anzeigen der Route zum Fahrgast
Akustische Anweisungen (z.B. „in 100m rechts abbiegen“)

Serviceprozess (geplant)

Zusätzlich zu den bereits definierten Prozessen werden Serviceprozesse definiert. Dies sind Prozesse, die vor allem darauf ausgerichtet sind, dem Fahrgast zusätzliche Services und Dienste anzubieten. Dies wären

Drucken des Fahrplanes (Reisebegleiter)
Drucken eines Fahrscheines
Zahlung durch Verwendung einer Kundenkarte
Zahlung durch Verwendung einer Kreditkarte

5 ZUSAMMENFASSUNG

MAKE.IT ist durch ein intermodales Verkehrskonzept und ein innovatives technisches System geprägt.

Das Verkehrskonzept ***MAKE.IT*** verfolgt folgende Ziele:

Attraktivierung des Öffentlichen Verkehrs für den Berufsverkehr durch Verkürzung der Reisezeiten

Sicherstellung einer flächendeckenden Bedienung

Verbesserung der Kostenstruktur ohne Verschlechterungen des Angebots

Öffnung des ÖV für nicht ritualisierte Fahrten durch ein einfach zu bedienendes Informations- und Buchungssystem

Die Eckpunkte des Verkehrskonzepts ***MAKE.IT*** sind:

Entlang der Hauptverkehrsachsen werden – wo keine Bahn vorhanden ist – Buslinien als Schnellverkehre und im Taktverkehr geführt.

Die Knoten der Hauptsverkehrsachsen sind als symmetrische Taktknoten ausgebildet, d.h. dass das direkte Umsteigen von jeder Fahrtrichtung in jede andere Fahrtrichtung möglich ist. Um das zu ermöglichen müssen die Fahrzeiten zwischen den Knoten jeweils 30 Minuten oder ein Vielfaches davon betragen.

Schwachlasträume zwischen den Hauptverkehrsachsen werden mit einem bedarfsgesteuerten Zubringersystem erschlossen, das die Fahrgäste zur nächsten bedienten ÖV-Haltestelle bringt bzw. sie von dort abholt. Wo ausreichend Bedarf besteht, erfolgt die Flächenerschließung durch Zubringerlinien.

Nach dem Konzept ***MAKE.IT*** wird der Öffentliche Verkehr zu einem Gesamtsystem umgestaltet, das einerseits nachhaltig wirtschaftlich tragfähig und andererseits in Punkto Flexibilität und Geschwindigkeit mit dem privaten PKW konkurrenzfähig ist.

Das technische System ***MAKE.IT***:

Die Organisation des Bedarfsverkehrs, die Sicherung der Taktknoten und der Informationsbedarf der Fahrgäste erfordern ein technisches System.

Der bedarfsgesteuerte Zubringerverkehr benötigt ein System zur Bestellung, zur Vermittlung und zur Dokumentation der Fahrten.

Zusätzlich stellt ***MAKE.IT*** ein System zur Information der Fahrgäste bereit, sodass intermodale Wegeketten problemlos und ohne Fahrplankenntnis geplant werden können.

Die Lage der Fahrzeuge im Fahrplan ist bekannt, sodass im Verspätungsfall eingegriffen werden kann.

Ein wichtiger Bestandteil des Projekts ist die Kundenservicezentrale mit Call-Center, welche dem Fahrgast des öffentlichen Verkehrs eine Plattform für die Planung von intermodalen „Tür zu Tür“ – Routen und deren Bestellung bietet. Eine intermodale Route kann aus Bahnen, Bussen und bedarfsgesteuerten Verkehrsmitteln bestehen. Der Zugang zur Kundenservicezentrale erfolgt über Internet, E-mail, Telefon oder SMS.

Ein innovatives technisches System wurde für die Bestellung, Vermittlung und Dokumentation der Fahrten entwickelt. Über die Kundenservicezentrale können mögliche und optimale Fahrtrouten berechnet und bestellte Fahrtaufträge bearbeitet werden. Zusätzlich kann das System die Beauftragung der Anschlussfahrzeuge verwalten, die über ein mobiles Endgerät mit der Kundenservicezentrale verbunden sind.

5.1 Konfiguration des Gesamtsystems

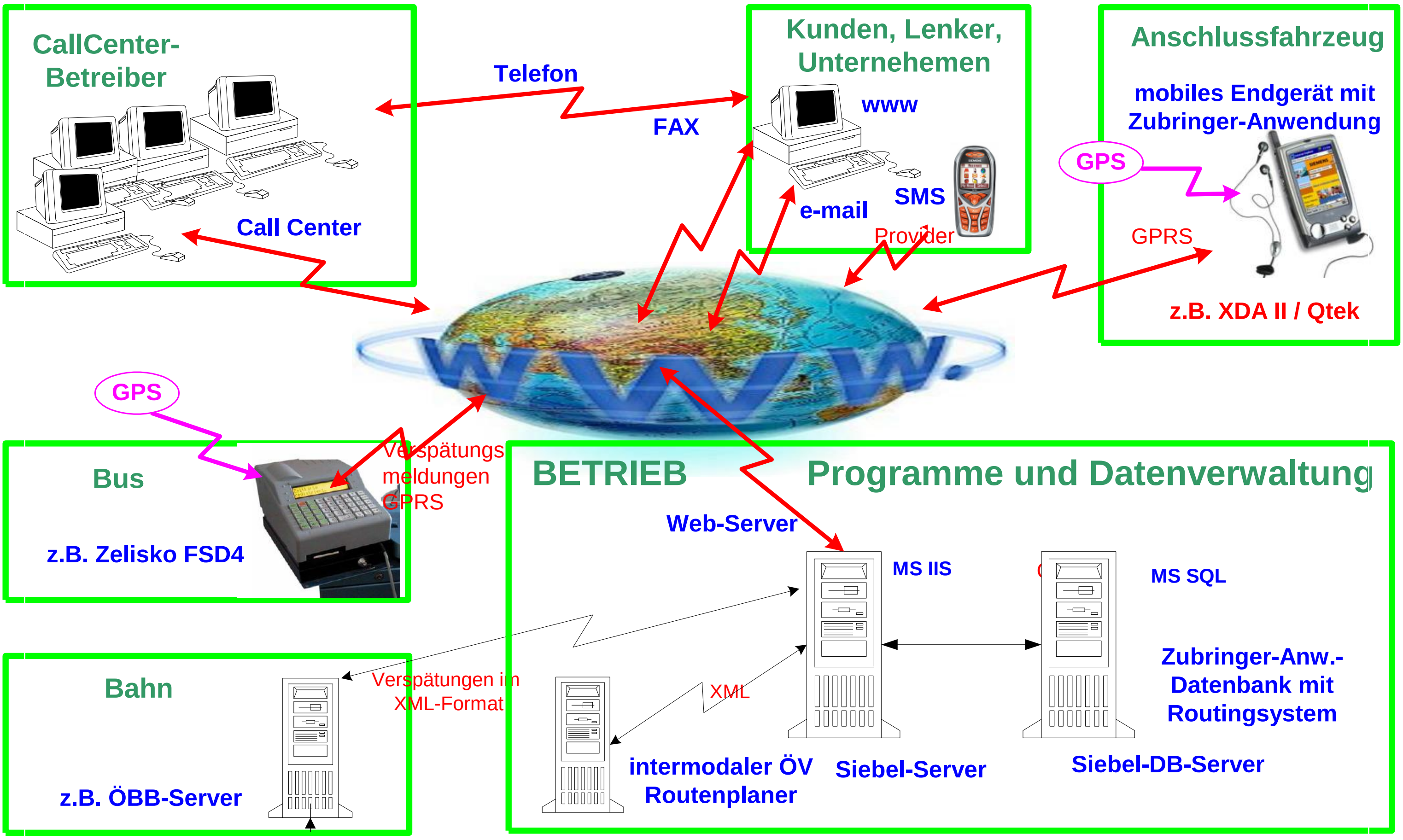

Abb. 10: Überblick über die Systemarchitektur

Die Entwicklung eines integrierten dynamischen Siedlungsentwicklungs- und Verkehrsmodells für Asiatische Städte

Günter EMBERGER, Nikolaus IBESICH, Paul C. PFAFFENBICHLER

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1 EINLEITUNG

In den letzten Jahrzehnten wurde sowohl in Europa als auch weltweit eine stetige Zunahme der Verkehrsprobleme beobachtet. Die angewendeten Lösungsstrategien, zumeist Einzelmaßnahmen im Infrastrukturbereich, waren wenig erfolgreich. Dies führte zu der Erkenntnis, dass nachhaltige Lösungen nur über integrierte Strategien, d.h. durch Kombination mehrerer Maßnahmen, erreichbar sind. Die Europäische Union förderte deshalb ab den 90-er Jahren des vergangenen Jahrtausends einen Forschungsschwerpunkt zur Entwicklung geeigneter Methoden zur Beurteilung integrierter Raumnutzungs- und Verkehrsplanungsstrategien (Emberger and Bruntsch 2002). Konkret wurde z.B. die Entwicklung von kombinierten Flächennutzungs- und Verkehrsmodellen (Land Use and Transport Interaction models - LUTI models) gefördert. Diese Modelle sollten in der Lage sein eine Vielzahl verkehrs- und raumplanerischen Maßnahmen gleichzeitig zu simulieren und dabei auch räumliche und zeitliche Effekte abbilden. Zusätzlich sollten die entwickelten Methoden dazu geeignet sein, Maßnahmebündel hinsichtlich synergetischer oder kompensatorischer Effekte zu evaluieren. Die Ergebnisse der Anwendung dieser Methoden wie auch die Methoden selbst sollten für die Entscheidungsfindung auf strategischer Ebene herangezogen werden können. Das Institut für Verkehrsplanung und Verkehrstechnik der Technischen Universität Wien war Teil mehrerer in diesem Rahmen geförderter Forschungsprojekte[81].

Zwei dieser Projekte, PROSPECTS[82] und PLUME[83], bilden den Ausgangspunkt für die hier vorgestellte Arbeit. Ergebnisse des Projekts PROSPECTS sind zum einen das Handbuch für Entscheidungsträger und Planer (May, Karlstrom et al. 2003; Minken, Jonsson 2003)[84]. In diesem werden die unterschiedliche Stufen und Methoden der Entscheidungsfindung vorgestellt und die Anwendung einer logischen Struktur vorgeschlagen. Zum anderen wurde das dynamische integrierte Flächennutzungs- und Verkehrsmodell MARS entwickelt (Pfaffenbichler 2003). Das Modell wurde in der Folge für die Städte Wien, Edinburgh, Leeds, Madrid, Oslo, Stockholm und Helsinki aufgesetzt und zur Bearbeitung verschiedenster Fragestellungen herangezogen (Emberger, May et al. 2003; Pfaffenbichler and Emberger 2004). Im Projekt PLUME wurde und wird das in anderen EU Land-use –Projekten (inklusive PROSPECTS) produzierte Wissen zu Syntheseberichten zusammengefasst[85]. Diese repräsentieren einen hoch verdichteten Status quo der europäischen Verkehrswissenschaft mit Bezug zur Raumplanung. Im Rahmen des Programms EU-Asia Pro Eco[86] fördert die Europäische Union den Wissensaustausch zwischen Europa und Asien. Das Motto des Programms Asia Pro Eco lautet: *Promoting sustainable solutions for the Environment between Europe and Asia*. Die Projekte PROSPECTS und PLUME bilden die Basis für das im folgenden Kapitel beschriebene Asia Pro Eco Project SPARKLE (**S**ustainability **P**lanning for **A**sian cities making use of **R**esearch, **K**now-how and **L**essons from **E**urope).

2 DAS PROJEKT SPARKLE

Ziel des Projekts SPARKLE ist: "*promote and transfer knowledge to the countries of South East Asia on the process of developing sustainable urban land use and transport policies, and to provide technical training to local planners and decision makers on how to use scientific and logical approaches to formulate a sustainable land use and transport policy*"[87].

In den Projekten PROSPECTS und PLUME wurden Strategien für eine nachhaltige Entwicklung in den Bereichen Flächennutzung und Verkehr für den europäischen Kontext entwickelt. SPARKLE verwendet diese Ergebnisse und Verfahrensweisen als Basis für den Wissensaustausch mit Entscheidungsträgern in den asiatischen Regierungen und Kommunalverwaltungen. Der Wissensaustausch erfolgt im Rahmen von zwei dreitägigen Großkonferenzen mit mehr als 200 geladenen Gästen (September 2005, Bangkok und Mai 2006, Hanoi) und sechs dreitägigen Trainingskursen in Thailand, Laos, Kambodscha und Vietnam mit jeweils maximal 20 Teilnehmern. Für diese Veranstaltungen werden die PROSPECTS Handbücher an die Verhältnisse in Südostasien angepasst und übersetzt. Darüber hinaus wird das Flächennutzugs- und Verkehrsmodell MARS für asiatische Verhältnisse adaptiert und in je einer Stadt in Thailand und in Vietnam angewendet. Anhand dieser Fallbeispiele wird in den Trainingskursen gezeigt, wie dynamische Modelle in der Entscheidungsfindung genutzt werden können. Das Projekt SPARKLE startete am 1. November 2004 und hat eine

81 Z.B.: Optimisation of Policies for Transport Integration in Metropolitan Areas (OPTIMA), Financial Assistance for Transport Integration in Metropolitan Areas (FATIMA), Strategic Assessment Methodology for the Interaction of CTP-Instruments (SAMI), TRANSport Planning, Land Use and Sustainability (TRANSPLUS), Procedures for Recommending Optimal Sustainable Planning of European City Transport Systems (PROSPECTS) und Planning Urban Mobility in Europe (PLUME).

82 http://www.ivv.tuwien.ac.at/projects/prospects.html

83 http://www.lutr.net

84 Die PROSPECTS Handbücher sind als Download unter der Adresse http://www.ivv.tuwien.ac.at/projects/prospects.html verfügbar.

85 Die Syntheseberichte von PLUME sind unter der Adresse http://www.lutr.net verfügbar.

86 http://europa.eu.int/comm/europeaid/projects/asia-pro-eco/index_en.htm Zugriff: 2.12.2004

87 http://europa.eu.int/comm/europeaid/projects/asia-pro-eco/pdf/projectsheets/projectsheet_22.pdf

Laufzeit von 22 Monaten. Beteiligt sind insgesamt 8 Partner[88]. Die folgenden Kapitel geben einen Überblick über wesentliche Unterschiede zwischen Europa und Südostasien und leiten daraus notwendige Entwicklungsschritte für das Modell MARS ab.

3 VERGLEICH SÜDOSTASIEN – EUROPA

Im folgenden Kapitel werden die Verhältnisse in Südostasiatischen und Europäischen Städten anhand einiger für die Modellierung des Verkehrsverhaltens und der Standortwahl relevanter Parameter verglichen.

3.1 Vergleich sozio-ökonomischer Basisdaten

In Tabelle 3 sind sozio-ökonomische Daten jener Staaten zusammengefasst, aus denen die SPARKLE Projektpartner stammen. Innerhalb der asiatischen Partner nimmt Thailand eine Sonderstellung ein. Vor allem in den städtischen Ballungsräumen kann Thailand als hoch entwickelt gelten. Das pro Kopf Bruttoinlandsprodukt in Kaufkraftparitäten ist etwa 4 mal so hoch wie jenes in den drei anderen asiatischen Partnerländern. Allerdings ist das pro Kopf Bruttoinlandsprodukt in den Europäischen Partnerländern etwa viermal so hoch wie in Thailand. Das pro Kopf Bruttoinlandsprodukt hat einen wesentlichen Einfluss auf den Motorisierungsgrad und damit auf die Verkehrsmittelwahl (siehe auch Tabelle 4). Ausserdem weisen die Asiatischen und Europäischen Partnerländer eine sehr unterschiedliche Altersstruktur auf. Diese wird in Tabelle 3 durch den Indikator Median-Alter[89] dargestellt. Entsprechend dem höheren Entwicklungsstand ist das Median-Alter in Thailand höher als in den drei anderen Asiatischen Staaten. Das Median-Alter in den Europäischen Partnerstaaten ist rund doppelt so hoch wie in Kambodscha, Laos und Vietnam. Unterschiedliche Altersgruppen haben sehr unterschiedliche Mobiltätsbedürfnisse. Eine verschiedene Alterstruktur hat daher einen wesentlichen Einfluss auf die Gesamtmobilität. Sowohl das Bruttoinlandsprodukt je Kopf als auch die Bevölkerung wächst in Asien stärker als in Europa. Der Anteil der Einwohner unter der Armutsgrenze ist in Kambodscha, Laos und Vietnam doppelt bis zehnfach so hoch wie in Großbritannien, Österreich und Thailand. Die Auswirkungen dieser Unterschiede für die Modellierung werden in Kapitel 4 näher erläutert.

Kontinent	Land	Einwohner (Mio.)	Einwohner Wachstumsrate	Median-Alter (Jahre)	BIP je Einwohner (US-$)	BIP Wachstumsrate	Einwohner unter Armutsgrenze
s	Kambodscha	13.4	1.8%	19.5	1,700	5.5%	36%
	Laos	6.1	2.44%	18.6	1,700	5.7%	40%
	Thailand	64.9	0.91%	30.5	7,400	6.3%	10.4%
	Vietnam	82.7	1.3%	24.9	2,500	7.3%	37%
Europa	Österreich	8.2	0.14%	40.0	30,000	0.8%	3.9%
	UK	60.3	0.29%	38.7	27,700	2.1%	17%

Quelle: http://www.maps4free.com/ Zugriff: 30.11.2004

Tabelle 3: Vergleich soziodemographischer Merkmale der im Projekt SPARKLE vertretenen Länder

3.2 Vergleich der Verkehrsmittelwahl und des allgemeinen Verkehrsgeschehens

Als Fallstudien für die Anwendung des Flächennutzungs- und Verkehrsmodells MARS wurden von den Projektpartnern die Städte Ubon Ratchasthani (Thailand) und Da Nang (Vietnam) ausgewählt. Ubon Ratchasthani ist eine Provinzhauptstadt im Nordosten Thailands. Da Nang liegt etwa auf der Höhe des 16. Breitengrades an der Küste Vientams[90]. In Abbildung 8 ist die Lage der beiden Städte gekennzeichnet. Tabelle 4 zeigt einen Vergleich mit jenen Europäischen Städten in denen das Modell MARS bereits angewendet wurde[91]. Ein Vergleich der Verkehrsmittelwahl zeigt drastische Unterschiede zwischen den Asiatischen und den Europäischen Städten. In der vietnamesischen Stadt Da Nang ist das Motorrad das dominierende Verkehrsmittel. Dagegen spielt das Motorrad in Europa nur eine gewisse Rolle als Sport- und Freizeitgerät. Als Alltagsverkehrsmittel wird es im Allgemeinen vernachlässigt.

Auch die in Asien für den öffentlichen Verkehr verwendeten Fahrzeuge untescheiden sich zum Teil wesentlich von jenen in Europa. Zwar existieren in den modernen asiatischen Metropolen auch U-Bahnsysteme[92], große Teile der Bevölkerung sind aber auf andere öffentliche Verkehrsmittel angewiesen. Die Bandbreite reicht dabei von Autobussen aller Größen über Songtaew und Tuk-tuk (siehe Abbildung 10) bis zum Samlor[93]. Eine in Bangkok neue Form des öffentlichen Verkehrs bzw. Paratransits sind Motorradtaxis[94].

88 Institute for Transport Studies, University of Leeds (UK), Institut für Verkehrsplanung und Verkehrstechnik, Technische Universität Wien (A), Ubon Ratchathani University, Chiang Mai University, Khon Kaen University (alle Thaliand), Transport Development and Strategy Institute (Vietnam), National Transport Committee, Ministry of Communication, Transport, Post and Construction (Laos) und Department of Planning, Ministry of Public Works and Transport (Kambodscha).

89 50% der Bevölkerung sind jünger als das Median-Alter, 50% der Bevölkerung sind älter.

90 http://www.danang.gov.vn/ bietet eine sehr gute Übersicht und eine Vielzahl an Daten über die Stadt Danang.

91 Die für die Europäischen Städte angegebenen Daten sind jene, die im Modell MARS verwendet wurden. Sie können aus modelltechnischen Gründen etwas von den Daten verschiedener statischer Quellen abweichen.

92 Zum Beispiel in Bangkok der BTS Skytrain, http://www.bangkok.sawadee.com/skytrain.htm Zugriff: 2.12.2004

93 Dreirädrige Fahrräder http://sawadee.com/thailand/transportation/ Zugriff 2.12.2004

94 http://sawadee.com/thailand/transportation/ Zugriff 2.12.2004

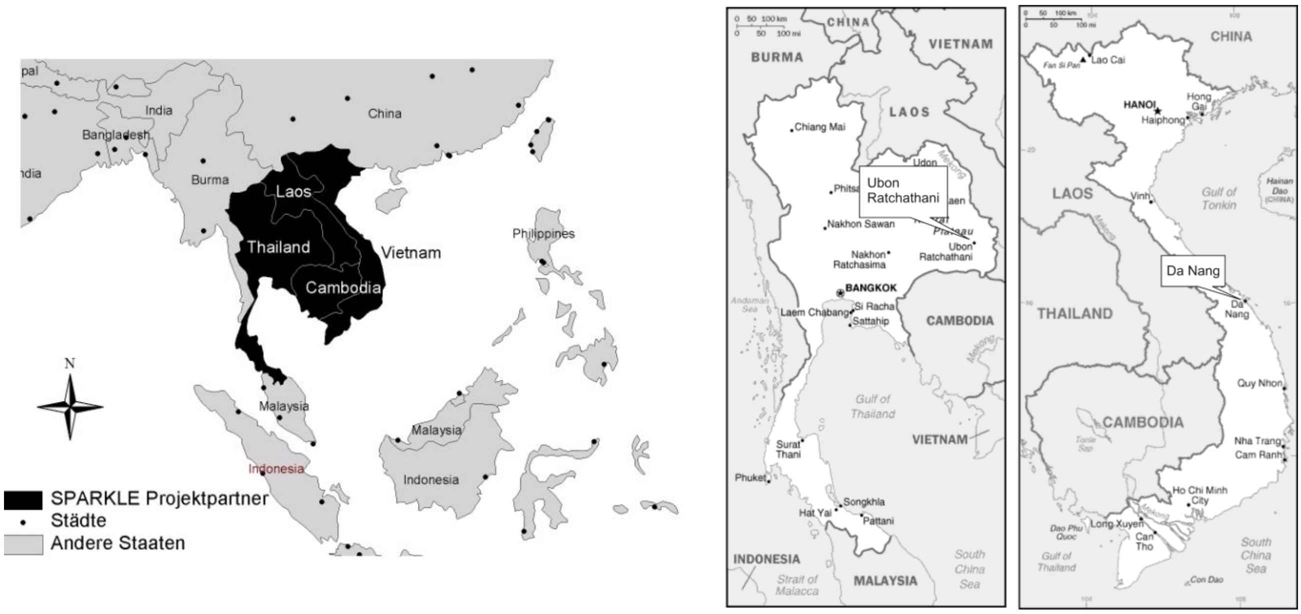

Abbildung 8: Asiatische SPARKLE Projektpartner und Lage der beiden MARS Fallstudien

Stadt (Land)	Bevölker-ung	Fläche [km^2]	Modal Split				Pkw je 1000 Personen	Motorrad je 1000 Personen
			Nicht Motorisiert	Motor-räder	ÖV	Pkw		
Asien								
Da Nang (Vietnam)	754,494	1,256	28%	61%	7%	4%	2.4	322
Ubon Ratchathani (Thailand)	140,000	42	k.A.	k.A.	k.A.	k.A.	106	k.A.
Europa								
Edinburgh (UK)	1,071,768	53*	22.1%	-	24.5%	53.4%	371	-
Helsinki (FI)	920,732	742	29.5%	-	26.3%	44.2%	346	-
Leeds (UK)	727,700	559	23.4%	-	23.9%	52.7%	307	-
Madrid (ESP)	5,022,289	8,011	37.2%	-	33.8%	29.1%	448	-
Oslo (N)	396,974#	454	17.0%	-	22.7%	60.3%	400	-
Stockholm (S)	1,682,595	5,866	37.0%	-	19.3%	43.7%	279	-
Wien (A)	1,550,123	415	27.6%	-	27.2%	45.3%	354	-

- vernachlässigbar, * bebaute Fläche, nicht mit den anderen Flächen vergleichbar, # Einwohner über 12 Jahre

Quelle: Asiatische Städte: Information durch die Projektpartner Transport Development and Strategy Institute (TDSI), Vietnam und Ubon Ratchathani University (UBU), Thailand; Europäische Städte: (Pfaffenbichler and Emberger, 2003, Emberger and May, et. al., 2003)

Tabelle 4: Vergleich einiger Daten der asiatischen Fallstudien mit jenen Europäischer Anwendungen des Modells MARS

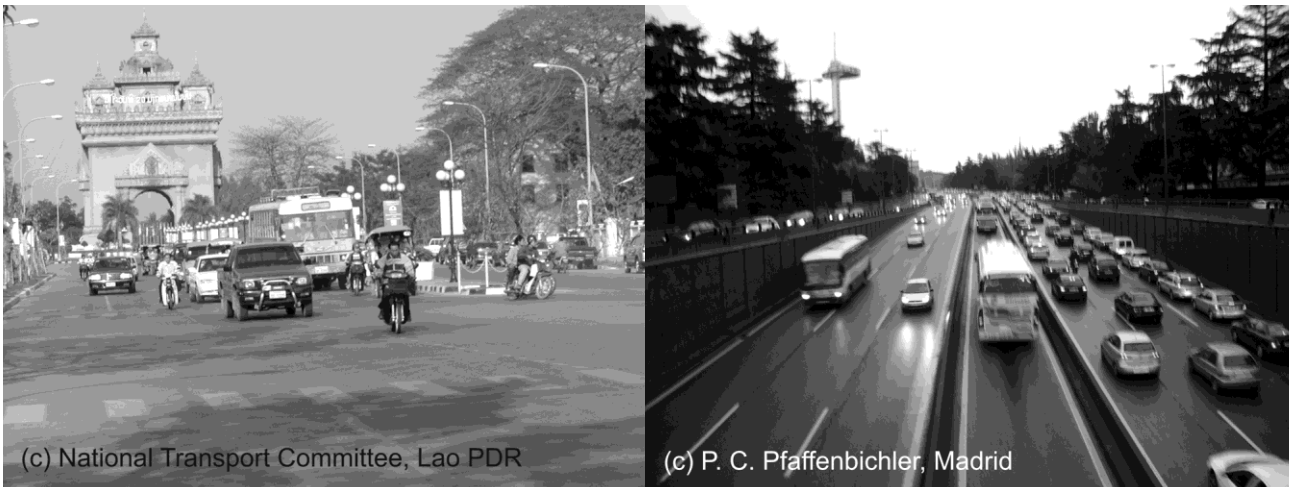

Abbildung 9: Vergleich des Verkehrsgeschehens auf einer Hauptverkehrsader in Vientane, Lao PDR und Madrid, E

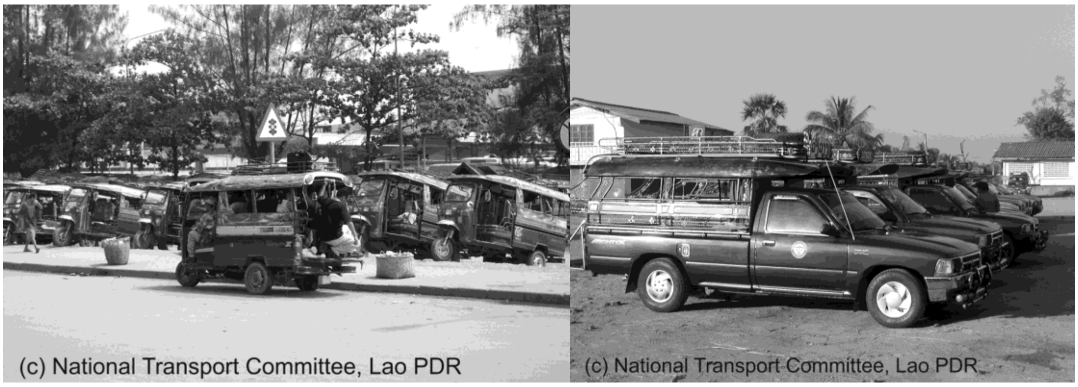

Abbildung 10: Öffentliche Verkehrsmittel in Asien: links dreirädrige Motorfahrzeuge (Tuk-tuk) und rechts umgebaute Pickup Trucks (Songtaew)

4 EINFLUSS DER UNTERSCHIEDE SÜDOSTASIEN – EUROPA AUF DAS FLÄCHENNUTZUNGS- UND VERKEHRSMODELL MARS

Die Unterschiede in der beobachteten Verkehrsmittelwahl machen die Einführung einer vierten Verkehrsmittelgruppe „Motorisierte Zweiräder“ unbedingt notwendig. Das Modell MARS berücksichtigt gegenwärtig den Zusammenhang zwischen Geschwindigkeit und Verkehrsmenge in der folgenden Form:

$$V_{ij}^{Pkw} = \frac{V_{ij}^{Pkw,0}}{1 + 0.15 * \left(A_{ij}\right)^{4}}$$

Gleichung 1: Der im Modell MARS verwendete Zusammenhang Geschwindigkeit – Verkehrsmenge (Pfaffenbichler 2003)

Legende:

V_{ij}^{Pkw}............ Geschwindigkeit des Pkw-Vekehrs im belasteten Straßennetz (km/h)

$V_{ij}^{Pkw,0}$.......... Geschwindigkeit des Pkw-Vekehrs im unbelasteten Straßennetz (km/h)

A_{ij}................ Auslastungsgrad (Verkehrsmenge durch Kapazität) (-)

Aufgrund des geringeren Platzbedarfs haben die in Gleichung 1 verwendeten Parameter für Motorräder keine Gültigkeit. Motorräder können sich an den vor Lichtsignalanlagen haltenden Pkw-Kolonnen vorbeischlängeln um sich in erster Reihe aufzustellen. Dadurch erreichen sie in hoch belasteten Zuständen eine höhere Durchschnittsgeschwindigkeit als Pkw. Die beiden Verkehrsmittel beeinflussen sich gegenseitig. Die Geschwindigkeiten hängen damit auch von der Verkehrszusammensetzung ab. Bislang wurde zu diesem Thema keine Literatur gefunden. Auch den Asiatischen Kollegen war zu diesem Thema nichts bekannt. Zwei mögliche Wege der Berücksichtigung der gegenseitigen Beeinflussung werden ins Auge gefasst. (Mailer, 2004) behandelte Fragen der Leistungsfähigkeit in Abhängigkeit von der Verkehrszusammensetzung Pkw, Lkw und Bus. Die Möglichkeit einer Adaption dieses Ansatzes wird untersucht. Als weitere Möglichkeit wird die Mikrosimulation eines Referenznetzes mit der Software VISSIM®[95] untersucht.

Es ist wahrscheinlich, dass der hohe Anteil an Einwohnern unter der Armutsgrenze Änderungen sowohl im Verkehrs- als auch im Flächennutzungssubmodell notwendig macht. Die derzeitige Version von MARS berücksichtigt die eingeschränkte Verkehrsmittelwahlmöglichkeit („Captive Riders“) in Haushalten ohne Pkw-Verfügbarkeit. In den Haushalten unter der Armutsgrenze besteht die Möglichkeit, dass auch der öffentliche Verkehr nicht leistbar ist und somit als einzige Möglichkeit die nicht motorisierte Verkehrsteilnahme bleibt. Im Lauf des Projekts soll untersucht werden, ob eine Einteilung in zwei Klassen von „Captive-Riders“ notwendig sein wird. Haushalte unter der Armutsgrenze haben selbstverständlich auch eingeschränkte Wahlmöglichkeiten im Hinblick auf die Wohnstandortwahl. Eine Unterteilung der Haushalte in Gruppen unter und über der Armutsgrenze scheint zu jetzigen Zeitpunkt notwendig und wird im Detail untersucht werden.

Eine detailliertere Abbildung der verschiedenen Verkehrsmittel des öffentlichen Verkehrs scheint erstrebenswert. Die Notwendigkeit dazu wird im Projektverlauf untersucht werden. Derzeit wird davon ausgegangen, dass die zuvor genannten Anpassungen von MARS höhere Priorität haben.

Abschliessend muss darauf hingewiesen werden, dass jede weitere Unterteilung des Modells den Aufwand der Datensammlung bzw. die Schwierigkeiten durch mangelnde Datenverfügbakeit erhöht. Zur Kalibrierung und Validierung[96] des Modells MARS sind Datensätze von mindestens drei verschiedenen Zeitpunkten notwendig, z.B.: die Volkszählungsjahre 1981, 1991 und 2001. Dieser

95 http://www.ptv.de

96 Unter Kalibrierung ist die Variation bestimmter Modellparameter mit dem Ziel der Übereinstimmung der Modellergebnisse mit beobachteten Daten zu verstehen. Unter Validierung wird die Überprüfung der Übereinstimmung der Simulationsergebnisse des kalibrierten Modells mit beobachteten Daten verstanden. Die in der Kalibrierung und Validierung verwendeten Datensätze müssen unbedingt verschieden sein! (Sterman 2000) argumentiert zu Recht, dass der Terminus Validierung streng genommmen nicht zulässig ist. Validierung und Verifizierung leiten sich vom lateinischen *verus* – Wahrheit ab. *„Nach diesen Definitionen kann kein Modell je verifiziert oder validiert werden. Warum? Weil alle Modelle falsch sind. ..., alle Modelle, mental oder formal, sind eingeschränkte, vereinfachte Abbildungen der realen Welt.“* (Sterman 2000) S. 846, eigene Übersetzung. Richtiger ist es, von Modelltests zu sprechen. Da sich der Begriff Validiering in der Modellpraxis eingebürgert hat, wurde er hier dennoch verwendet.

Vorgang gestaltete sich schon für die Europäischen Modelle aufwändig und schwierig (Pfaffenbichler 2003). Es muss davon ausgegangen werden, dass die Datenlage in Asien auch nicht optimal sein wird.

5 DAS INTEGRIERTE, DYNAMISCHE FLÄCHENNUTZUNGS- UND VERKEHRSMODELL MARS

MARS (Metropolitan Activity Relocation Simulation) ist ein aggregiertes, dynamisches Flächennutzungs- und Verkehrsmodell. Mit MARS können wahrscheinliche Entwicklungspfade urbaner Regionen für einen Zeitraum von 30 Jahren simuliert werden. Es wurde als Kernstück eines Bewertungs- und Optimierungssystems zur Beurteilung der Nachhaltigkeit von urbaner Regionen entwickelt. Das Modell basiert auf der Hypothese, dass Städte selbstorganisierende Systeme sind und daher die Prinzipien der Synergetik zur Beschreibung des kollektiven Verhaltens angewendet werden können. Aufbauend auf Wiener Forschungsergebnissen (Knoflacher and Pfaffenbichler 1999) wurde zuerst ein qualitatives Modell erstellt. Dabei kam die Methode der Causal-Loop-Diagramme zur Anwendung, um Ursache-Wirkungsbeziehungen darzustellen. Auf dieser Basis wurde ein quantitatives Modell entworfen und in Computercode transformiert. Am Beginn der Entwicklung von MARS stand dem Institut für Verkehrstechnik und Verkehrsplanung keine System Dynamics Software zur Verfügung, welche in der Lage gewesen wäre, einfach und effizient mit Matrizen und Vektoren zu operieren. Als Softwareentwicklungsumgebung wurde deshalb 1996 Visual Basic® für Applikationen und Excel® gewählt.

Modelltechnisch gesehen basierten die MARS Submodelle auf Gravitations- bzw. LOGIT-Modellen. Dieser Modellansatz wird für den Verkehrsteil wie auch dem Flächenutzungsteil angewandt. In beiden Fällen werden Ziel- und Quellpotentiale von Zonen berechnet und hinsichtlich so genannter Widerstandsfunktionen simultan verteilt. Die Widerstandsfunktionen im Verkehrsmodellteil basieren auf deutschen Forschungsergebnissen (Walther 1991; Walther, Oetting et al. 1997). Diese Widerstandsfunktionen können als generalisierte Kostenfunktionen mit subjektiver Gewichtung von Zugang-, Warte-, Umsteige- und Abgangszeiten verstanden werden. Für das Flächenutzungsmodell werden die Widerstandsfunktionen getrennt für Wohnzwecke und Arbeitsstättenentwicklung ermittelt. Hierbei werden Information bzgl. Arbeitsplätzen, Grundstückspreisen, Flächenverfügbarkeiten etc. mit den verkehrsmittelspezifischen Reisezeiten gewichtet, zur Berechung der Widerstände herangezogen. Mit MARS können strategische verkehrsplanerische und raumplanerische Maßnahmenbündel simuliert und ihre räumlichen und zeitlichen Auswirkungen auf die Stadtentwicklung abgeschätzt werden. Eine detaillierte Beschreibung von MARS bietet (Pfaffenbichler 2003). Die Entwicklung und Anwendung des Modells MARS wurde auch in mehreren CORP Beiträgen präsentiert (Pfaffenbichler and Emberger 2004; Pfaffenbichler and Emberger 2003; Pfaffenbichler and Emberger 2001).

5.1 Vorteile der Portierung von MARS auf VENSIM

Die Entwicklung von MARS erfolgte über einen Zeitraum von mehren Jahren. Softwaretechnische Beschränkungen von Visual Basic® machten eine Limitierung auf maximal 34 Verkehrszonen und drei Verkehrsmittel (Pkw, ÖV und Fußgeher) notwendig. Die ständige Weiterentwicklung des Modells innerhalb der letzten 8 Jahre erhöhte die Komplexität des Modells derart, dass, obwohl der Quellcode öffentlich verfügbar ist, das Modell heute praktisch ein Black-Box Modell ist. Die nachträgliche Hinzufügung von Funktionalitäten, wie zum Beispiel, der Einbau eines ÖV-Kapazitätsmodelles (public transport overcrowding model) erweist sich als schwierig und fehleranfällig. Zunehmende Rechnerleistung und die Erhöhung der elektronischen Verfügbarkeit von Inputdaten ermöglichen heute einen höheren Detaillierungsgrad. Eine Anhebung der möglichen Verkehrszonenanzahl und die Hinzunahme von weiteren Verkehrsmitteln wird daher angestrebt. Aus folgenden Gründen wurde die Entscheidung getroffen, MARS auf VENSIM® als neue Software Plattform zu portieren: Limitation der Zonenanzahl, Problematik der Erweiterbarkeit, die rasante Entwicklung der Computerleistung und Erhöhung der Datenverfügbarkeit und vor allem die Notwendigkeit, für das Projekt SPARKLE zusätzliche Verkehrsmittel zu berücksichtigen.

Die wichtigsten Vorteile dieser Portierung sind:

- einfache Kontrolle existierender Ursache-Wirkungsbeziehungen,
- die Kontrolle der Umsetzung dieser Ursache-Wirkungsbeziehungen in Programmcode,
- die Möglichkeit einer Restrukturierung der einzelnen Modellteile,
- die Möglichkeit eines schnellen „Prototypings“ durch die Verwendung der 4th Generation Language VENSIM®,
- die Möglichkeit das Modell mit relativ geringem Aufwand um neue Verkehrsmittel, Reisezwecke, verhaltenshomogene Personengruppen usw. zu ergänzen,
- die verbesserter Modellierung der Zeitdimension,
- die Nutzung der graphischen Ausgabemöglichkeiten der VENSIM® Programmierumgebung und
- die Nutzung der VENSIM® internen Optimierungsalgorithmen.

Die Verwendung von VENSIM® ermöglicht es ausserdem MARS nutzergruppenspezifisch darzustellen. Für Diskussionen mit Politiker zum Beispiel können nur die wichtigsten Ursache-Wirkungsbeziehungen dargestellt werden. Es ist durchaus denkbar, dass in Brainstormingsessions am Computer qualitative Ursachen-Wirkungsdiagramme (Causal Loop Diagramme – CLD) gemeinsam erstellt und diskutiert werden. Auf der anderen Seite ist es möglich mit versierten Verkehrs- und Landnutzungsmodellierern bis in die letzten Details der mathematischen Umsetzung der Ursache-Wirkungsbeziehungen hinabzusteigen. Ein wesentlicher Vorteil dieser Arbeitsweise ist, dass einerseits die Kommunikation gefördert und anderseits die Modellstruktur (oberster Level) mit dem Programmcode (unterster Level) fix verbunden ist. Um eine Kompatibilität mit dem existierenden MARS Modellen zu gewährleisten, werden die Inputdatenfiles weiterhin im Exceldateiformat belassen. Somit können Modelläufe bis auf weiteres auf beiden Plattformen durchgeführt werden.

6 ZUSAMMENFASSUNG

Das Projekt SPARKLE und damit auch die Adaptierung des dynamischen Flächennutzungs- und Verkehrsmodells wurde erst kürzlich gestartet (November 2004). Wenn auch nicht schon mit konkreten Lösungen aufgewartet werden kann, so ist die Anwendung des LUTI Models MARS in südostasiatischen Städten schon jetzt in zweierlei Hinsicht sehr interessant.

Auf der einen Seite ist die Kenntnis von modernen Planungswerkzeugen speziell für Entwicklungsländer von großer Bedeutung um zukünftige Herausforderungen bewältigen zu können. In SPARKLE wird versucht, diesbezügliches Wissen an Entscheidungsträger wie auch an Stadt und Verkehrsplanern in Form von Schulungen weiterzuvermitteln.

Auf der anderen Seite ist eine einfache Portierung existierender Werkzeuge und Modelle auf asiatische Verhältnisse nicht möglich und eröffnet somit einige sehr interessante Forschungsgebiete, dies es zu lösen gilt. Z.B. ergab der Vergleich flächennutzungs- und verkehrsrelevanter Indikatoren die Notwendigkeit, das Verkehrsmittel „Motorrad“ als eigenständigen Mode in MARS abzubilden. Mit der eigenständigen Modellierung des Verkehrsmittels „Motorrad“ wurde nach dem jetzigen Wissensstand ein neues, bisher auch in Asien unterbewertetes Feld der Verkehrsmodellierung betreten.

Weiters erscheint eine Unterteilung der Haushalte entsprechend ihrer Lage zur Armutsgrenze notwendig. Zusätzliche Adaptierungen, wie zum Beispiel die empirische Erhebung von Verhaltensdaten zur Modellkalibrierung, oder die Berücksichtigung von Bevölkerungswachstum, Altersverteilung der Bevölkerung und vom wirtschaftlichen Aufschwung ausgelöste Motorisierungsentwicklungen müssen ebenfalls in der Modeladaptierung berücksichtig werden.

Mit diesen notwendigen Änderungen stiess die derzeitige Visual Basic® basierte MARS Version an ihre softwaretechnischen Grenzen. Es wurde deshalb beschlossen, MARS im Zuge der Adaptierungsmaßnahmen auf die neue Softwareplattform VENSIM® zu portieren. Die Vorteile der Portierung sind neben der leichteren Erweiterbarkeit um Verkehrsmittel auch die bei weiten besseren Möglichkeiten der Modelkommunikation mit Entscheidungsträgern und aber auch mit Technikern.

Abschließend möchten wir nochmals festhalten, dass der Wissenstransferprozess von allen Projektmitgliedern nicht einseitig gesehen wird. Es ist <u>nicht</u> das Ziel des Projektes europäische Erkenntnisse <u>direkt</u> auf asiatische Städte zu übertragen. Natürlich wollen wir versuchen, die unterschiedlichen vergangenen, gegenwärtigen und zukünftigen Entwicklungen in Asien und Europa zu verstehen. Neben kulturgeschichtlichen sind auch wachstumsdynamische Effekte für diese Entwicklungen verantwortlich. Diese müssen von uns erst in Ihrer vollen Tragweite verstanden werden, um dann Adaptierungen der europäischen Vorgehensweisen auf asiatische Verhältnisse vornehmen zu können.

Im Namen aller an diesem Projekt Beteiligten möchten wir sagen, dass wir uns alle sehr auf die Herausforderungen im wissenschaftlichen wie auch in interkulturellen Bereich freuen, und unser Bestes zu einer Verständniserhöhung leisten wollen.

Schlussbemerkung

Wir bedanken uns bei den Reviewern für Ihre wertvollen Anregungen den Beitrag zu verbessern.

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GIS-gestützte Optimierung von Haltestellenstandorten im städtischen Nahverkehr

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1 EINLEITUNG

Aus standortplanerisch-regionalwissenschaftlicher Sicht ist bei der Versorgung von (Wohn-)Gebieten mit öffentlichem Verkehr (ÖV) darauf zu achten, dass die Erschließungsqualität für die Bewohner bzw. Beschäftigten optimiert wird. Linienführung und Anordnung der Haltestellen sind also in einer Weise zu wählen, die es gestattet, jedem Bewohner bzw. jedem Beschäftigten oder auch – modellhaft gesprochen – jeder statistischen Bevölkerungseinheit einen optimalen ÖV-Anschluss zur Verfügung zu stellen.

Neben anderen Parametern wie Nahversorgung, Lärm, Nähe zu Grün- und Freiräumen, Anbindung an den Individualverkehr, Zentrumsnähe etc. stellt auch die ÖV-Versorgung einen Teil der Standortqualität dar. Eine Verbesserung des ÖV-Anschlusses wirkt sich somit direkt proportional in einer Verbesserung der Qualität des betrachteten Standortes aus und steigert seine Attraktivität – in dieser Betrachtungsweise dient Haltestellenoptimierung als Mittel zur Standortaufwertung.

Die Schlüsselstellen einer ÖV-Wegekette liegen am Beginn und am Schluss. Werden die Zugangs- bzw. Abgangswege als zu beschwerlich empfunden, so wird der (wahlfreie) Verkehrsteilnehmer ein alternatives Verkehrsmittel bevorzugen. Diese Zugangs- und Abgangswege gibt es natürlich auch beim Individualverkehr (IV) – nur mit dem Unterschied, dass die Wege zum eigenen Auto auf Grund der derzeitigen Stadt- und Parkraumstruktur meist kürzer sind als die zur nächsten Haltestelle und daher auch als weniger unangenehm empfunden werden. Die Länge der Zugangswege zu ÖV und IV ist somit einer jener Parameter, mittels derer der Attraktivitätsunterschied beider Verkehrsarten beeinflusst werden kann. Dies kann bei dem genannten Parameter auf zwei Arten geschehen:

Entweder bringt man den Standort der parkenden Individualfahrzeuge weiter weg von den Quell- und Zielorten des Verkehrs. Diese Ansicht, zu der es übrigens bereits einige Abhandlungen gibt , ist allerdings nicht Gegenstand der vorliegenden Arbeit. Oder man bringt die ÖV-Haltestellen näher zu den Quell- und Zielorten des Verkehrs. In dieser Betrachtungsweise dient Haltestellenoptimierung als Mittel zur ÖV-Attraktivierung bzw. zur Verbesserung der Chancengleichheit zwischen ÖV und IV.

2 MODELLANSATZ

2.1 Betrachtungsweise der Linie, deren Haltestellenstandorte zu optimieren sind

Für den Haltestellenstandort-Optimierungsprozess wird nur eine einzige Linie gleichzeitig betrachtet. Eine Sichtweise im Kontext mit dem umgebenden oder ganzen öffentlichen Verkehrsnetz erfolgt nicht, da keinerlei Daten vorliegen, wie groß der Anteil der ÖV-Benutzer in den einzelnen statistischen Einheiten ist bzw. welche Ziele zu welchen Zeiten die Bevölkerung mittels ÖV anfährt. Aus diesem Grund werden in dem Modell Attraktivitäten von Zielen entlang oder in weiterer Entfernung von der Streckenführung nicht berücksichtigt. Die Standortoptimierung soll lediglich darauf abzielen, wahlfreien Verkehrsteilnehmern die Option „ÖV" attraktiver zu gestalten.

Da nun eine Linie ohne Berücksichtigung ihrer Rolle innerhalb des Gesamtnetzes betrachtet wird, ergeben sich zwei Einschränkungen für das Optimierungsmodell:

Der Streckenverlauf der Route hat gleich zu bleiben, da sich Routenänderungen eventuell auf andere Teile des gesamten ÖV-Netzes auswirken könnten. Eine Untersuchung solcher Auswirkungen ist in dem Optimierungsmodell allerdings nicht vorgesehen. Das Unverändert-Lassen der Linienführung stellt außerdem einen Vorteil für eine allfällige Umsetzung des Optimierungsmodells in die Praxis dar, da keine Änderung der Linienkonzession vonnöten ist.

Haltestellen, an denen Umsteigebeziehungen vorgesehen sind, behalten ihren Standort. Eine Veränderung von Umsteigebeziehungen hätte ebenfalls Auswirkungen auf die Struktur weiterer Teile des ÖV-Netzes und ist nicht Gegenstand dieser Arbeit.

2.2 Berechnung der Fußwege über das Straßennetz

Nachdem die Realisierung des Optimierungsmodells auf kleinräumiger Ebene vorgenommen wird, erscheint es notwendig, die darin vorkommenden Wege möglichst genau zu berechnen. Da die Berechnung ausschließlich auf Grund von Zugangswegen von Baublocks zu Haltestellen beruht, sind aus diesem Grund sämtliche Fußwege auf der Basis eines Verkehrsgraphen durchzuführen, der dem städtischen Straßennetz im betrachteten Bereich entspricht. Eine Annäherung an Gehdistanzen mittels Messung der Luftlinienentfernung ist als zu ungenau abzulehnen.

Jeder Fußweg setzt sich somit aus drei zu berechnenden Komponenten zusammen:

Weg vom Quellort (Wohnungstür bzw. Baublockgrenze) zum nächstgelegenen und zielführenden Knoten des Verkehrsnetz-Straßengraphen.

zurückzulegender Weg innerhalb des Straßengraphen

Weg vom Zielknoten des Straßengraphen bis zum tatsächlichen Standort der Haltestelle.

Zum letzten Punkt ist anzumerken, dass diese Entfernung durchaus auch im direkten Verfahren, also mittels Luftlinie, berechnet werden kann, da die Standorte von Haltestellen üblicherweise im Bereich des Straßennetzes liegen und somit an einer der an den Zielknoten angrenzen Kanten – meist sogar in unmittelbarer Nähe des Zielknotens, da sich die Mehrzahl aller Haltestellen im Straßenverlauf direkt vor oder nach Straßenkreuzungen befindet.

2.3 Gegenüberstellung verschiedener Bewertungsergebnisse

Für die Bewertung der bestehenden und der im Optimierungsmodell errechneten Haltestellenstandorte soll die Möglichkeit bestehen, die Berechnung mit unterschiedlicher Gewichtung der einzelnen Standortfaktoren durchzuführen. Da unterschiedliche Gewichtsverteilungen bei mehreren Modelldurchläufen für abweichende Ergebnisse sorgen können, ist es notwendig, die Ergebniszahlen zu normieren. Die Normierung ermöglicht es, Ergebnisunterschiede im direkten Vergleich einander gegenüber zu stellen und sich auf Grund dessen für eine Faktorengewichtung zu entscheiden, die den jeweiligen örtlichen und (netz-)strukturellen Gegebenheiten besser gerecht wird.

Für die Normierung der Ergebnisse der Standortbewertung bietet sich ein fixes Intervall – beispielsweise [0;1] oder [0;100] – an. Auch die Bestandssituation kann zu Vergleichszwecken herangezogen werden, da diese unveränderlich ist und für dieselbe Gewichtsverteilung bei den Standortfaktoren immer dasselbe Ergebnis liefert. Der Output des Optimierungsprozesses kann sodann in Relation zur Bestandsbewertung gesetzt werden – ein Vergleich dieser relativen Ergebnisgrößen ist von großem Nutzen für die Überlegung, welche Gewichtsverteilung bei der Berechnung der einzelnen Standortfaktoren von Vorteil ist. Durch die Normierung auf ein fixes Intervall ist ein Vergleich mit dem Bestand nicht zwingend nötig, um die Güte des Ergebnisses abschätzen zu können; somit ergibt sich auch die Möglichkeit, den Optimierungsprozess für neu zu planende Routen einzusetzen, für die noch keine Haltestellen existieren.

2.4 Weitestgehend automatisierter Verfahrensablauf

Das Optimierungsmodell soll als Programm weitgehend automatisiert ablaufen und die Kommunikation mit dem Benutzer auf den Beginn der Gesamtprozedur beschränken. Diese Forderung erscheint auf Grund der längeren Rechenzeiten während des Optimierungsprozesses – für eine kürzere Linie können dies bereits einige Stunden sein – notwendig. Vor dem Programmstart hat der Benutzer die benötigten Daten an dem dafür vorgesehenen Ort bereitzustellen; nach der Eingabe der Werte für gewisse vom Programm benötigte Parameter sollen Bestandsbewertung, Optimierung und Visualisierung der Ergebnisse ohne weiteres Zutun des Benutzers erledigt werden. Dabei ist vor allem auf eine klare und unmissverständliche Benutzerführung zu achten. Alle für die Berechnung notwendigen Zwischenergebnisse sind temporär und für den Benutzer unsichtbar zu speichern, da sie für das Endergebnis irrelevant sind. Zu Kontrollzwecken muss das Löschen der Zwischenergebnisse selbstverständlich unterbunden werden können.

3 EINSATZ EINES GENETISCHEN ALGORITHMUS ZUR STANDORT-OPTIMIERUNG

3.1 Kurzabriss über die Funktionsweise genetischer Algorithmen

Genetische Algorithmen ahmen jene Vorgänge nach, die in der Natur bei der Fortpflanzung von Organismen auf molekularbiologischer Ebene ablaufen, und ermöglichen es, mittels „virtueller Evolution“ Problemlösungen zu errechnen. Dazu ist es notwendig, die Parameter des jeweils anstehenden Problems in die Sprache der Genetik zu übersetzen, um die folgenden Schritte des Algorithmus durchführen zu können:

1. Initialisierung einer Population bestehend aus Individuen;
2. Bewertung der Fitness eines jeden Individuums;
3. Auswählen der Individuen für das Crossover;
4. Durchführen von Paarung und Crossover (Rekombination);
5. Bewertung der Fitness der neuen Individuen;
6. Überprüfen der Abbruchkriterien – falls diese nicht erfüllt werden, weiter mit Schritt 3.

Bevor auf die einzelnen Schritte des Algorithmus näher eingegangen wird, seien zunächst die verwendeten Fachbegriffe einer genaueren Definition unterzogen: Unter „Individuum“ versteht man eine Trägereinheit von Erbinformation. Die Erbinformation ist auf Chromosomen aufgebracht. Einzelne Abschnitte von Chromosomen, die jeweils für ein bestimmtes Merkmal des Individuums verantwortlich sind, werden als Gene bezeichnet. Die Gene entsprechen Werten bestimmter Parameter des zu behandelnden Problems und werden im genetischen Algorithmus üblicherweise durch Zahlencodes, z. B. Binärstrings, ausgedrückt.

Alle Individuen, die gleichzeitig (in einer Generation, d. h. innerhalb eines Iterationsschrittes des genetischen Algorithmus) vorhanden sind, nennt man Population. Die Evolution erfolgt schrittweise von einer Generation zur nächsten; hierbei gilt das darwinistische Prinzip „Survival of the fittest“. Individuen mit höherer Fitness haben eine größere Wahrscheinlichkeit, für die nachfolgende Generation als Elternteil herangezogen zu werden und so ihre Merkmale vererben zu können.

Zu Schritt 1: Zu Beginn des genetischen Algorithmus wird eine Ausgangspopulation mittels Zufallsgenerator erzeugt. Im Normalfall kann davon ausgegangen werden, dass an dieser Stelle Individuen mit Fitnesswerten von „sehr schlecht“ über „durchschnittlich“ bis „sehr gut“ vorhanden sind.

Zu Schritt 2: Bei der Bewertung der Fitness jedes einzelnen Individuums müssen zunächst die Gene wieder in die eigentlichen Parameter des zu behandelnden Problems rückübersetzt werden. Diese Parameter werden in die Zielfunktion des Modells eingesetzt und liefern einen Funktionswert, der von einer Lösung der Funktion mehr oder weniger weit entfernt ist. Die Individuen mit den besseren Funktionswerten erhalten höhere Fitnesswerte als jene, deren rückübersetzte Gene für ein schlechteres Ergebnis gesorgt haben.

Zu Schritt 3: Die Auswahl der Individuen für die Erzeugung der Nachfolgegeneration kann auf mehrere Arten erfolgen. Auf jeden Fall muss jedoch darauf geachtet werden, dass Individuen mit hoher Fitness mit großer Wahrscheinlichkeit für die Fortpflanzung ausgewählt werden, während dies bei den schlechter geeigneten Individuen genau umgekehrt ist.

Zu Schritt 4: Die Paarung erfolgt mittels Crossover. Hierbei werden die Chromosomen von zwei Individuen, die als Elternteile fungieren, an den gleichen Stellen „zerschnitten“ und überkreuzt, sodass neue Genkombinationen entstehen, die zuvor noch nicht existiert haben (vgl. Abb. 1). An welchen Stellen die Chromosomen zerschnitten werden, wird durch einen Zufallsgenerator bestimmt. Auch die Anzahl der Schnitte pro Crossover (in der Abbildung: 2 Schnitte) kann frei gewählt werden; in der Praxis ist es üblich, sie mit 1 oder 2 festzulegen.

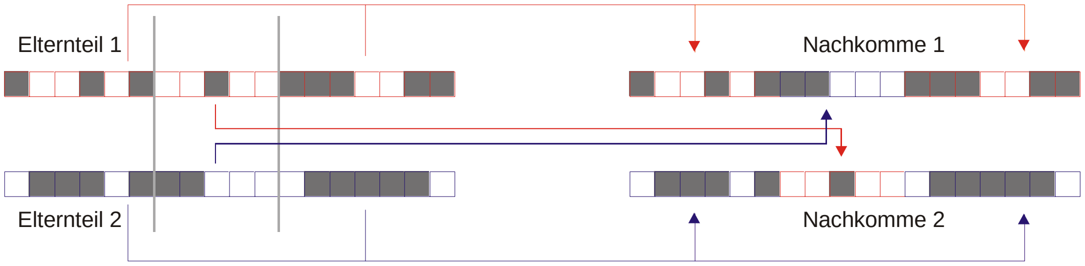

Abb. 1: Fortpflanzung im genetischen Algorithmus mittels Crossover. Quelle: eigene Darstellung.

Je nach Erfordernis kann nach dem Crossover auch die Möglichkeit zur Mutation im Algorithmus vorgesehen werden (vgl. Abb. 2). Bei einer Mutation wird der Zustand eines einzelnen, durch Zufall bestimmten Gens verändert. So wie in der Natur zufällige Mutationen über Generationen hinweg für die Anpassung der Arten an ihre Lebensbedingungen sorgen, so dient die Mutation im genetischen Algorithmus dazu, durch Zufall Lösungswege zu finden, die nur durch die Fortpflanzungsmechanismen nicht zustande gebracht werden könnten, da diese lediglich danach trachten, Bestehendes zu verbessern, aber nicht, Neues zu entwickeln.

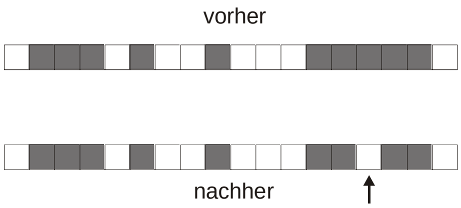

Abb. 2: Mutation im genetischen Algorithmus. Quelle: eigene Darstellung.

Zu Schritt 5: Nachdem in den vorangegangenen Schritten die Nachfolgepopulation (d. h. die nächste Generation) entstanden ist, sind nun deren Individuen analog zu Schritt 2 zu bewerten.

Zu Schritt 6: Genetische Algorithmen finden nicht zwingend die optimale Lösung für ein Problem. Sie sind jedoch in der Lage, Lösungen zu finden, die einem eventuell vorhandenen Optimum sehr nahe kommen. Aus diesem Grund muss mittels Abbruchkriterien nach jeder Iteration geprüft werden, ob weitere Iterationen noch zielführend sind. Falls für das zu lösende Problem nicht bekannt ist, ob – und wenn ja, wo – zufrieden stellende bzw. optimale Lösungen existieren, kann auch das Erreichen einer bestimmten Anzahl von Iterationsschritten als Abbruchkriterium herangezogen werden.

3.2 Vergleich genetischer Algorithmen mit „traditionellen" Optimierungsverfahren

Gleich zu Beginn dieses Abschnitts sei auf einen wesentlichen Unterschied zwischen genetischen Algorithmen und herkömmlichen Optimierungsmethoden hingewiesen: Während „traditionelle" Verfahren tatsächlich – so vorhanden – ein Optimum der problemspezifischen Zielfunktion als Resultat ausgeben (aber für dessen Berechnung mitunter sehr lange brauchen), finden genetische Algorithmen ein eventuell vorhandenes Optimum nicht zwangsläufig. Die meist kürzere Rechenzeit von genetischen Algorithmen bei komplexen Zielfunktionen liefert meist ein Ergebnis, das einer Optimallösung sehr nahe kommt – doch im Prinzip kann selbst das nicht garantiert werden, da genetische Algorithmen auf wahrscheinlichkeitsgesteuerten Vorgängen basieren und nicht, wie andere Problemlösungsverfahren, deterministisch arbeiten.

Die schnellere Rechenzeit bei genetischen Algorithmen kommt unter anderem dadurch zu Stande, dass diese Algorithmen gleich von Beginn an mit einer ganzen Reihe von möglichen Problemlösungen rechnen, anstatt nur von einem einzigen Punkt auszugehen, wie dies bei herkömmlichen Methoden der Fall ist. In der Fachliteratur wird dieser Umstand bei genetischen Algorithmen, der die Suche nach der optimalen Lösung stark beschleunigt, als „impliziter Parallelismus" bezeichnet.

Während bei traditionellen Optimierungsverfahren oft mit abgewandelten bzw. abgeleiteten Formen der ursprünglichen Zielfunktion gerechnet werden muss, kann im genetischen Algorithmus die Zielfunktion in der Bewertung jedes einzelnen Individuums direkt angewendet werden. Daher können gewisse Einschränkungen, wie Kontinuität und Differenzierbarkeit der Zielfunktion als Voraussetzung für die Rechenbarkeit des Modells oder Ungenauigkeit durch (zwangsweise) Umformung der ursprünglichen Funktion bzw. der problembezogenen Daten, vermieden werden.

3.3 Arten der Merkmalscodierung auf Chromosomen bei genetischen Algorithmen

Die (klassische) binäre Codierung ist jene, die dem Vorbild Natur am nächsten steht. Die verschiedenen Merkmale, die ein Individuum aufweisen kann, werden durch Binärzahlen bestimmt; weist ein Individuum mehrere Merkmale zugleich auf, werden einfach mehrere Binärzahlen hintereinander gesetzt, die zusammen das Chromosom des Individuums ergeben. Im nachfolgenden Beispiel ist ein Individuum dargestellt, das drei Merkmale aufweist, nämlich – wie sich aus der Umwandlung der Binärzahlen in Dezimalzahlen ergibt – die Merkmale 37, 12 und 59.

`100101001100111011`

Crossover ist bei dieser Form der Codierung an jeder Stelle des Chromosoms möglich; bei der Mutation wird an einer – durch Zufallsgenerator bestimmten – beliebigen Stelle 0 in 1 bzw. 1 in 0 verwandelt. Die Anzahl der Merkmale pro Individuum – hier z. B. drei – wird fix vorgegeben. Ein Nachteil dieser Methode ist allerdings, dass die Anzahl der möglichen Merkmalsausprägungen genau einer Zweierpotenz (2^n) entsprechen muss, da es andernfalls durch die evolutorischen Prozesse zur Ausbildung ungültiger Individuen kommen kann, deren Binärcode keiner existierenden Merkmalsausprägung entsprechen würde. Weiters wird die Bitsequenz bei gleichzeitigem Auftreten vieler Merkmale innerhalb eines Individuums schnell sehr lang, was den Speicherbedarf erhöht und die Rechengeschwindigkeit herabsetzt.

Eine andere Form der Binärcodierung ist die „Ein/Aus"-Codierung. Die Anzahl der Bits im Chromosom entspricht hierbei genau der Zahl an möglichen Merkmalsausprägungen. Für das oben abgebildete Chromosom würde eine Interpretation nach dieser Methode bedeuten, dass bei diesem Individuum von insgesamt 18 möglichen Merkmalen die Merkmale 1, 4, 6, 9, 10, 13, 14, 15, 17 und 18 vorhanden sind. Alle anderen Merkmale weist dieses Individuum nicht auf. Auch bei dieser Methode sind Crossover und Mutation an jeder beliebigen Stelle des Chromosoms möglich und funktionieren in der gleichen Weise wie bei der klassischen binären Codierung.

Der Einsatz der „Ein/Aus"-Codierung ist überall dort unvorteilhaft, wo das Verändern von Merkmalen und nicht das bloße Hinzufügen oder Entfernen selbiger verlangt wird. Wenn die Anzahl der Merkmale pro Individuum gleich bleiben soll, wird diese Methode hauptsächlich ungültige Resultate erzeugen, da eine exakte Anzahl gesetzter Bits durch den Zufallsgenerator nur bei einem geringen Prozentsatz aller Individuen erreicht wird. Der Rest müsste als Ausschuss gelten oder erst durch einen zusätzlichen Reparaturalgorithmus in die passende Form gezwängt werden.

Die Codierung mit Dezimalzahlen entspricht weitgehend der klassischen Binärcodierung. Der Unterschied besteht lediglich darin, dass die Umwandlung ins Binärsystem nicht stattfindet. Das in diesem Abschnitt verwendete Beispielindividuum wäre daher nicht durch die abgebildete Bitsequenz identifiziert, sondern durch die Aneinanderreihung der dezimalen Nummern seiner Merkmale – für das erwähnte Beispiel also 371259.

Bei Crossover und Mutation gelten für diese Codierung einige Einschränkungen: Das Crossover kann nur an jenen Stellen erfolgen, wo die Dezimalzahlen aneinander stoßen, da sonst ungültige Codes entstehen könnten. Bei der Mutation muss eine komplette Dezimalzahl gegen eine andere – zufallsgesteuert erzeugte – ausgetauscht werden, da beim Mutieren nur einzelner Ziffern die Resultate ebenfalls ungültig sein könnten. Ansonsten gelten für diese Methode die gleichen Eigenschaften wie für die klassische Binärcodierung – mit einer Ausnahme: Die Anzahl der möglichen Merkmalsausprägungen muss nicht genau einer Zweierpotenz (2^n) entsprechen, sondern kann beliebig sein.

Der im Rahmen dieser Arbeit verwendete genetische Algorithmus basiert auf der Verwendung von Dezimalzahlen. Eine Dezimalzahl steht für eine zu positionierende Haltestelle. Die Bezeichnungen für die neuen Haltestellen sind bereits so gewählt, dass in ihren Namen der vom genetischen Algorithmus verwendete Dezimalcode bereits enthalten sind. Da die Code-Teile zur späteren Entschlüsselung dieselbe Länge aufweisen müssen, werden jenen Zahlen, deren Ziffernzahl kleiner als die maximal vorgesehene Ziffernanzahl ist, führende Nullen vorangestellt. *(Beispiel: 20 verschiedene Haltestellenstandorte stehen zur Auswahl; diese sind von 0 bis 19 durchnummeriert. Die maximale Ziffernanzahl für eine dieser Zahlen ist 2, daher muss den Zahlen von 0 bis 9 jeweils eine führende 0 vorangestellt werden, sodass die Nummerierung 00..09, 10..19 lautet.)*

4 AUFBAU DER ZIELFUNKTION FÜR DIE STANDORTBEWERTUNG

Für die Standortoptimierung mittels genetischen Algorithmus ist eine Zielfunktion nötig, um verschiedene Standortkombinationen miteinander vergleichen und in der Folge die optimale Standortverteilung finden zu können. Auch die bestehende Haltestellensituation kann mit derselben Zielfunktion bewertet werden – somit wird ein direkter Vergleich von derzeitigem Bestand und berechneter Optimallösung ermöglicht. Auch in verschiedenen Betrachtungsgebieten durchgeführte Berechnungen können durch die Normierung des Ergebnisses – es befindet sich in jedem Fall im Intervall [0;1] – miteinander verglichen werden.

4.1 Gehdistanz zur nächstgelegenen Haltestelle

Die optimale fußläufige Erreichbarkeit einer Haltestelle ist gegeben, wenn die Gehdistanz vom jeweiligen Baublock zur nächstgelegenen Haltestelle möglichst kurz ist. Da nur eine ÖV-Linie isoliert betrachtet wird, ist es nicht notwendig, die Distanzen zu weiteren, entfernter gelegenen Haltestellen zu bewerten, da der potenzielle Fahrgast den kürzest möglichen Fußweg bewältigen wird, um zu einer Haltestelle der betrachteten Linie zu gelangen. Für die Zielfunktion wird daher jedem Baublock genau ein Distanzwert, i. e. jener zur nächstgelegenen Haltestelle, zugewiesen (MinDist-Modell). Die Entfernung vom Baublock zur Haltestelle wird durch eine geteilte Funktion indirekt proportional mit Nutzenpunkten auf einer Skala von 0 bis 1 bewertet.

4.2 Wohnbevölkerung im betrachteten Gebiet

Die für die Bewertung herangezogenen Baublockabschnitte sind unterschiedlich dicht bzw. teilweise gar nicht bewohnt. Um die Relevanz eines jeden Baublockabschnittes in die Bewertungsfunktion einfließen zu lassen, erscheint es nahe liegend, die Bevölkerungszahl als Gewichtungsfaktor für die Nutzenpunkte der jeweiligen Gehdistanzen heranzuziehen. Fußwege von stark oder dicht bewohnten Baublockabschnitten zur nächstgelegenen Haltestelle bekommen hierdurch einen stärkeren Einfluss auf das Ergebnis des Optimierungsprozesses.

4.3 Abstand der Haltestellen zueinander

Ein weiterer Faktor in der Nutzenfunktion ist der Abstand der Haltestellen zueinander. Eine gleichmäßige Verteilung entspricht einer optimalen Flächenerschließung, während eine ungleichmäßige Verteilung eventuell Bevölkerungsschwerpunkte besser berücksichtigen, aber auch gleichzeitig dünner besiedelte Gebiete benachteiligen könnte.

Als Bewertungsgrößen können Schrankenwerte festgelegt werden: Das Unterschreiten eines Minimalabstandes oder das Überschreiten eines Maximalabstandes verringern den Gesamtnutzen einer Variante. Für die innerhalb dieser Schranken liegenden Abstandswerte ist die Abweichung vom mittleren Haltestellenabstand maßgeblich; dies lässt sich z. B. über die Summen der absolute

Differenzen zum Mittelwert oder mittels der Standardabweichung messen. Für die Programmierung des Modellprototyps wurde die Berechnung mittels der absoluten Differenz zum Mittelwert gewählt.

Die Zahl der neu zu bestimmenden Haltestellenstandorte wird zu Beginn des Optimierungsprozesses festgelegt und ist nicht veränderlich; bei Optimierung der Haltestellenstandorte einer bereits bestehenden Route entspricht sie der Anzahl an ursprünglich vorhandenen Haltestellen, die zuvor für die Standortoptimierung freigegeben wurden. Deshalb wäre es auch hier möglich, das Bewertungsergebnis des Bestands als Vergleichsgröße heranzuziehen bzw. Ergebnisse aus unterschiedlichen Betrachtungsgebieten einander direkt gegenüber zu stellen.

4.4 Gewichtung der Bewertungsfaktoren

Die Gesamtzahl an Nutzenpunkten je Haltestellenkombination setzt sich aus zwei Teilbeträgen zusammen: Die Güte einer Kombinationsvariante wird einerseits von den zurückzulegenden Gehdistanzen bestimmt, andererseits von der Verteilung der Haltestellen entlang der Linienführung. Da die Möglichkeit bestehen soll, den Einfluss eines jeden der beiden Teile der Nutzungsfunktion auf den Gesamtnutzen unterschiedlich stark festzulegen, ist eine komplementäre Gewichtung beider Größen vorgesehen. Komplementäre Gewichte ergänzen einander immer auf 100 %, d. h. wenn beispielsweise die eine Größe einen Einfluss von 70 % auf das Gesamtergebnis haben soll, so wird der anderen Größe automatisch ein Gewicht von 30 % zugeschrieben.

Die Stärke des Einflusses der Bevölkerungszahl auf den Teilnutzen aus den Fußwegdistanzen ist hingegen unabhängig von den anderen Gewichten, da diese Gewichtung direkt in Bezug auf die räumlichen Einheiten vorgenommen wird und in keiner direkten Beziehung zu einer anderen Gewichtsgröße steht.

5 ZUSAMMENFASSUNG

In dieser Arbeit wurde der Prototyp eines Modells zur Optimierung der Haltestellenstandorte im städtischen öffentlichen Personennahverkehr entwickelt, das einerseits darauf abzielt, die Fußwege zwischen Wohnort und der nächstgelegenen Haltestelle einer auszuwählenden Linie möglichst gering zu halten. Es besteht andererseits aber auch die Möglichkeit, auch auf gleichmäßige Verteilung der Haltestellen entlang der befahrenen Route zu achten. Diese beiden Faktoren, die den Hauptbestandteil der Zielfunktion für den Optimierungsprozess darstellen, sind komplementär gewichtet. Außerdem kann die subjektive Distanzempfindung – weitere Wege werden vom Menschen als überproportional lang empfunden, während kurze Wege dazu neigen, unterschätzt zu werden – durch einen Zeitbewertungsfaktor in das Modell einbezogen werden.

Die Berechnung der zurückzulegenden Fußwege erfolgt nicht über die Luftliniendistanz, da dies für den Betrachtungsmaßstab zu ungenau wäre, sondern wird über das Straßennetz berechnet. Dazu ist es notwendig, sowohl Quelle als auch Ziel dieser Fußwege an das Straßennetz anzubinden. Die Berechnung der ÖV-Versorgungsqualität jeder räumlichen Einheit erfolgt mit dem MinDist-Modell, das davon ausgeht, dass nur ein Attraktor, d. h. nur eine Haltestelle, und zwar die am nächsten liegende, für die Qualität eines Standortes Maß gebend ist. Das bedeutet, dass jede räumliche Einheit mit genau einer Haltestelle verknüpft wird. Die Güte dieser Verknüpfung ist von der (über das Straßennetz berechneten) Entfernung abhängig.

Im vorliegenden Optimierungsmodell wird jeweils eine ÖV-Linie ohne Berücksichtigung ihrer Rolle innerhalb des Gesamtnetzes betrachtet. Die Haltestellenstandorte werden unter Beibehaltung der von der Linie befahrenen Route optimiert. Dabei besteht die Möglichkeit, gewisse Haltestellen – etwa Endstationen oder Umsteigeknoten – von der Optimierung auszuschließen und deren bereits existierenden Standort beizubehalten.

Der Optimierungsprozess selbst läuft mit Hilfe eines genetischen Algorithmus ab: In Nachahmung evolutionsbiologischer Vorgänge in der Natur wird in einem iterativen Verfahren eine – anfangs durch Zufallsgenerator ermittelte – Situation stufenweise auf Basis einer Zielfunktion verbessert. Genetische Algorithmen liefern nicht zwangsweise das globale Optimum der Zielfunktion; sie sind aber bei guter Konfiguration der nötigen Parameter in der Lage, ein Ergebnis zu finden, das der Optimallösung zumindest sehr nahe kommt. Die Qualität der Population wird von Generation zu Generation evolutorisch verbessert.

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Das Projekt VEMA – Stand Jänner 2005

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1 DAS PROJEKT VEMA – STAND 2005

Das Projekt Vema (Verkehrsmanagement Region Wien) wurde von der Stadt Wien im Jahre 2000 zur Entwicklung eines kooperativen Verkehrsmanagements für die Region Wien gestartet. Darin soll in enger Zusammenarbeit mit den Projektpartnern Niederösterreich, Burgenland, bmvit, Polizei, ASFINAG, VOR, Wiener Linien und ÖBB eine Organisationsstruktur aufgebaut werden, die künftig einen systematischen Informationsaustausch zwischen den Verkehrsbetreibern, die Zusammenführung und Nutzung von Verkehrsdaten und eine strategische Verkehrssteuerung und –information erlauben wird. Neben diesem Integrationsprojekt betreibt jeder Projektpartner seine betrieblichen Projekte (Rechnergestützte Betriebsleitsystem, Verkehrsbeeinflussungsanlage, Elektronische Fahrplanauskunft,...) unabhängig, aber in Abstimmung mit Vema, da sie komplementäre Steuerungsbereiche des Verkehrssystems abdecken. Sie sind auf den optimalen Betrieb des jeweiligen Partners ausgerichtet und können zumeist ohne Verlust an betrieblicher Wirksamkeit in kooperative Strategien eingebunden werden. Das hat den Vorteil, dass zusätzliche Aufwände minimiert werden, und die Vorzüge aus allen Projekten allen Partnern zugute kommen. Darüber hinaus können die Strategien abgestimmt werden und stehen für die Maßnahmenentscheidungen im sektoralen Betriebssystem globale Informationen zur Verfügung.

Das Verkehrsmanagement Ostregion besteht im Wesentlichen aus zwei Teilen:

dem Verkehrslagebild, das aus den Daten eines regionalen Verkehrsdatenverbundes erzeugt wird, und

der Organisation, die das Verkehrslagebild betreibt und die Projektpartner koordiniert.

Zur CORP 2004 durfte ich Ihnen dieses Projekt auf dem damaligen Entwicklungsstand vorstellen. Im vorliegenden Beitrag möchte ich Ihnen über die Projektfortschritte des abgelaufenen Jahres berichten und einige in diesem Zeitraum realisierte Teilprojekte der Stadt Wien kurz vorstellen.

1.1 Verkehrsdatenverbund

Das „Systemkonzept für den Verkehrsdatenverbund“[97] beschreibt die Architektur der ersten Ausbaustufe des Verkehrsdatenverbundes der Region Wien und die zu seiner Erstellung und Fortführung erforderlichen Schritte. Es wurde abgeschlossen und abgenommen.
Aufgrund der Erkenntnisse der prototypischen Bearbeitung von Testgebieten und der intensiven Diskussionen zwischen den Projektpartnern wurde zur Ergänzung des Systemkonzepts die Studie „Verkehrsbezugssystem Ostregion“[98] beauftragt, die ebenfalls abgeschlossen werden konnte und den Projektpartnern vorliegt. Die Analyse ging von folgender Charakterisierung der Situation im Bereich digitaler Verkehrsnetze In der Ostregion aus:

Es existiert eine große Anzahl an parallel und teilweise auch überlappend (redundant) entwickelten digitalen Verkehrsnetzen.

Diese sind oft vor dem Hintergrund unterschiedlicher Zielsetzungen entstanden (beispielsweise ÖV-Fahrplanauskunft vs. Straßenverwaltung) und damit sowohl inhaltlich als auch datenstrukturell kaum miteinander vergleichbar.

Die Wartung dieser digitalen Verkehrsnetze ist mit einem hohen Aufwand verbunden und erfolgt vielfach redundant (Überschneidungen beispielsweise zwischen VOR und den Bundesländern bzw. zwischen unterschiedlichen Bearbeitern von Verkehrsmodellierungsnetzen).

Aussagen mit Bezug auf Verkehrsplanung und Verkehrsmanagement können daher derzeit nicht auf verlässliche Art und Weise über Ländergrenzen beziehungsweise Zuständigkeitsgrenzen hinweg getätigt werden.

Diese Situation erschwert den Datenaustausch – sowohl zwischen den Partnern als auch mit Dritten – und beeinträchtigt die Möglichkeiten der Informationsnutzung im Planungsfall oder im Verkehrsmanagement.

In den bestehenden Graphen ist derzeit die Abbildung der Intermodalität noch nicht bzw. nur in geringem Ausmaß gegeben. Intermodales Verkehrsmanagement oder intermodale Navigationshinweise sind damit derzeit nicht (flächendeckend und verlässlich) möglich.

Nach vielen Diskussionen und aufwändigen Vergleichen der unterschiedlichen Datenmodelle kam die Studie zum Ergebnis, dass für den Erfolg des Projekts Verkehrsdatenverbund Ostregion folgende Voraussetzungen wesentlich sind:

Die unterschiedlichen Anforderung der Partner an ihre Graphen führen zu grundsätzlich unterschiedlichen technischen und organisatorischen Lösungen. Diese Unterschiedlichkeit zu würdigen und einen gemeinsamen Nenner zu finden, der die vorhandenen gemeinsamen Bedürfnisse im Bezug auf gegenseitige Information und Datenabgleich berücksichtigt, ist eine Voraussetzung für eine gelungene Zusammenarbeit aller Beteiligten.

Die Initiativen, die in der Ostregion im Bereich Verkehrsmanagement und Verkehrsinformation entwickelt werden, sind die Basis für den Verkehrsdatenverbund Ostregion. Das zentrale Ziel des Verkehrsdatenverbunds ist es, die Synergien, die sich aus den einzelnen Projekten ergeben können, zu nützen.

Das VBO nützt – wo immer möglich - technische Lösungen und Ansätze, die bei den Initiativen der Partner entwickelt oder verwendet werden. Die Schnittstellen orientieren sich einerseits an offenen Standards und andererseits an vorhandenen Schnittstellen zu den Systemen der Partner.

[97] Beauftragt von der Stadt Wien (MA 46 und MA 14-ADV) an die Büros Rosinak & Partner und Axmann GeoInformationssysteme

[98] beauftragt vom Land Niederösterreich an die Büros Rosinak & Partner und Prisma Solutions

Um den laufenden Overhead beim Betrieb des VBO zu minimieren, wird empfohlen, auf vorhandene organisatorische Strukturen und Infrastruktur bei den Partnern zurückzugreifen.

Das ambitionierte längerfristige Ziel, die Graphen synchron abzugleichen, wird über einen sicheren Weg erreicht. Dabei wird mit einem überschaubaren Ansatz (Integrator) begonnen. Der weitere Ausbau wird von den dabei gewonnenen Erfahrungen und den Möglichkeiten und Bedürfnissen der Partner getrieben.

1.2 Organisationskonzept

Im Organisationskonzept wurden unterschiedlich geeignete staatliche bis private Organisationsformen geprüft. Als geeignetste Form wurde eine gemeinsam betriebene, gemeinnützige Dachgesellschaft vorgeschlagen. Die Gesellschaft soll die folgenden Aufgaben erfüllen:

Aufbau und Betrieb des Verkehrsdatenverbundes und eines gemeinsamen Verkehrslagebildes entsprechend dem unten beschriebenen Systemkonzept.

Kooperatives Strategiemanagement ohne Eingriffe in die dezentralen Entscheidungsbefugnisse: Das Strategiemanagement soll – beginnend mit der Planung vorhersehbarer Ereignisse und Veranstaltungen – im Laufe der Fortentwicklung die Kompetenz aufbauen, kooperative Strategien zu erarbeiten zu prüfen und zu managen. Diese Strategien werden den Partnern Handlungsempfehlungen und den Bürgern Verhaltensempfehlungen vorschlagen. Hierzu werden in den ersten Ausbauphasen auf der Basis der archivierten Daten und der Erfahrungen der Projektpartner vorhersehbare Ereignisse (Großbaustellen, Veranstaltungen usw.) durchgeplant. Mit zunehmender Erfahrung sollte es möglich werden, auch auf unvorhersehbare Ereignisse immer besser zu reagieren. Dazu müssen für diese Verkehrslagen komplexe Szenarien definiert, Lösungsstrategien erarbeitet, simuliert, evaluiert und zwischen den Projektpartnern vorweg abgestimmt werden. Diese bilden die Vorgaben für ein synchronisiertes, zielgerichtetes Verhalten der Projektpartner im Auslösungsfall. Im Endausbau werden automatisch die festgelegten Strategien ausgelöst, da aufgrund der laufenden automatisierten Beobachtung des Verkehrslagebildes krisenhafte Entwicklungen frühzeitig erkannt und bezüglich der Szenarien bewertet werden. Die Strategien münden in Empfehlungen an die Projektpartner und die Verkehrsteilnehmer. An automatische Eingriffe des regionalen Verkehrsmanagements in die dezentrale Verantwortung der Verkehrsträger ist zur Zeit nicht gedacht! Die Automatisierung des Verkehrsmanagements setzt voraus, dass aufbauend auf dem Verkehrslagebild organisatorisch und technisch ein Strategiemanagement geschaffen wird, das in der Lage ist, diese anspruchsvollen Aufgaben mit einem Minimum an personellen Ressourcen optimal zu bewältigen.

Die Gesellschaft soll aus Beiträgen (Leistungsentgelten, Zuschüssen) der Projektpartner finanziert werden, da namhafte Erlöse aus dem Vertrieb der Verkehrsdaten den verkehrspolitischen Zielsetzungen zuwiderlaufen würden. Über die Größenordnung der Kosten wurden Grundlagen erarbeitet.

Im Bereich der Organisationsvorbereitung wurden auf Basis des Konzepts Gespräche zur Gründung der Trägerorganisation und zur Finanzierung geführt. Ein publizierbares Ergebnis liegt zur Zeit nicht vor. Jedenfalls ist geplant, das Projekt in den Rahmen des Telematik-Rahmenplans des Bundes (bmvit 2004) als Leitprojekt einzubringen.

2 ERGÄNZUNGSPROJEKTE DER STADT WIEN

Parallel zur Bearbeitung der genannten zentralen Komponenten des Vema wurde an einigen Ergänzungsprojekten gearbeitet, von denen ausgewählte Entwicklungen bei der Stadt Wien kurz vorgestellt werden sollen:

2.1 Verkehrs-Internet-Portal

Seit 2004 wächst das Internetportal der Stadt Wien www.verkehrslage.wien.at parallel zu den Internetportalen der anderen Projektpartner. Die Portale bieten viele der als Grundversorgung angesehenen Informationen öffentlich an – wenn auch noch nicht vollständig, und manchmal in rudimentärer und unkoordinierter Art und Weise. Ganz neu ist der URL www.verkehrslage.at, der auf informeller Basis und mit minimalem Aufwand versucht, eine organisationsübergreifende Plattform einzurichten, bevor die organisatorischen Fragen endgültig gelöst sind. Folgende Inhalte wurden bisher auf den Websites der Stadt Wien eingerichtet:

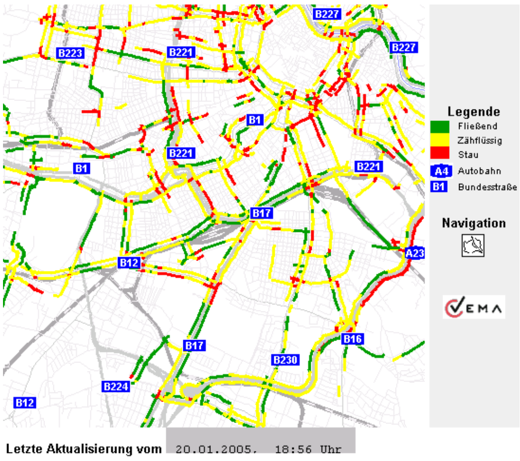
2.1.1 Verkehrsbilder

Derzeit stehen für 13 strategisch wichtige Örtlichkeiten in Wien unter www.verkehrsbilder.wien.at Webcams zur Verfügung und liefern rund um die Uhr Online-Informationen zum aktuellen Verkehrsgeschehen. Für einen Teil der Örtlichkeiten sind die Bilder auch über Handy abrufbar. Der Ausbau auf 60 und mehr Standorte ist geplant.

2.1.2 Floating Car Data:

Vom Magistrat der Stadt Wien - Verkehrsorganisation und technische Verkehrsangelegenheiten (MA 46), dem Deutschen Zentrum für Luft- und Raumfahrt (DLR, Berlin) und der Wiener Taxizentrale WIHUP wird seit 2003 ein gemeinsames Forschungsprojekt zur Verkehrslageermittlung auf Basis von FCD durchgeführt und im Internet der Öffentlichkeit zur Verfügung gestellt (http://www.verkehrslage.wien.at), das den Bürgern einen Überblick über das Verkehrsgeschehen im motorisierten Individualverkehr geben soll:

Bis zu 800 Taxis der Flotte sind für die betriebliche Disposition mit GPS und Datenfunk ausgerüstet. Ca. ein Drittel davon ist laufend unterwegs und sendet alle 15-30 Sekunden den Standort an die Zentrale. Die Standorte werden nach Ausscheiden von unplausiblen Daten Straßenabschnitten zugeordnet und die mittlere Reisegeschwindigkeit des Taxis errechnet. Aus den am Straßenabschnitt „gemessenen" Geschwindigkeiten aller dort erfassten Fahrzeuge wird sodann eine mittlere Reisegeschwindigkeit für den Abschnitt errechnet und einem Level Of Service (Rot – Gelb – Grün) zugeordnet und räumlich dargestellt. Die Daten werden alle 10 Minuten aktualisiert. Mit dem Verkehrsbarometer wird zusätzlich die aktuelle mittlere Fahrgeschwindigkeit im Vergleich zur üblichen mittleren Fahrgeschwindigkeit dargestellt. Für 11 ausgewählte Routen (z.B. Westeinfahrt von der A1 West Autobahn bis Karlsplatz) werden auch noch die aktuellen Fahrzeiten ausgewiesen.



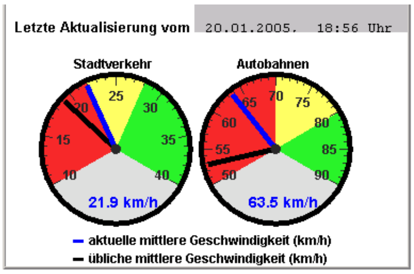


Abb.1: FCD-Verkehrslagebild und Verkehrsbarometer

Der Pilotversuch ergab, dass FCD für freie Strecken ohne Lichtsignalanlagen sehr gute Aussagen über die Verkehrsqualität zulassen, da das Einzelfahrzeug das Fahrzeugkollektiv auf dem Streckenabschnitt gut repräsentiert und die Geschwindigkeiten der Fahrzeuge nur geringfügig um die mittlere Geschwindigkeit schwanken. Das heißt, wird auch nur ein Fahrzeug im Abschnitt gemessen, ist die Wahrscheinlichkeit trotzdem sehr hoch, dass es mit der mittleren Geschwindigkeit unterwegs ist.

Anders verhält es sich im Stadtnetz, wo die Fahrgeschwindigkeit durch kurze Straßenabschnitte und dichte VLSA zwischen Stillstand und 50 km/h stark schwankt, und zwar abhängig von der Durchfahrzeit des Ampelquerschnitts und der dann gerade aktiven Phase. Da aufgrund der Anzahl der Straßenabschnitte und der Fahrzeuge nicht damit gerechnet werden kann, dass an einem Ampelquerschnitt in einem Messzeitraum mehr als ein Fahrzeug gemessen werden kann, entstehen in der Darstellung die Artefakte, dadurch dass

Taxis, die eine Ampel in der Grünzeit erreichen und übersetzen eine sehr hohe mittlere Geschwindigkeitsdarstellung erzeugen, obwohl die echte mittlere Geschwindigkeit geringer ist,

während Fahrzeuge, die den VLSA-Querschnitt zum Beginn der Rotzeit erreichen, durch ihren Stillstand – auch wenn sie alleine dort stehen – die dargestellte mittlere Geschwindigkeit zufällig absenken.

Diese Artefakte machen das Verkehrslagebild schwer lesbar. Darüber hinaus wird der Wert der Darstellung auch durch die Verzögerung relativiert, die gegenüber der gemessenen Verkehrslage entsteht, weil das gezeigte Bild alle zehn Minuten über die Daten der vergangenen 20 Minuten erzeugt wird, sodass die Aussage in Teilbereichen zum Zeitpunkt der Ansicht bis zu 30 Minuten alt sein kann. Daneben verflacht die Mittelbildung über die Zeit systematische Reisezeitschwankungen.

Zur Erleichterung der Interpretation für den ungeübten Betrachter wird die Gesamtlage im „Verkehrsbarometer“ zusammengefasst, das durch die große Zahl der darin verarbeiteten Daten ein verlässlicheres Bild zeigt. Darüber hinaus werden die routenbezogenen Fahrzeitprognosen errechnet, die ebenfalls leichter interpretierbar sind, als das flächige Lagebild. Es lassen sich sicherlich Methoden erfinden, die mit relativ geringem finanziellen Aufwand die Datenqualität heben, können doch müssen diese erst erforscht werden.

2.1.3 Stellplatzbörse und Garagenauslastung:

Die Stadt Wien stellt unter dem URL http://www.parkplatzboerse.wien.at gemeinsam mit den Garagenbetreibern der gewerblichen Garagen im Internet Informationen über verfügbare Dauerparkplätze und freie Stellplätze für Kurzparker zur Verfügung. Diese Wiener Parkplatzbörse soll einen Beitrag zur Verbesserung der Parkraumbewirtschaftung leisten. Die von der Wiener Wirtschaftskammer unterstützte Initiative zielt auf größtmögliche Nutzung gewerblicher wie öffentlicher Parkplätze zur Auslastung vorhandener Stellflächen sowie Entlastung des innerstädtischen Verkehrs im Sinne des Wiener Verkehrskonzepts 1994 und des Masterplans Verkehr Wien 2003 ab.

Die Parkplatzbörse liefert eine Liste mit Namen und Adressen der Anbieter von Dauer -und Kurzparkplätzen. Bei den Kurzparkplätzen werden die freien Stellplätze angezeigt, wo diese verfügbar sind. Private und gewerbliche Anbieter können jederzeit und kostenlos ihre freien Garagenplätze eintragen und anbieten. Durch Eingabe einer Adresse kann ein Kartenausschnitt angewählt werden, in dem die Garagen und die darin verfügbaren freien Kurzpark-Stellplätze (in den angeschlossenen Garagen) abgebildet sind.

Abb 2: Parkplatzbörse Wien, Kurzparkplätze

2.2 Modernisierung des Verkehrsrechnersystems und Erneuerung von ca. 50 VLSA

Wien hat mit der Erneuerung seiner Verkehrsleitzentrale begonnen und wird in den kommenden Jahren sukzessive die bestehenden Lichtsignalanlagen umrüsten. Die Technologie des neuen Verkehrsrechnersystems wird nicht nur für die reine Lichtsignalsteuerung eingesetzt werden, sondern muss auch die Basis zur Umsetzung von Steuerungs-, Lenkungs-, Leit- und Informationsstrategien bilden. Zentrale Features sind:

Rückübermittlung der Sensordaten von den Knoten an die Zentrale,

Weiterführung und Verbesserung der Priorisierung des ÖPNV

situations- und verkehrsabhängige Lichtsignalsteuerung (Knoten, Linie, Netz); Routenschaltung mittels dynamischen Schildern/Alternativroutenauswahl außerorts und innerorts

Verkehrslagebild-Darstellung auf einer VidiWall.

Integration mit den Verkehrsdaten der anderen Vema-Partner.

Die Leistung wurde aufgrund eines Vergabeverfahrens an den Bestbieter, die Firma SIEMENS vergeben und wird im Jahr 2005 realisiert werden.

2.3 Baustellengenehmigungen

Baustellen sind notwendig, um das Funktionieren der Infrastruktur Wiens sicher zu stellen. Egal, ob es sich um Straßenneubauten, Sanierungsmaßnahmen der Fahrbahn oder zum Beispiel Arbeiten am Kanalsystem handelt: Beeinträchtigungen des Verkehrs sind oft nicht zu vermeiden. Diese sollen aber so klein wie möglich bleiben und zeitlich und räumlich optimal koordiniert werden.

Im Rahmen des e-Governments wurde von der Stadt Wien (MA 14-ADV und Unisys) 2004 ein Programmsystem zur automationsunterstützten Abwicklung von Baustellengenehmigungs-Verfahren in Betrieb genommen, mit dessen Hilfe das Verfahren für den Antragsteller im Internet abgewickelt werden kann, und die Daten für Kollisionsprüfungen und geografische Selektionen in einem GIS zur Verfügung stehen. Mit Hilfe einer Datenbank werden das Ausmaß, die Art der Verkehrsbeeinträchtigung und der Baubeginn bzw. das Bauende aller Baustellen und Lagerungen im gesamten Straßennetz verzeichnet. Somit kennt man in den Koordinationsstellen immer aktuell alle Baustellen Wiens. Auch die rechtzeitige Information der Öffentlichkeit ist so gewährleistet.

Umleitungen gehören zum gewohnten Bild rund um Baustellen. Sie müssen aufeinander und mit anderen Baustellen abgestimmt sein. Das elektronische System der Baustellenkoordinierung verfügt über die so genannte Umleitungsuntersuchungsroutine. Das bedeutet, es kann im Vorhinein kontrolliert werden, ob sich eine weitere Baustelle in der Umleitungsstrecke befindet. Ist das der Fall, kann die Umleitung anders gelegt werden. Größere Veranstaltungen wie zum Beispiel der Stadtmarathon oder Straßenfeste bedingen oft eine Sperre von Straßenzügen und machen Umleitungen nötig. Auch diese Daten sollen in Zusammenarbeit mit der Polizei hier gespeichert und bei der Koordination berücksichtigt werden. Mit der Kollisionsprüfung wird ausgeschlossen, dass zwei unverträgliche Maßnahmen zur gleichen Zeit im selben Straßenabschnitt bewilligt werden. Mit der Korrelationsanalyse, einer speziellen Anwendung des elektronischen Systems, lässt sich weiters ausschließen, dass an zwei verkehrstechnisch wichtigen Punkten gleichzeitig Behinderungen bewilligt werden wird und diese einander gegenseitig behindern.

2.4 Forschungsprojekte

Darüber hinaus wurden zwei Forschungsprojekte definiert, die im Jahr 2005 begonnen werden sollen, und zwar zu den Themen „Auswirkungen des kleinräumigen Wettergeschehens auf den Verkehr“ und „Fusion von Sensordaten und Floating Car Data zur Gewinnung verlässlicher Zustandsdaten“.

🏆 **reviewed paper**

Visualisierung in der Planung als Chance zur Mobilisierung endogenen Potentials in ländlichen Räumen - Beispiel Veränderung der Landnutzung infolge agrarpolitischer Rahmenbedingungen

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ABSTRACT

Based on the fact that sustainable planning in rural areas can only be achieved with involvement of local citizens visualisation of planning scenarios is introduced as one promising means to communicate spatial planning matters because of its power to depict them in an easy and generally understandable way.

Afterwards the introduced power of maps and virtual reality images will be discussed in detail considering land use changes as a result of changes in agro-political determining factors as an example. This consideration concludes with the insight that maps and pictures have the power to carry more information and meaning than plain texts and speeches.

Because of this power they are especially suitable to describe spatial planning contexts and its future impacts to experts as well as to non-experts. Thus they are able to render spatial planning matters transparent. In this regard it will be shown that they have a great potential to assist as powerful tools to activate the public participation that is demanded in sustainable spatial planning.Afterwards the potentials to reach a wider range of interested citizens and animate them to participate that will open up by combining webbased GIS technology with virtual reality visualization technology will be adressed. This consideration will conclude with the insight that the resulting application combines all the advantages of texts, maps and pictures. Furthermore it will be shown that therefore its potential to transport Information and meaning and render spatial coherences transparent is far greater than that of plain maps or images.

Moreover as such an application is accessible via the Internet it is expected that it will reach a wider range of citizens and expand the circle of public participation – especially when applied in peripheral rural regions with sparcely populated areas.Upon the basis of this insights the thesis that a well-designed Web-GIS by interacting with its users will render from a mere tool to an true acting actant in a rural development setting is discussed. This discussion will show that by transporting meaning and information such an application influences the thoughts and actions of its users and therefore motivates them to think and discuss about the information given to them – and even act according to it.

Last but not least after the discussion of the advantages that will open up by using the power of maps and images in a spatial planning context the dangers of this power are addressed resulting in the recommodation to introduce suitable means of control in order to prevent its unethical misuse by utilizing it in order to serve “politically desired” interests. The discussion about the potentials of visualization in a spatial planning context concludes with a consideration about technical requirements in connection with the use and introduction of telegeoprocessing technologies in rural areas.

1 BÜRGERBETEILIGUNG ALS VORAUSSETZUNG FÜR EIGENVERANTWORTLICHE NACHHALTIGE PLANUNG

Die Gemeinden im 21. Jahrhundert stehen vor großen Herausforderungen. Um in Zeiten des Strukturwandels in der Landwirtschaft, der Globalisierung und Internationalisierung der Wirtschaft und der immer neuen Aufgaben und Zuständigkeiten aufgrund von staatlichen Vorgaben und Delegationen bestehen zu können, ist es notwendig, vorgegebene Trends, Rahmenbedingungen und globale Entwicklungen für eine positive Gemeindeentwicklung zu nutzen.

Insbesondere vor der aktuellen Diskussion über nachhaltige Planung im Rahmen der Agenda 2000 gewinnt in diesem Zusammenhang das Thema der Bürgerbeteiligung in den Bereichen der Architektur, Stadt-, Landschafts- und Umweltplanung – besonders im ländlichen Raum - zunehmend an Bedeutung. Dabei geht es im Gegensatz zu früher nicht mehr nur um die reine Information der Betroffenen um deren Akzeptanz und Zustimmung für eine anvisierte Maßnahme zu erreichen. Aktive Einbeziehung in den Planungsprozeß und Mitwirken ist heute gefordert.

Dieses Konzept der sogenannten „Aktiven Bürgergesellschaft“ ist weitaus mehr als ein Programm, das mehr bürgerschaftliches Engagement einfordert (LUTHER, 2001). Im Kern geht es bei diesem umfassenden gesellschaftlichen Entwurf darum, den Einzelnen zu mehr Verantwortung für sich selbst und für die Gemeinschaft zu aktivieren (LUTHER, 2001). Eigeninitiative und Selbstorganisation sollen gefördert und Bürger motiviert werden sich an Planung, die ihr Wohn- und Lebensumfeld belangt, zu beteiligen, um Maßnahmen letztendlich selbst zu tragen (FÜRST; et al, 1998). Hierfür ist der Einsatz neuer Methoden sowie ein hohes Maß an Kompetenz und Einsatzbereitschaft bei den Akteuren, sowie insbesondere Transparenz der Planung unerlässlich.

Eine relativ neue innovative Methode im Rahmen der räumlichen Planung die heute in der Planung geforderte Transparenz zu gewährleisten und Betroffene aktiv in den Planungsprozeß mit einzubeziehen und zur Partizipation anzuregen wird im Folgenden am Beispiel der Visualisierung von Landnutzungsveränderungen infolge agrarpolitischer Rahmenbedingungen vorgestellt und diskutiert.

2 VERÄNDERUNG DER LANDNUTZUNG INFOLGE AGRARPOLITISCHER RAHMENBEDINGUNGEN

Bereits seit der EU-Agrarreform im Jahr 1992 kam es in Deutschland auf Grundlage der Verordnung (EWG) 2078/92 zu einer umfassenden Einführung von Agrarumweltprogrammen (vgl. OSTERBURG, 2002). Beim Reformpaket der EU im Rahmen der Agenda 2000 erhielten die Entwicklung des ländlichen Raums und als ihr zentraler Bestandteil auch der Schutz der Umwelt noch wesentlich mehr Gewicht und wurden zur sogenannten "zweiten Säule" der EU-Agrarpolitik. Die bisherigen

Agrarumweltmaßnahmen wurden mit der Umsetzung der Agrarreform im Rahmen der Verordnung (EG) 1257/99 weiter fortgesetzt und verstärkt, verbunden mit einer Erhöhung der Gesamtmittel für die Agrarumweltprogramme (vgl. OSTERBURG, 2002).

Durch die Spielräume, welche die Agrarumweltpolitik bei ihrer Ausgestaltung und Umsetzung den einzelnen Ländern einräumt, sowie durch die unterschiedlichen Haushaltssituationen und Agrarpolitiken der einzelnen Länder existieren jedoch große Unterschiede in ihrer Umsetzung.

Trotz dieser Unterschiede zielen die Agrarumweltprogramme aller Länder vor dem Hintergrund der Bedeutung des Einflusses der Landwirtschaft auf die Umwelt und der Entwicklung vielfältiger Landschaften sowie der biologischen Vielfalt einzelner Regionen – die europäischen Landschaften wurden in hohem Maße durch Jahrhunderte landwirtschaftlicher Nutzung geprägt; die Entwicklung der biologischen Vielfalt vieler Regionen steht in engem Zusammenhang mit der landwirtschaftlichen Nutzung – darauf ab, an die Situation der einzelnen Länder und deren Regionen angepaßte Instrumente zu entwickeln und Maßnahmen zu ergreifen die dazu beitragen können (vgl. AHNER, 2004)

die landschafts- und umweltpflegende Funktion der Landwirtschaft zu stärken,

die Kulturlandschaften zu erhalten und

mögliche negative Entwicklungen zu vermeiden.

Ziel der Agrarumweltprogramme ist es also, einen Beitrag zur Erreichung der im Rahmen der Diskussion über die EU-Agrarpolitik geforderten nachhaltigen, naturbezogeneren Landwirtschaft zu leisten (vgl. FISCHLER, 2001).

Gleichzeitig tragen die Agrarumweltprogramme damit der Erkenntnis der Multifunktionalität der Landwirtschaft Rechnung, welche besagt, daß Landwirtschaft nicht allein auf das Produzieren von Agrargütern reduziert werden darf sondern noch vieles andere produziert bzw. produzieren soll, nämlich Landschaften, ländliche Räume, Umwelt, etc. (vgl. FISCHLER, 2001).

Damit wird klar, daß bei den Agrarumweltprogrammen nicht nur ökonomische Belange im Zentrum der Betrachtung stehen dürfen sondern genauso ökologische und sozio-kulturelle. In Konsequenz bedeutet dies, daß bei der Bewertung und Abwägung von Agrarumweltmaßnahmen ebenfalls nicht nur ökonomische Aspekte sondern in gleichem Maße auch ökologische und sozio-kulturelle Aspekte berücksichtigt werden müssen!

In der aktuellen Diskussion um die Multifunktionalität ländlicher Räume, sowie der Landnutzung stellt sich heute – auch vor dem Hintergrund des sich in der Landwirtschaft vollziehenden Strukturwandels – oftmals die Frage nach Naturschutzmaßnahmen, sowie nach Erhalt, Intensivierung, Extensivierung oder sogar Aufgabe der Landbewirtschaftung. Besonders betrifft dies agrarische Rückzugsgebiete, die sich durch klimatische Nachteile, ertragsschwache Lagen sowie ungünstige Betriebsstrukturen auszeichnen (vgl. HEIßENHUBER, et al 2004).

Die Umsetzung entsprechender Agrarumweltmaßnahmen innerhalb einzelner Regionen bedeutet aber immer auch einen Eingriff in die vorherrschende Landnutzung, welcher sich je nach Art der Maßnahme auch auf die regionale Kulturlandschaft auswirkt. Da entsprechende Landnutzungsveränderungen langsam ablaufen, meist irreversibel sind und von der Gesellschaft somit kaum wahrgenommen werden, besteht die Gefahr, daß es ohne entsprechend vorausschauende Planung zu einer Fehlentwicklung kommt. Daher ist es notwendig mögliche Konsequenzen entsprechender Maßnahmen bereits im Vorfeld im Hinblick auf ihre ökonomischen, ökologischen und sozio-kulturellen Folgen einzuschätzen und zu bewerten.

Vor dem Hintergrund, daß heute - wie einleitend angesprochen - an die Planung insgesamt der Anspruch gestellt wird transparent zu sein und eine stärkere Bürgerbeteiligung zu ermöglichen, um Akzeptanz für Maßnahmen zu schaffen sowie Betroffene zu eigenverantwortlichem Handeln, zur Eigeninitiative und Partizipation anzuregen, besteht die Notwendigkeit deren Ziele und Konsequenzen Experten und Laien in gleichem Maße möglichst anschaulich und effektiv zu vermitteln (vgl. APPLETON; LOVETT, 2003). Besonders wichtig ist dies, so Appleton und Lovett, wenn die Entscheidungen die dabei getroffen werden sollen auch Auswirkungen auf die Struktur und das Erscheinungsbild der Kulturlandschaft haben (vgl. APPLETON; LOVETT, 2003), wie dies bei Agrarumweltmaßnahmen häufig der Fall ist.

3. VISUALISIERUNG ALS MEDIUM ZUR KOMMUNIKATION VON PLANUNG

„If a picture is worth a thousand words, a map can be worth a million – but beware” (Blij, de, H. J.: 1996. S. xi).

“Power is the ability to work. Which is what maps do: they work. (...) maps work by serving interests” (Wood, D.: 1992. S.1)

Auf Grund der Tatsache, daß visuelle Informationen von Menschen i.d.R. besser aufgenommen und verstanden werden, als Informationen in Form von Texten, numerischen Daten und Diagrammen (vgl. TUFTE, 1992 zitiert nach SHEPPARD, 1999) bietet sich an die Visualisierung als Kommunikationsmedium zur Vermittlung von Planung einzusetzen – insbesonders wenn deren Umsetzung sich auf das Landschaftsbild auswirkt. Dementsprechend ist es nicht verwunderlich, daß davon von Planern bereits seit geraumer Zeit, meist in der Form von Karten, Gebrauch gemacht wird. Denn, wie bereits z.B. DE BLIJ [1996], CRAMPTON [2001], MacEACHREN [2001] MONMONJER [1996] und WOOD [1992] erkannt und nachgewiesen haben sind Karten Informationssammlungen und Kommunikationsmedien zugleich. Mit Karten können deutlich mehr Informationen vermittelt werden als mittels schriftlicher Dokumente, da die sequentielle und lineare Struktur von Texten oftmals ungeeignet ist, Raum, Regionen und räumliche Beziehungen adäquat zu beschreiben (vgl. WOOD, 1992). Monmonier geht in seinen Ausführungen sogar noch etwas weiter und merkt an, daß Karten das Potential besitzen dem Betrachter, abgesehen von den dargestellten offensichtlichen Informationen, unterbewußt Botschaften zu übermitteln (vgl. MONMONIER, 1986).

Obwohl Karten für Planer somit ein geeignetes Medium zur Kommunikation von Planung darstellen ergibt sich bei der Vermittlung von Planung mit Hilfe von Karten an Entscheidungsträger und Bürger häufig das Problem, daß diese nicht an den Umgang mit kartographischen Darstellungen und deren Interpretation gewöhnt sind. Sie haben somit Probleme alle dargestellten Zusammenhänge und die sich daraus ergebenden Konsequenzen richtig zu erfassen und die Folgen ins Auge gefaßter Maßnahmen richtig abzuschätzen. Da dies aber eine wichtige Voraussetzung ist, um über geplante Maßnahmen diskutieren zu können und Entscheidungen zu treffen, wurden und werden Karten häufig durch Luftbilder, Orthophotos und Photos ergänzt, da diese es erleichtern komplexe Zusammenhänge zu erfassen, indem sie den Betrachtern einen noch besseren, realitätsnäheren Eindruck über den Status-Quo einer von Planung betroffenen Region vermitteln (vgl. Abbildung 1). Eine in diesem Zusammenhang interessante Pespektive, Konsequenzen von Planungen, die Auswirkungen auf das Landschaftsbild haben, noch besser als mittels herkömmlicher Karten, Photos oder Photomontage potentieller Auswirkungen Betroffenen darzulegen, eröffnen die in den letzten Jahren erzielten Fortschritte der Computertechnologie in der virtuellen dreidimensionalen Darstellung realistischer Landschaften verknüpft mit der GIS-Technologie (vgl. z.B. APPLETON, 2003). Diese erlauben es durch geschickte Kombination von Landschaftselementen auf Basis von topographischen Daten, Landnutzung, Vegetationsparametern, etc. realitätsnahe, detailreiche, virtuelle Bilder von Landschaften zu generieren (vgl. z.B. APPLETON, 2003), die zeigen, wie eine Landschaft nach erfolgtem Eingriff in Zukunft aussehen wird, und somit die Potentiale von Karten und – auf Grund der Möglichkeit verschiedene Szenarien etc. abzubilden – Photos Zustände zu visualisieren deutlich übertreffen. Es können z.B. unterschiedliche Zustände landwirtschaftlicher Nutzflächen und deren Auswirkungen auf das Landschaftsbild wie z.B. Grünlandwirtschaft, großflächige Beweidung, Aufgabe der Landbewirtschaftung visuell dargestellt werden (vgl. Abbildung 2). Dies ist möglich da die Verknüpfung von GIS- und Visualisierungssoftware Planern heute erlaubt, basierend auf exakten Geodaten, reale Landschaften unter Einbeziehung des Raumbezugs im Computer zu modellieren, zu visualisieren und darauf aufbauend realitätsnahe Planungszenarien visuell darzustellen. Die Technik der Visualisierung ermöglicht aber nicht nur die Darstellung von „einfachen" Landnutzungsveränderungen und ihrer Auswirkungen auf die Kulturlandschaft bzw. die Ästhetik der Landschaft (vgl. Abbildung 2).Aufbauend auf detaillierten ökologischen Daten lassen sich z.B. auch Zeitreihen darstellen, die dem Betrachter die Vegetationsentwicklung einer Region anschaulich vor Augen führt. Als Beispiel läßt sich hier die Visualisierung von Waldwachstum nennen, die es erlaubt - aufbauend auf realen Daten - visuell die Sukzession des Waldes in Abhängigkeit der Zeit, z.B. nach einer Rodung, zu berechnen und darzustellen (vgl. Abbildung 3).

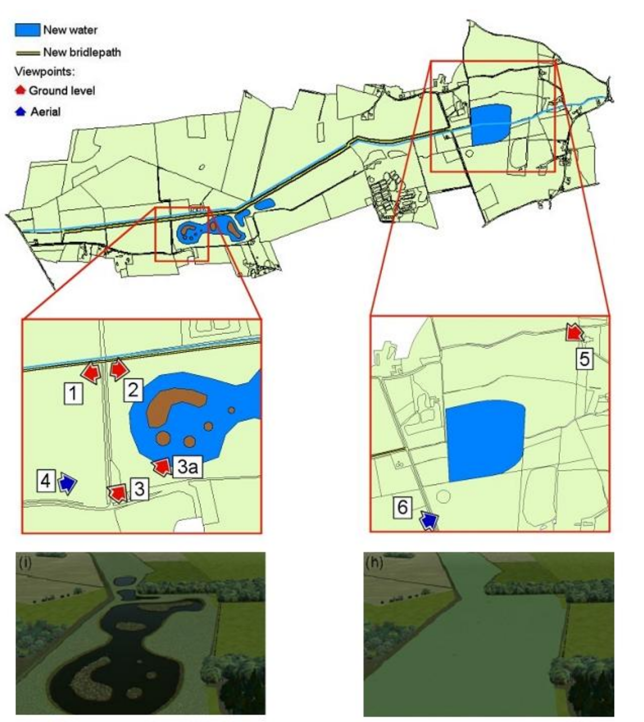

Abb. 1: Vergleich Karte – Bild (Quelle: Appleton, K.: 2003)

Laien und Experten kann so in gleichem Maße in Form von Computeranimationen oder Videos im Rahmen von Workshops, Informationsveranstaltungen oder sogar über das Internet z.B., der langwierige Prozeß der Regeneration des Waldes verdeutlicht und erklärt werden oder die Auswirkungen der Veränderung der Landnutzung auf das Landschaftsbild anschaulich näher gebracht werden, etc.; Experten können wichtige Daten und Erkenntnisse zu Auswirkungen von Landnutzungsveränderungen gewinnen, die sich anders nicht oder nur sehr schwer ermitteln lassen. Laien lassen sich Auswirkungen und Zusammenhänge etc. besser verdeutlichen.

Des weiteren können auch anthropogene Eingriffe in die Landschaft, die mit einer Veränderung des Landschaftsbildes verbunden sind (Bau von Erschließungswegen, Brücken, Retentionsflächen, etc.) visualisiert werden, so daß potentielle Auswirkungen auf die Kulturlandschaft und das Landschaftsbild bereits im Vorfeld beurteilt und in Folge diskutiert werden können. Auch hier bietet sich neben Printmedien das Internet, wie auch von Appleton praktiziert (vgl. APPLETON, 2003), zur Verbreitung der generierten Landnutzungszenarien an.

Die Vorteile Planung – insbesondere auch von ins Auge gefaßten Agrarumweltmaßnahmen – wie hier skizziert a priori bildlich darzustellen und mit Alternativszenarien visuell vergleichen zu können, liegen klar auf der Hand:

Potentielle Veränderung der Landschaft können bereits im Vorfeld visuell beurteilt und bewertet werden;

Entscheidungsträger und Betroffene können umfassend und in allgemein verständlicher Weise über Auswirkungen informiert werden.

Abb. 2: Beispiel für Landnutzungszenarien (Quelle: Schaller, J.: 2003)

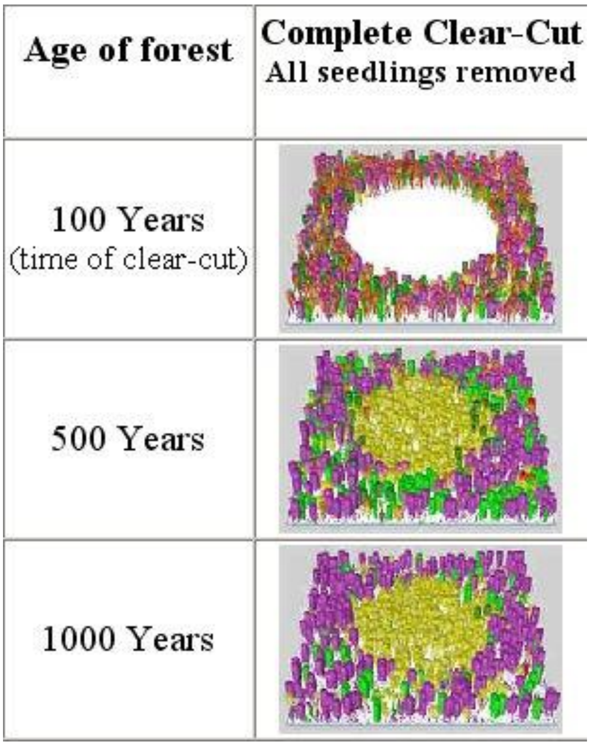

Abb. 3: Beispiel für Waldwachstumssimulation (Quelle: http://www.sciencemag.org/feature/ data/deutschman/ tour_clearcut.htm)

4 VERKNÜPFUNG DER VISUALISIERUNG MIT WEB-GIS ALS INNOVATIVE PERSPEKTIVE DER NUTZERBETEILIGUNG

in der Planung

Potentiale von Public Participation GIS

GIS-gestützte Visualisierung bietet, wie erläutert, das Potential die Folgen von Planung verständlicher zu kommunizieren als dies mit herkömmlichen Medien der Fall ist, denn auf Grund der Möglichkeit raumbezogene Informationen auszuwerten, kann die Visualisierung auf Grundlage der GIS-gestützten Modellierung einen wichtigen Beitrag leisten, um auch unterschiedliche fachliche Bereiche zu verknüpfen (vgl. HERRMANN, 2002).

Mit der entsprechenden Software lassen sich relativ schnell entsprechende Ergebnisse produzieren und anschließend veröffentlichen bzw. im Planungs- und Entscheidungsfindungsprozeß nutzen. Ein Problem der

Bürgerbeteiligung an Planungsprozessen ist, daß sich über klassische Wege der Bürgerbeteiligung mittels Informationsveranstaltungen,Workshops, etc. nur ein bestimmter, interessierter Kreis von Leuten bzw. Bürgern erreichen läßt. Das Ziel jeder Planung sollte aber eine Einbeziehung möglichst vieler in den Planungsprozeß sein. Eine interessante Perspektive den Kreis der Beteiligten zu erweitern bieten sogenannte Public-Participatory-GIS (PPGIS) (vgl. z.B. AL-KODMANY, 2000; CRAIG, HARRIS, WEINER, 2002; LEITNER, et al , 2000;/2002; YIGITCANLAR, 2002).

Dabei handelt es sich i.d.R. um Web-GIS, die Informationen über eine Region, insbesondere über regionale Planungsvorhaben, im Internet in Form interaktiver Sichten auf Karten, deren Aussehen und Inhalt der Benutzer gemäß seinen Wünschen – im Rahmen des Spielraums des Systems – selbst beeinflussen kann bereitstellen. Dies ist möglich, da Web-GIS die Programmierung einfacher, intuitiver Benutzeroberflächen erlauben, die eingebunden in Web-Seiten jedem Internetbenutzer den Zugriff auf vom Systementwickler definierte GIS-Funktionen und -Daten über das World Wide Web bieten. Zur Nutzung von Web-GIS benötigt der Benutzer – bei entsprechender Gestaltung der Graphischen Benutzeroberfläche (vgl. hierzu z.B. MENG, 2002; NIELSEN, 2000; THISSEN, 2000) – keine GIS- Kenntnisse.

Insgesamt kann über PPGIS eine noch bessere und anschaulichere Information von Entscheidungsträgern und Bürgern erreicht werden als dies mittels herkömmlicher Informationsmedien der Fall ist, denn sie bieten dem Benutzer nicht nur eine einfache statische Karte oder Beschreibung, sondern geben ihm die Möglichkeit räumliche Sachverhalte kartographisch in verschiedenen Maßstäben darzustellen, untereinander in Beziehung zu setzen, selbst zu analysieren und Beschreibungen zu Objekten in der Karte abzurufen, etc.

Zusätzlich können durch die Präsentation im Internet potentiell mehr Bürger – insbesondere in dünn besiedelten, weitläufigen peripheren Regionen, wie sie z.B. in den neuen Bundesländern der Bundesrepublik Deutschland vorzufinden sind – über aktuelle räumliche Planungsprozesse informiert, mobilisiert und am Prozeß der Diskussion und Entscheidungsfindung beteiligt werden. Da GIS, wie z.B. Al-Kodmany herausgefunden hat, in starkem Maße zum Verständnis räumlicher Sachverhalte im regionalen Maßstab beitragen (Al-KODMANY, K., 2000), läßt sich Planung über dieses Medium einfach, verständlich und transparent einem breiten Kreis an Betroffenen und Interessierten kommunizieren. GIS eignet sich somit als Werkzeug Planung transparent zu vermitteln, Benutzer zu ermöglichen sich über Planung zu informieren bzw. dazu anzuregen sich aktiv am Planungsprozeß zu beteiligen.

Vorteile der Kombination von Public Participation GIS und der virtuellen Visualisierung von Landnutzungszenarien

In welchem Zusammenhang stehen nun aber diese Ausführungen zu PPGIS in der Bürgerbeteiligung zum Thema dieses Artikels – der Visualisierung von Landnutzungsveränderung?

Beides, sowohl PPGIS als auch die Visualisierung von Landschaften, zielen darauf ab Informationen zu transportieren, Planung transparent zu kommunizieren und zu einem besseren Verständnis der räumlichen Zusammenhänge beizutragen – und letztendlich, durch Einbeziehung und Information der Betroffenen, auch eine Mobilisierung des endogenen Potentials zu erreichen.

Es bietet sich daher an, die Vorteile beider Techniken miteinander zu verknüpfen und die Visualisierung mit PPGIS zu kombinieren, um so Entscheidungsträgern, Betroffenen und Interessierten einer Region potentielle Szenarien anvisierter Landnutzungsveränderungen in ihrem räumlichen Kontext sowohl kartographisch als auch visuell - im Medium Internet - in Form einer virtuellen Darstellung (virtuelles Bild) inklusive Beschreibung (Text) und Lageinformationen (Karte) zu präsentieren. Ein entsprechend angelegtes PPGIS vereint somit die Vorteile der drei Medien Karte, virtuelles Bild und Text.

Geschehen kann das z.B. in der Art und Weise, daß im Internet auf einer Karte der Region betroffene Gebiete selektiert werden können, über die sich anschließend Planungszenarien zusammen mit den dazugehörigen Informationen visuell darstellen lassen.

Aber auch komplexere Anwendungen sind denkbar, die es dem normalen Internetbenutzer erlauben ohne GIS- und Visualisierungs-Fachkenntnisse sich z.B. ein Szenario über die Auswirkungen der Landnutzungsveränderung eines Landschaftsausschnitts der für ihn von Interesse ist – auf Grundlage der im System vorgehaltenen Daten – online visualisieren zu lassen. Des weiteren ist denkbar, dem Benutzer eines entsprechenden Systems zu ermöglichen, die Eingangsparameter, welche Grundlage zur Visualisierung eines Szenarios sind, selbst zu ändern und sich das entsprechende Ergebnis anzeigen zu lassen.

Daß PPGIS im ländlichen Raum akzeptiert und angenommen werden zeigen Beispiele aus den USA (vgl. HOWARD, 1998; LEITNER, 2000/2002; PARKER, o.J.; YIGITCANLAR, 2003). Es ist daher anzunehmen, daß Anwendungen die die Vorteile von PPGIS sowie der virtuellen bildlichen Visualisierung vereinen auch auf Akzeptanz stoßen werden.

Web-GIS als Akteure der regionalen Entwicklung

Richtig eingesetzt besitzt ein Web-GIS, wie eine explorative Untersuchung am Beispiel der Regionen Bayerischer Wald und Berchtesgadener Land gezeigt hat, das Potential eine Eigendynamik zu entwickeln und abgebildete Informationen über Entwicklungsziele etc. zu transportieren (vgl. NEUMEIER, o.J.). Durch Interaktion mit dem Benutzer bringt es diesem die im System abgebildeten Ziele näher, schafft dadurch Transparenz und regt zum Nachdenken und Handeln an. Am Beispiel des Berchtesgadener Landes konnte diesbezüglich nachgewiesen werden, daß z.B. die Ausrichtung des Systems auf die Propagierung der Region als autofreie Kur- und Fremdenverkehrsregion durch verstärkte Informationsbereitstellung über den regionalen ÖPNV zu einer besseren Abstimmung der Region mit dem Salzburger Land bezüglich der ÖPNV-Fahrplaninformationen, sowie zur Erweiterung des Busangebotes für Touristen geführt hat (vgl. NEUMEIER, o.J.).

Abstrakt betrachtet lassen sich diese Beobachtungen als Ergebnis der Interaktion des Web-GIS mit seinen Benutzern interpretieren, so daß entsprechend konzipierte Web-GIS nicht mehr nur als reine Werkzeuge, sondern als aktive handelnde Akteure[99] der regionalen Entwicklung angesehen werden können.

Durch diese Erkenntnisse ergeben sich viele interessante Perspektiven und Einsatzmöglichkeiten entsprechender Applikationen – besonders in der räumlichen Planung und Bürgerbeteiligung. Auf Grund der Möglichkeiten welche sich durch die Kombination von Web-GIS und virtueller Visualisierung von z.B. Landnutzungszenarien ergeben, Informationen, Inhalte und Ideen zu transportieren, ist davon auszugehen, daß solch eine Applikation sich noch stärker als Partner für kreative Allianzen als ein reines Web-GIS anbietet, indem es durch die Vereinigung der Möglichkeiten Informationen in Karten- und Bildform zu transportieren Benutzer noch stärker beeinflußt und zum Handeln anregt.

Die Potentiale welche die Betrachtung und Berücksichtigung entsprechender Applikationen als Akteure in der Raumentwicklung bzw. Planung eröffnen sind vielversprechend. Da es aber derzeit noch kaum Anwendungen gibt, welche die Intention besitzen gezielt entwicklungsstrategische Informationen und Inhalte zu transportieren, ist in Zukunft, aufbauend auf den hier kurz skizzierten Erkenntnissen, noch weiterer Forschungsbedarf gegeben.

5 PROBLEME DER VISUALISIERUNG

Trotz aller Perspektiven und Vorteile, welche die Visualisierung dem Planer bietet, wirft diese aber auch offene Fragen auf und birgt Gefahren.

99 Der Begriff „Akteur“ wird hier im Sinn der Actor-Network Theory für Subjekte und Objekte verwendet.

Wie schon bei den Ausführungen zu Karten angesprochen wurde, bieten diese die Möglichkeit unterbewußte Botschaften zu übermitteln (vgl. MONMONIER, 1986), indem Informationen z.B. bewußt vorenthalten, besonders betont oder mißverständlich dargestellt werden.

Das selbe trifft in ähnlicher Weise auch auf die virtuelle Konstruktion einer potentiellen Realität durch GIS und Visualisierung zu. Das birgt, wie Sheppard bereits [1999] in seinem Aufsatz „Visualization Software Brings GIS Applications to Life" treffend zusammenfaßt, die Gefahr des Mißbrauchs:

„(...) This power has the obvious risk of unethical behavior, wich has been a more subtle threat in conventional GIS. There will be the temptation to cross the boundary of objectivity to make data look attractive or to just play with the tools available – growing trees, making waves, desining sunsets (in short, playing God)" (SHEPPARD, 1999).

Ähnlich wie Sheppard, sieht Towers [1997] diese Gefahren und resümiert nach einer ausführlichen Auseinandersetzung mit dieser Thematik, daß GIS in starkem Maße politisch ist und die Möglichkeit bietet, es zum Erreichen definierter „erwünschter" Ziele zu nutzen/mißbrauchen (vgl. TOWERS, 1997).

In Konsequenz müssen zur Visualisierung von Planungsbelangen Standards, Richtlinien und Kontrollmöglichkeiten entwickelt und eingeführt werden, die es ermöglichen den Mißbrauch der Visualisierung zu unterbinden und zu verhindern diese bewußt zur politisch-strategischen Beeinflussung und zur Durchsetzung "erwünschter" Ziele zu nutzen. Diese Kontrollmöglichkeiten existieren noch nicht. Auf Grund der immer besser werdenden GIS- und Visualisierungs- Applikationen sowie sinkenden Kosten für die zur Nutzung entsprechender Applikationen notwendige Hard- und Software entstehen mehr und mehr Anwendungen wie die oben skizzierten. Es ist daher höchste Zeit sich Gedanken über entsprechende Kontrollmechanismen zu machen. Hier ist also dringender Handlungs- und aktueller Forschungbedarf gegeben.

6 TECHNISCHE VORAUSSETZUNGEN UND DATENBEDARF ALS FLASCHENHALS BEI DER GIS-GESTÜTZTEN VISUALISIERUNG UND BÜRGERINFORMATION VON LANDNUTZUNGSVERÄNDERUNGEN

Technisch ist sowohl die oben angesprochene GIS-gestützte Visualisierung verschiedener Landnutzungsszenarien, als auch deren verortete Präsentation im Internet mittels Web-GIS heute relativ problemlos möglich.

Als Wehrmutstropfen und somit verbesserungsbedürftig sind in diesem Zusammenhang jedoch die zur Visualisierung notwendigen Datengrundlagen wie auch die entsprechende technische Infrastruktur zur Nutzung neuer innovativer Medien, wie z.B. Web-GIS für die Belange ländlicher Räume zu nennen:

- Fehlende landwirtschaftliche und landschaftsplanerische Ausgangsdaten, zu große Aktualisierungszeiträume, zu großräumige Aggrigationsebenen, fehlender oder unzureichender Raumbezug sind nur einige Aspekte die in diesem Zusammenhang bezüglich der Daten zu nennen sind;
- Hohe Kosten für entsprechende Visualisierungs- und GIS-Software sowie für amtliche Geobasisdaten - auch für Kommunen und Landkreise - sowie
- Einschränkungen der Datennutzung insbesondere im Rahmen von Internetauftritten (Web-GIS) und
- z.T. nur schwer nachvollziehbare Datenschutzrichtlinien erschweren die Einführung entsprechender Applikationen noch zusätzlich.

Hinzu kommt, daß Applikationen wie Web-GIS auf Grund des in der Regel hohen Datenvolumens welches zwischen Server und Client übertragen wird, sich nur bei Vorhandensein einer entsprechend leistungsfähigen Telekommunikationsinfrastruktur mit entsprechenden Bandbreiten sinnvoll betreiben und nutzen lassen. Herkömmliche analoge 56k Modems eignen sich auf Grund der geringen Bandbreite nur bedingt zur Nutzung von Web-GIS. Sinnvoll läßt sich Web-GIS erst unter Zuhilfenahme der Breitbandtechnologie, wie sie in Deutschland z.B. T-DSL bietet, einsetzen. Obwohl in Deutschland bereits viel in den flächendeckenden Ausbau der Breitbandtechnologie investiert wurde, steht z.B. T-DSL nur in 6315 von 7904 deutschen Anschlußgebieten zur Verfügung, wodurch vier Millionen potentielle Kunden noch nicht mit einem schnellen Onlinezugang auf DSL-Basis ins Internet gehen können (vgl. DSLweb.de; URL: http://www.dslweb.de/ ; Stand 13.07.2004). Betroffen sind hier insbesondere Kunden und Regionen die einen Glasfaseranschluß besitzen, wie das häufig nach der Modernisierung in den neuen Bundesländern der Fall ist. Dementsprechend verfügt insbesonders Ostdeutschland nur über wenige DSL-Anschlüsse (vgl. DSLweb.de; URL: http://www.dslweb.de/ ; Stand 13.07.2004).

Aber auch die Entfernung zur Vermittlungsstelle spielt dabei eine Rolle, da die Übertragungsgeschwindigkeit der Daten mit zunehmender Entfernung von der Vermittlungsstelle abnimmt.

Insbesonders ländliche Räume in größerer Entfernung von Verdichtungsräumen sind hier im Hinblick auf die zur Nutzung moderner IuK-Technologien notwendige technische Telekommunikationsinfrastruktur benachteiligt. Es existiert somit trotz aller Bemühungen um den Ausbau einer leistungsfähigen Telekommunikationsinfrastruktur immer noch ein sog. Digital Divide, welcher es für betroffene Regionen erschwert leistungsfähige Telematikapplikationen wie z.B. Web-GIS einzuführen, zu betreiben und zu nutzen.

Hier ist politischer Handlungsbedarf gegeben. Um das Potential, welches die moderne Informations- und Kommunikationstechnologie wie z.B. die Visualisierung von Landnutzungsveränderungen zur Unterstützung der Planung und des Entscheidungsfindungsprozesses sowie der Bürgerbeteiligung für die Entwicklung ländlicher Räume bietet, ausschöpfen zu können, muß in Zukunft noch stärker als bisher geschehen, auf eine Verbesserung der flächendeckenden Telekommunikationsinfratruktur – insbesondere im ländlichen Raum - und der Datenpolitik für Geobasisdaten hingearbeitet werden.

7 FAZIT

Visualisierung in der Planung – wie oben am Beispiel der Visualisierung von Landnutzungsveränderungen infolge agrarpolitischer Rahmenbedingungen erläutert - bietet Entscheidungsträgern, Planern und Betroffenen das Potential, die langfristigen Auswirkungen ins Auge gefaßter Maßnahmen auf die Landnutzung sowie die Struktur und das Erscheinungsbild der Landschaft besser und anschaulicher abschätzen und beurteilen zu können als dies mit klassischen Medien der Fall ist. Dadurch kann die Visualisierung die herkömmlichen Methoden der Entscheidungsfindung gut ergänzen.

Zusätzlich bietet sich die Visualisierung, da sie die potentiellen Auswirkungen einer Maßnahme sehr klar und allgemeinverständlich transportiert, dazu an sie nicht nur für Experten sondern in Zukunft noch stärker als bisher geschehen auch im Rahmen der Akteursbeteiligung einzusetzen. Verknüpft mit Web-GIS eröffnen sich hier, wie gezeigt wurde weitere vielversprechende Perspektiven der Mobilisierung endogenen Potentials, besonders in peripheren ländlichen Regionen.

Weitere interessante Nutzungsmöglichkeiten und Fragen ergeben sich in diesem Zusammenhang, wenn man berücksichtigt, daß PPGIS wie dargestellt grundsätzlich das Potential besitzen eine Eigendynamik zu entwickeln, so daß sie nicht mehr nur Werkzeug und Hilfsmittel der Planer darstellen, sondern selbst zu aktiven, handelnden Akteuren werden, indem sie z.B. Entwicklungsziele transportieren und Ideen verbreiten sowie zu deren Annahme anregen, bzw. zur Beteiligung an Planungsprozessen beitragen (vgl. NEUMEIER, o.J.).

Der Bedarf nach entsprechenden Anwendungen ist eindeutig gegeben. Information und Beteiligung sind heute neben der Berücksichtigung sowohl ökonomischer Belange als auch ökologischer und sozio-kultureller Belange wie eingangs skizziert wichtige Grundvoraussetzung für vorausschauende nachhaltige Planung im ländlichen Raum wie sie von der EU-Agrarpolitik heute gefordert und anvisiert wird.

In Konsequenz läßt sich an Planer und Entscheidungsträger, die sich mit räumlicher Planung beschäftigen, die Empfehlung aussprechen, in Zukunft im Planungsprozeß stärker als dies bisher geschehen ist die GIS-gestützte Visualisierung, sowie den Einsatz von Web-GIS zur Information und Kommunikation von Planung in Erwägung zu ziehen.

An Wissenschaftler läßt sich der Appell richten, sich noch stärker als bisher Themen wie der

„Visualisierung als Medium der Planungsunterstützung“;

„Kombination von PPGIS und Visualisierung“;

„Wege und Maßnahmen der Kontrolle von Planungswerkzeugen“;

„Telegeoprocessing als soziale Technologie“, etc. zu widmen.

Um diese Empfehlungen entsprechend umsetzen zu können, werden allerdings auch valide, exakte und nutzbare Daten und Geodaten benötigt. Hier ergeht daher die Forderung an die Verantwortlichen zu handeln, d.h. Aktualisierungszeiträume zu verkürzen, kleinere Aggregationsebenen einzuführen, Nutzung von Daten zuzulassen etc.; Rahmenvereinbarungen, wie sie z.B. erst kürzlich die Bayerische Vermessungsverwaltung mit den bayerischen Landkreisen zur Nutzung amtlicher Geobasisdaten einging, sind hier ein erster Schritt in die richtige Richtung.

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Standortbewertung mit ERRAM 04 (Erreichbarkeitsbasiertes Raster-Raumanalyse Modell)

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1 EINLEITUNG

Im Jahr 2003 erhielt das Konsortium IPE, ARC Seibersdorf und Büro Dr. Paula von der niederösterreichischen Landesregierung den Auftrag, potenzielle Standorte für Industrie, Gewerbe und wirtschaftsnahe Dienstleistungen aus Sicht nachfragender Unternehmen sowie aus Sicht der Raumordnung zu bewerten. Zu diesem Zweck wurde ERRAM – Erreichbarkeitsbasiertes Raster-Raumanalyse Modell – entwickelt, das auf Basis eines 500m/2.500m Rasters flächendeckend die Standortqualität aus Sicht von 23 unabhängigen Nachfragertypen (unterschiedlichen Typen von Unternehmen) sowie der Raumordnung mittels zahlreicher Indikatoren ermittelt.

2 ERRAM – ERREICHBARKEITSBASIERTES RASTER-RAUMANALYSE MODELL

2.1 Ausgangs- und Problemlage

Bisher lag der Fokus bei der Festlegung von vorrangig wirtschaftlich zu entwickelnden Gebieten primär darauf, strukturschwache Gebiete durch Betriebsansiedlung zu stärken. Überlegungen, ob diese Standorte aus Sicht der Unternehmen für eine nachhaltige Entwicklung überhaupt geeignet sind, wurden zumeist nicht angestellt. Die Folge sind heute riesige, als Industrie- und Gewerbegebiet gewidmete Flächen, auf denen nie eine Betriebsansiedlung stattfindet bzw. von denen die Betriebe nach dem Auslaufen von Förderungen rasch wieder verschwinden.

Ziel von ERRAM ist es, Standorte zu finden, die auf Grund ihrer Ausstattung mit den wesentlichen Standortfaktoren eine nachhaltige wirtschaftliche Entwicklung zulassen, um diese dann in einem weiteren Schritt aus raumordnungsfachlicher Sicht zu bewerten. Das Endergebnis bilden jene Flächen, die sowohl aus Sicht der Unternehmen als auch aus Sicht der Raumordnung für eine Ausweisung als Industrie- und Gewerbegebiet geeignet sind.

ERRAM bildet die Meso-Ebene der Standortsuche von Betrieben ab, also jene Phase, in der die Entscheidung für eine bestimmte Region bereits gefallen ist. Makro-ökonomische Rahmenbedingungen, die die Regionen untereinander unterscheiden und die Suche nach einem konkreten Grundstück werden nicht im Modell berücksichtigt.

Folgende Probleme waren für die Beantwortung der Fragestellungen zu lösen:

Wie lässt sich der Begriff der „Standortqualität“ auf der Meso-Ebene eines Bundeslandes objektiv fassen?

Wie ist mit den unterschiedlichen Anforderungen an den Standort bei unterschiedlichen Unternehmen umzugehen?

Statistische Daten liegen gewöhnlich für bestimmte Verwaltungseinheiten vor. Die Beschaffenheit von Standorten richtet sich jedoch nicht nach Verwaltungsgrenzen. Wie können Standortfaktoren unabhängig von Verwaltungsgrenzen berücksichtigt werden?

Wie ist mit dem Themenkomplex „Erreichbarkeit“ umzugehen?

Da die Anzahl der potenziellen Standorte eine Einzelbewertung unmöglich machte, war eine Lösung zu finden, die eine flächendeckende Beurteilung des gesamten Untersuchungsgebietes ermöglicht.

2.2 ERRAM Modellprinzip

Zur Bewertung potenzieller Standorte wurde schließlich ERRAM – Erreichbarkeitsbasiertes Raster-Raumanalyse Modell – entwickelt. Die Charakteristika von ERRAM sind:

Die Bewertung der Standorte erfolgt flächendeckend auf Basis eines 500m-Rasters. Statistische Daten werden mit Raster-Schlüsseln auf das Raster umgelegt und liegen so zur Weiterbearbeitung unabhängig von Verwaltungsgrenzen vor.

Die Standortqualität wird mit Hilfe von quantifizierbaren Standortmerkmalen (Indikatoren) beschrieben.

Die Indikatoren beschreiben nicht die lokalen Gegebenheiten sondern „Erreichbarkeits-Potenziale“.

Die Bewertung erfolgt getrennt für unterschiedliche Typen von Standorte nachfragenden Unternehmen (Nachfragertypen).

Die Gesamteignung wird aus den Eignungen für die einzelnen Nachfragertypen ermittelt. Die aus Sicht der Unternehmen für sehr gut befundenen Standorte werden anschließend einer raumordnungsfachlichen Bewertung unterzogen.

3 INDIKATOREN DER STANDORTQUALITÄT

Die Qualität eines Standorts aus Sicht der Unternehmen kann durch seine Ausstattung mit quantifizierbaren Indikatoren beschrieben werden. Nach der Grundannahme von ERRAM haben Standorte mit ähnlicher Ausstattung – unabhängig von ihrer Lage – grundsätzlich ähnliche Voraussetzungen für eine wirtschaftliche Entwicklung.

Für die Bewertung der niederösterreichischen Standorte wurden 36 Indikatoren festgelegt, die ein thematisch weites Feld vom Arbeitskräftepotenzial unterschiedlicher Qualifikationsstufen über die Erreichbarkeit wichtiger Einrichtungen, Synergiepotenzialen mit anderen Unternehmen bis hin zu weichen Standortfaktoren wie Freizeitangebot u.Ä. abdecken. Die Indikatoren wurden aus einer Vielzahl von Quellen zum Thema Standortqualität zusammengestellt und gemeinsam mit dem Auftraggeber ausgewählt. Voraussetzung für eine Berücksichtigung eines Indikators im Modell war neben seiner Bedeutung für die Standortqualität auch sein diffenziertes Vorliegen innerhalb des Untersuchungsraumes. Standortfaktoren, die innerhalb der Region keine Standorte gegenüber anderen diskriminieren, wurden wegen der Konzentration auf die Meso-Ebene nicht berücksichtigt.

3.1 Indikatorgruppen

Die 36 gewählten Indikatoren stammen aus acht Indikatorgruppen:

Kundenpotenzial

Arbeitskräftepotenzial

Erreichbarkeit

Regionale Bedeutung

Leitungsinfrastruktur

Verfügbarkeit spezieller Einrichtungen und weicher Standortfaktoren

Synergie-/Konkurrenzpotenzial

Rahmenbedingungen und Förderkulisse

Jede dieser Indikatorgruppen fasst mehrere Einzel-Indikatoren zusammen. So enthält beispielsweise die Indikatorgruppe „Arbeitskräftepotenzial" die Verfügbarkeit von Arbeitskräften in vier Qualifikationsstufen und von jährlichen BHS-Absolventen sowie das Medianeinkommen. Die Indikatoren der Standortqualität wurden für alle ca. 76.000 500m-Rasterzellen Niederösterreichs berechnet.

3.2 Erreichbarkeitspotenziale

Viele wesentliche Standortmerkmale werden nicht durch die unmittelbar lokalen Gegebenheiten bestimmt, sondern durch innerhalb eines bestimmten Fahrzeitradius verfügbare Potenziale. So ist etwa für das verfügbare Arbeitskräftepotenzial nicht die Zahl der in der Standortgemeinde (-bezirk etc.) wohnhaften Personen einer bestimmten Qualifikationsstufe ausschlaggebend, sondern die Zahl der Personen, die einen Standort binnen einer gewissen Zeit erreichen können. Somit stellt Erreichbarkeit nicht einen von vielen Indikatoren dar, sie bildet vielmehr die Basis für eine Vielzahl unterschiedlicher Standortmerkmale.

Mit ERRAM sind flächendeckende Erreichbarkeits-Potenzialberechnungen und damit eine Ermittlung der tatsächlichen Ausstattung potenzieller Betriebsstandorte möglich. Darüber hinaus lassen sich mit ERRAM auch „gewöhnliche" Erreichbarkeitsberechnungen vornehmen. Typische ERRAM-Indikatoren sind:

Anzahl der Akademiker im Einzugsbereich von 30 Minuten (siehe Abb. 1)

Anzahl der Beschäftigten einer bestimmten NACE-Gruppe im Einzugsbereich von 15 Minuten

Fahrzeit zur nächsten Anschlussstelle des Hochleistungsstraßennetzes (siehe Abb. 2)

Fahrzeit zum nächsten intermodalen Güterterminal

Anzahl der unterschiedlichen NACE 2-Steller innerhalb von 15 Minuten (Wirtschaftsdiversität) (siehe Abb. 3)

Die Potenziale wurden generell für MIV-Fahrzeiten berechnet, da diese einerseits außerhalb der Großstädte praktisch immer unter den Fahrzeiten im ÖV liegen und andererseits die ÖV-Anschlussqualität derzeit kein Kriterium bei der Standortwahl von Unternehmen darstellt. Da das Ergebnis eine Grundlage für die künftige Standortpolitik darstellen soll, wurde den Berechnungen der Infrastrukturausbauzustand 2010 zugrunde gelegt.

Für die Berechnung der Potenziale wurden unterschiedliche Ansätze getestet. Der „harten Grenze" nach 30 bzw. 15 Minuten wurde schließlich gegenüber einer Abklingfunktion (etwa dem Wilson'schen LOGIT-Ansatz) trotz „ästhetischer" Nachteile aus folgenden Gründen der Vorzug gegeben:

Lässt sich das Ergebnis eines Potenzials mittels einer Abklingfunktion im Falle des Arbeitskräftepotenzials noch über den Umweg einer Arbeitsplatzwahl-Wahrscheinlichkeit als Anzahl von Personen deuten, so ist bei vielen vorgenommenen Potenzialberechnungen – etwa der oben genannten Anzahl der unterschiedlichen vorkommenden Wirtschaftsklassen – eine Interpretation und damit eine Gewichtung nicht mehr möglich. Von der Verwendung unterschiedlicher Potenzial-Begriffe wurde aus Gründen der Konsistenz verzichtet.

Abklingfunktionen erfordern – sollen sie eine Verbesserung gegenüber einer harten Grenze darstellen – eine Kalibrierung der Parameter, für die keine empirische Grundlage vorhanden war.

Der Vergleich der Rechenergebnisse mit unterschiedlichen Verfahren zeigt, dass es zwar im Bereich der mittleren bis unteren Eignungsklassen geringe Verschiebungen gibt, das Modell aber im Bereich der Flächen mit hohen Eingungen – die in weiterer Folge von Interesse sind – sehr stabil reagiert. Für die Beantwortung der Fragestellung war das gewählte Verfahren demnach nicht von großer Bedeutung.

Die Vermittelbarkeit der Indikatoren gegenüber dem Auftraggeber und der Wirtschaft setzt eine gewisse „Anschaulichkeit" voraus.

Generell wurden die Erreichbarkeits-Potenziale für alle Indikatoren mit Arbeitskräfte-Bezug mit 30 Minuten als typisches Zeitbudget für den Arbeitsweg[100] berechnet. Der bei vielen Indikatoren wesentliche Begriff des „unmittelbaren Umfelds" wurde als das mit dem PKW in 15 Minuten erreichbare Gebiet definiert. Die Berechnung der Potenziale und Erreichbarkeiten erfolgte für die niederösterreichischen Standorte auf Basis eines 2.500m-Rasters mittels einer vollständigen Fahrzeitmatrix von jeder Zelle zu jeder Zelle (ca. 36 Mio. Relationen).

[100] Vgl. z.B. Leibrand 1964, Lehner 1982, Szalai 1972

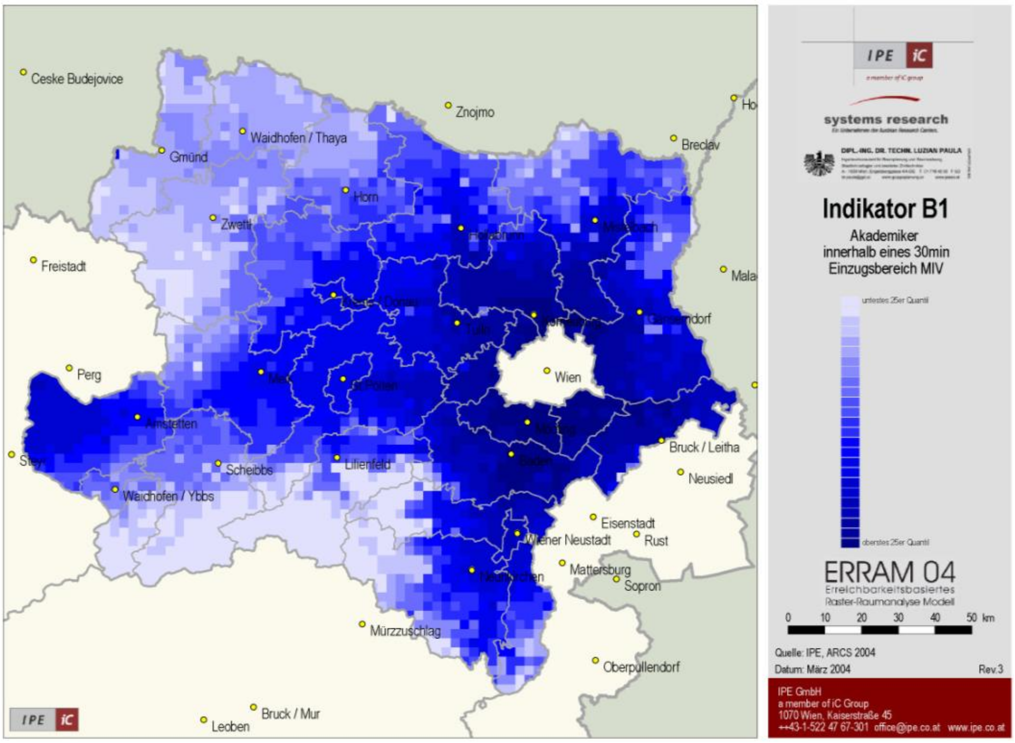

Abb. 1: Indikator „Akademiker innerhalb von 30 Minuten Einzugsbereich im MIV"
(Quelle: IPE, ARCS, Büro Dr. Paula)

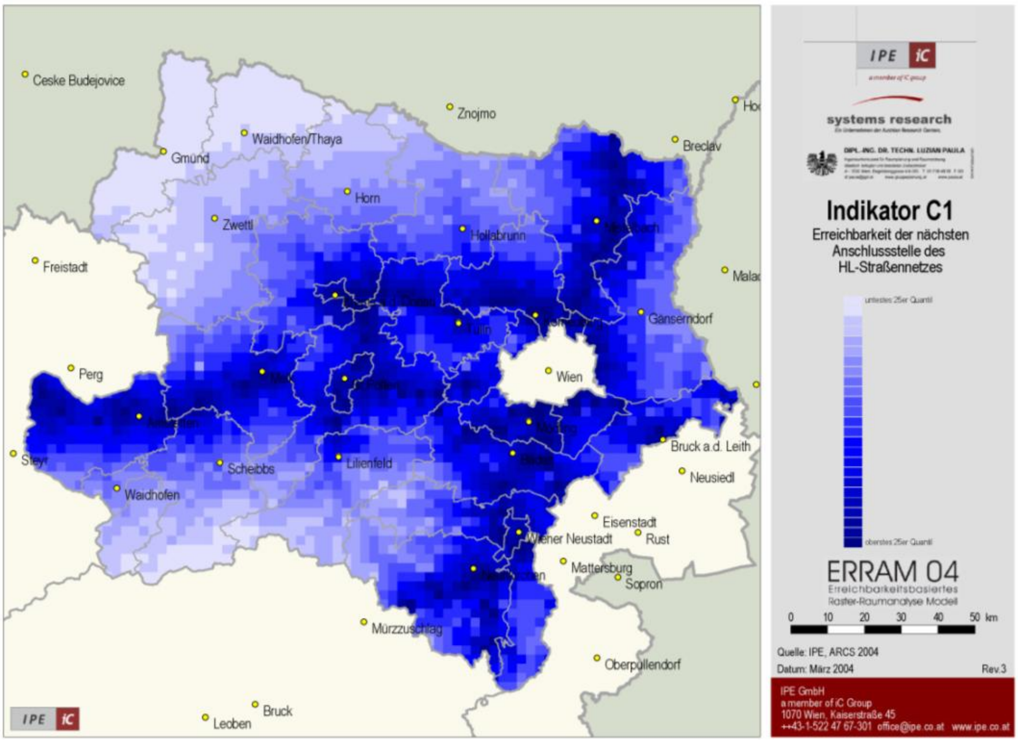

Abb. 2: Indikator „Fahrzeit zur nächsten Anschlussstelle des Hochleistungsstraßennetzes (Ausbauzustand 2010)"
(Quelle: IPE, ARCS, Büro Dr. Paula)

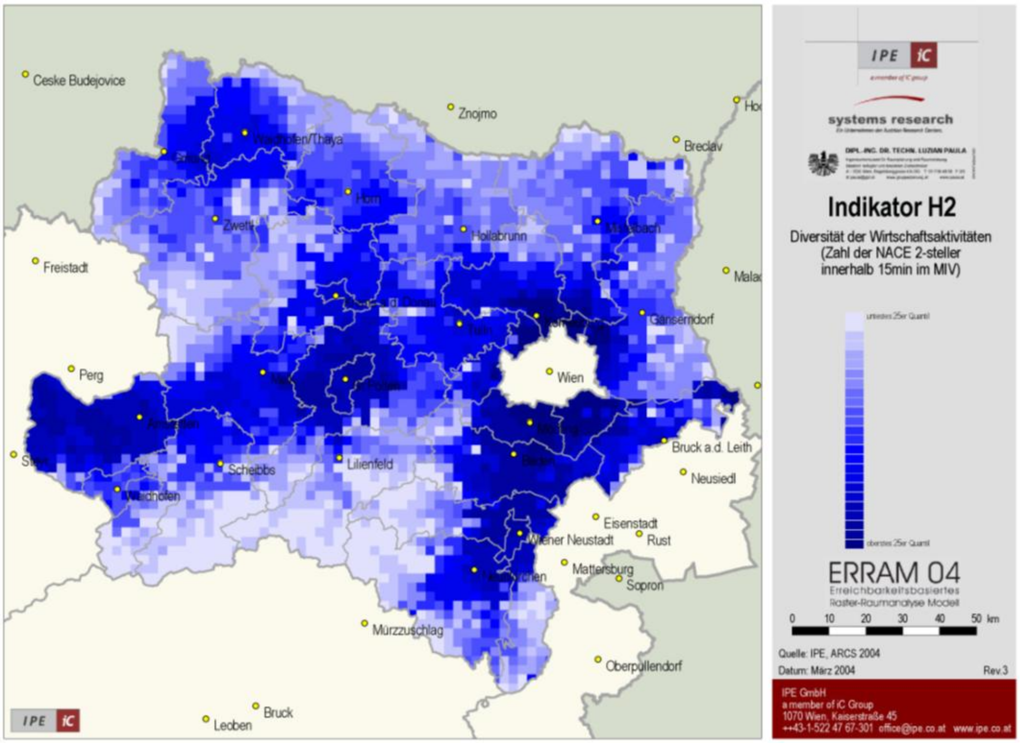

Abb. 3: Indikator „Wirtschaftsdiversität – Zahl der innerhalb von 15 Minuten vorkommenden unterschiedlichen NACE 2-Steller“ (Quelle: IPE, ARCS, Büro Dr. Paula)

4 NACHFRAGERTYPEN UND STANDORTQUALITÄT

Die einzelnen Merkmale der Standortausstattung haben für unterschiedliche Typen von Unternehmen höchst unterschiedliche Bedeutung. Die Beurteilung der Standortqualität erfolgt bei ERRAM daher zunächst getrennt nach Nachfragertypen. Die Typisierung erfolgte dabei nach vier Kriterien – Branche, Subbranche, Ausrichtung (regional bzw. überregional) und Funktion des Betriebs im Unternehmen (Beschaffung/Produktion, Leitung, Absatz). Für Niederösterreich wurden 23 unterschiedliche Typen von Standortnachfragern festgelegt (siehe Tab. 1).

Branche	Subbranche	Aktivitätsraum	Funktion
Sachgütererzeugung	Grundstofferzeugung	überregional	Beschaffung/Produktion
			Leitung
			Absatz
	Verderbliche Güter	überregional	Beschaffung/Produktion
	Hochtechnologie	überregional	Beschaffung/Produktion
			Leitung
			Absatz
	Mischtypen	regional	Beschaffung/Produktion
			Leitung
			Absatz
		überregional	Beschaffung/Produktion
			Leitung
			Absatz
Großhandel	Großhandel	regional	Absatz
		überregional	Absatz
Güterverkehr	Güterverkehr	überregional	Leitung/Organisation
			Übrige Funktionen
Unternehmensnahe Dienstleistungen	Unternehmensnahe Dienstleistungen	regional	Alle Funktionen
		überregional	Leitung/Organisation
			Übrige Funktionen

Tab. 1: Nachfragertypen (Quelle: IPE, ARCS, Büro Dr. Paula)

Auf Basis der Indikatoren der Standortausstattung wurde über ein Gewichtungssystem die Standorteignung für jeden Nachfragertyp (siehe Abb. 4) ermittelt. Die Gewichtung erfolgte hierbei zweistufig für die Indikatorgruppe und für die einzelnen Indikatoren. Die Gewichte wurden zunächst auf Basis unterschiedlicher Quellen geschätzt und anschließend anhand der realen wirtschaftlichen Aktivität kalibriert.

Für die Überlagerung der Standorteignung für die einzelnen Nachfragertypen zu einer Gesamt-Standorteignung aus Sicht der Unternehmen wurden mehrere Verfahren getestet. Zwei Verfahren für unterschiedliche Fragestellungen wurden schließlich für die Bewertung herangezogen:

Bei Verfahren A wurden die Rangzahlen der Einzelbewertungen addiert. Das Ergebnis stellt eine allgemeine Eignung für unterschiedliche Unternehmenstypen in Form eines Rankings aller ca. 76.000 Rasterzellen dar. (siehe Abbildung 5).

Bei Verfahren B wurde gezählt, für wie viele Nachfragertypen ein Standort gut geeignet ist.[101] Das Ergebnis weist zusätzlich zu Verfahren A Flächen auf, die trotz generell nur mäßiger Standortqualität für bestimmte Unternehmenstypen gut geeignet sind.

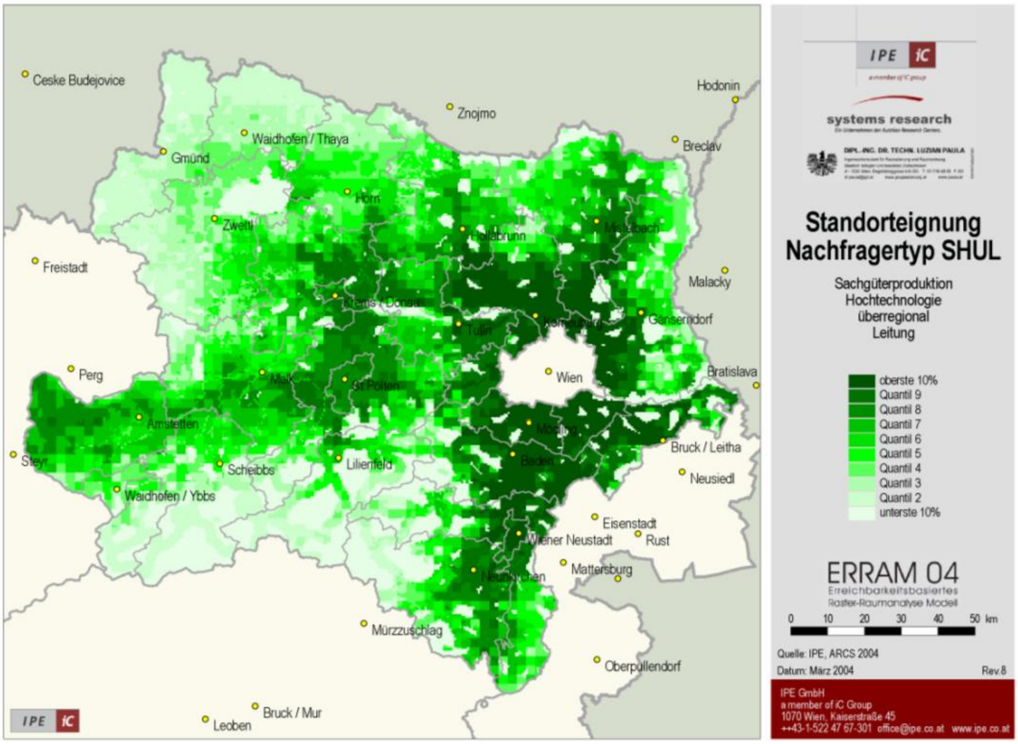

Abb. 4: Standorteignung für Nachfragertyp „Sachgüterproduktion – Hochtechnologie – überregional – Leitungsfunktion“
(Quelle: IPE, ARCS, Büro Dr. Paula)

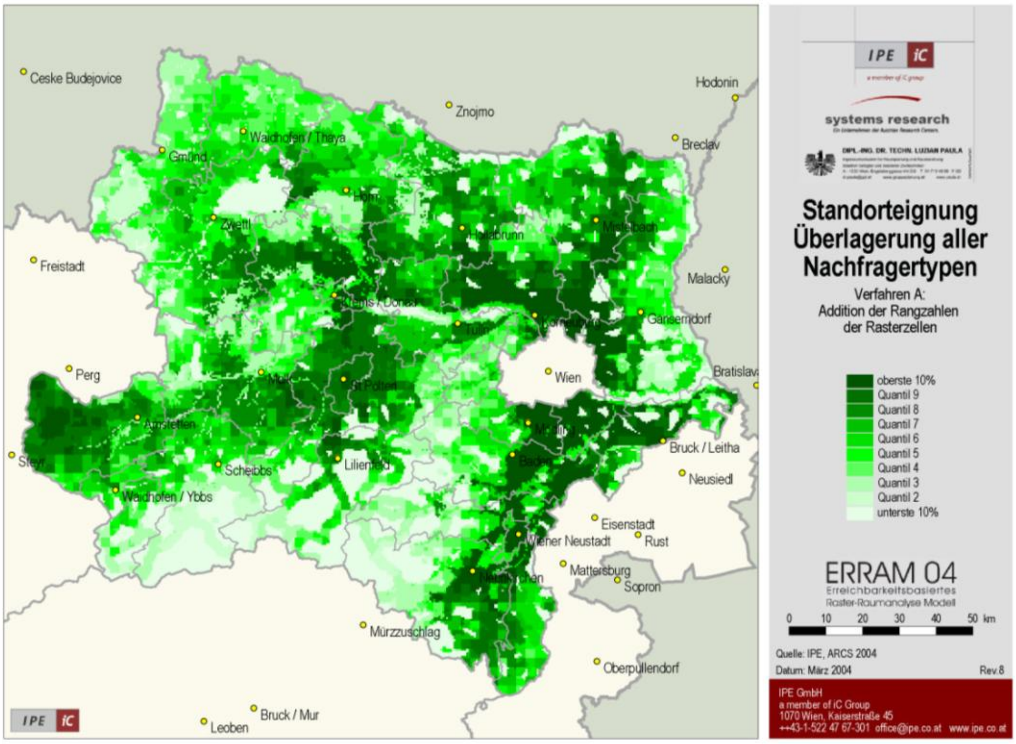

Abb. 5: Gesamtstandorteignung nach Überlagerungsverfahren A
(Quelle: IPE, ARCS, Büro Dr. Paula)

101 Als gut geeignet wurden generell die Standorte im besten Quintil einer Bewertung (Top 20%) definiert.

5 SICHT DER RAUMORDNUNG UND GESAMTSICHT

Zusätzlich zur Sicht der nachfragenden Unternehmen können bei ERRAM auch andere Blickwinkel, wie etwa die Sicht der Raumordnung, integriert werden. Wie bei der Bewertung aus Sicht der Unternehmen wurden auch hier Indikatoren festgelegt, gewichtet und zu einem Gesamtwert aggregiert.

Vom ursprünglichen Plan, komplexere raumplanerische Indikatoren – etwa angestrebte Verdichtungsräume o.Ä. – zu integrieren, wurde auf Wunsch des Auftraggebers abgewichen. Als raumplanerische Indikatoren wurden schließlich unterschiedliche Nutzungsbeschränkungen und die ÖV-Anschlussqualität berücksichtigt.

Die Gesamtbewertung der potenziellen Standorte erfolgte durch eine Überlagerung der verschiedenen Blickwinkel, wobei die aus Sicht der Unternehmen als gut geeignet errechneten Standorte anschließend aus Sicht der Raumordnung bewertet wurden (siehe Abb. 6).

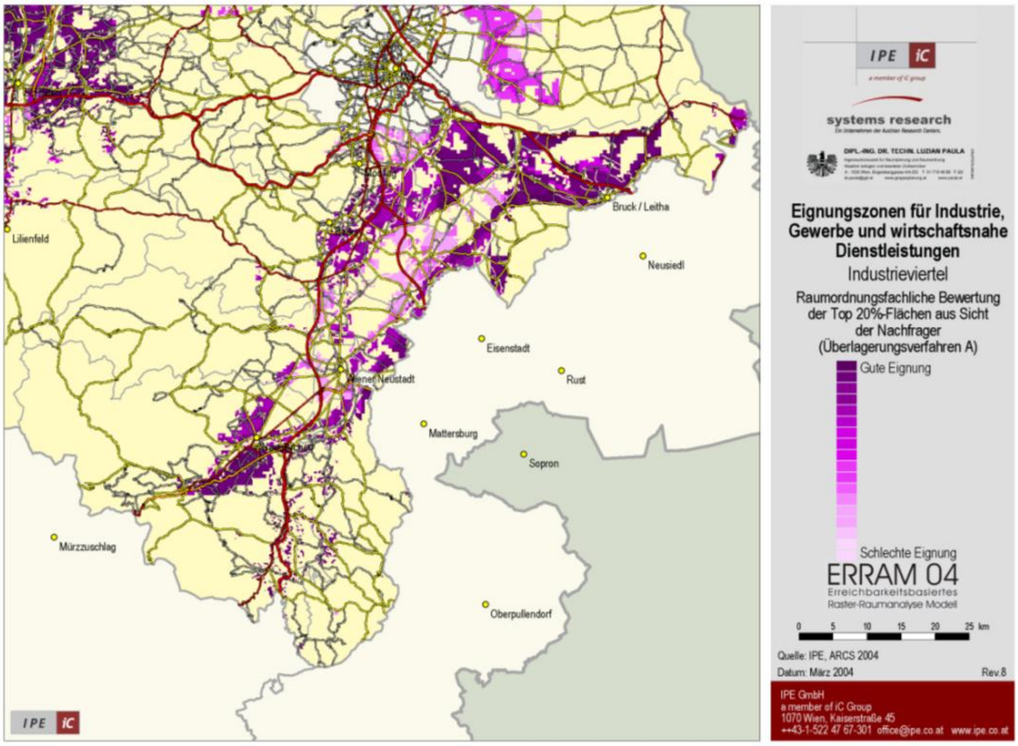

Abb. 6: Eignungszonen für Industrie, Wirtschaft und wirtschaftsnahe Dienstleistungen
(Quelle: IPE, ARCS, Büro Dr. Paula)

6 FAZIT

Der Vergleich der Beschäftigungsentwicklung mit dem Anteil der vom Modell als „gut geeignet" errechneten Flächen ist ein Hinweis auf die Qualität der ERRAM-Ergebnisse, womit der grundsätzliche Ansatz, Bewertungen auf Grund von Erreichbarkeitspotenzialen vorzunehmen, bestätigt werden kann (siehe Abbildung 7).

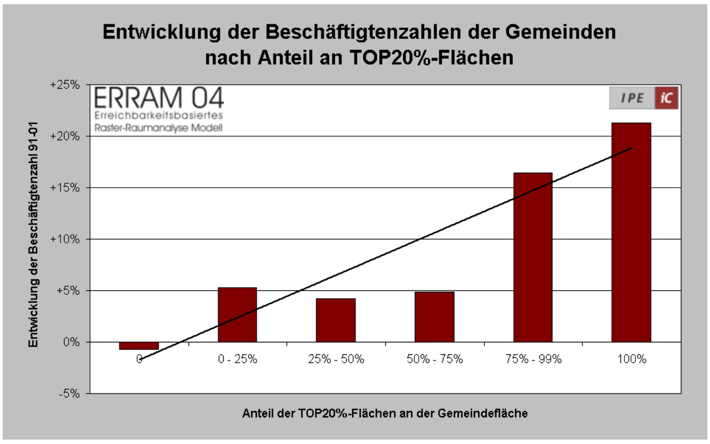

Abb. 7: Eignungszonen für Industrie, Wirtschaft und wirtschaftsnahe Dienstleistungen
(Quelle: IPE, ARCS, Büro Dr. Paula)

Im Bereich der raumordnungsfachlichen Bewertung der Flächen wurden die Möglichkeiten des Modells auf Wunsch des Auftraggebers – der sich die Bewertung selbst vorbehalten möchte – nicht ausgeschöpft. Ein wesentlicher, im Modell nicht zu berücksichtigender Faktor für die Festlegung einer künftigen Standortpolitik stellen regionalpolitische Aspekte dar, die es notwendig machen, in Regionen, die aus Sicht der Unternehmen über keine gut geeigneten Standorte verfügen, dennoch entsprechende Flächen zu widmen. Dem wurde begegnet, indem auch Standort-Rankings innerhalb einzelner Regionen vorgenommen wurden, um so auch die besten Standorte *der jeweiligen Region* errechnen zu können.

7 ERRAM IN ANDEREN PROJEKTEN

ERRAM wurde zunächst für das Projekt „Raumordnungsfachliche Bewertung potenzieller Standorte für Industrie, Gewerbe und wirtschaftsnahe Dienstleistungen in Niederösterreich“ entwickelt. Nach Abschluss des Projekts wurde ERRAM auch erfolgreich in anderen Projekten der IPE eingesetzt.

7.1 Projekt „SIC! – Sustrain implement corridor“

Abb. 8 zeigt für den Untersuchungsraum des Projekts SIC! das Ergebnis einer ERRAM-Potenzialberechnung. Ermittelt wurde das binnen 60 Minuten im MIV erreichbare BIP in € für das Jahr 2020. Abb. 9 zeigt die Differenz dieser Berechnung zur Berechnung für das Jahr 2000. Die Abnahmen des Potenzials im Umfeld der Metropolen Wien, Berlin und Hamburg sind auf die Verzögerungen durch die erwartete Überlastung der Infrastruktur zurückzuführen. Die Abnahmen im Bereich des südlichen Sachsen haben ihre Ursache im fortgesetzten Bevölkerungsverlust durch Abwanderung. Die Basis der Berechnung bildet ein 10km/5km Raster.

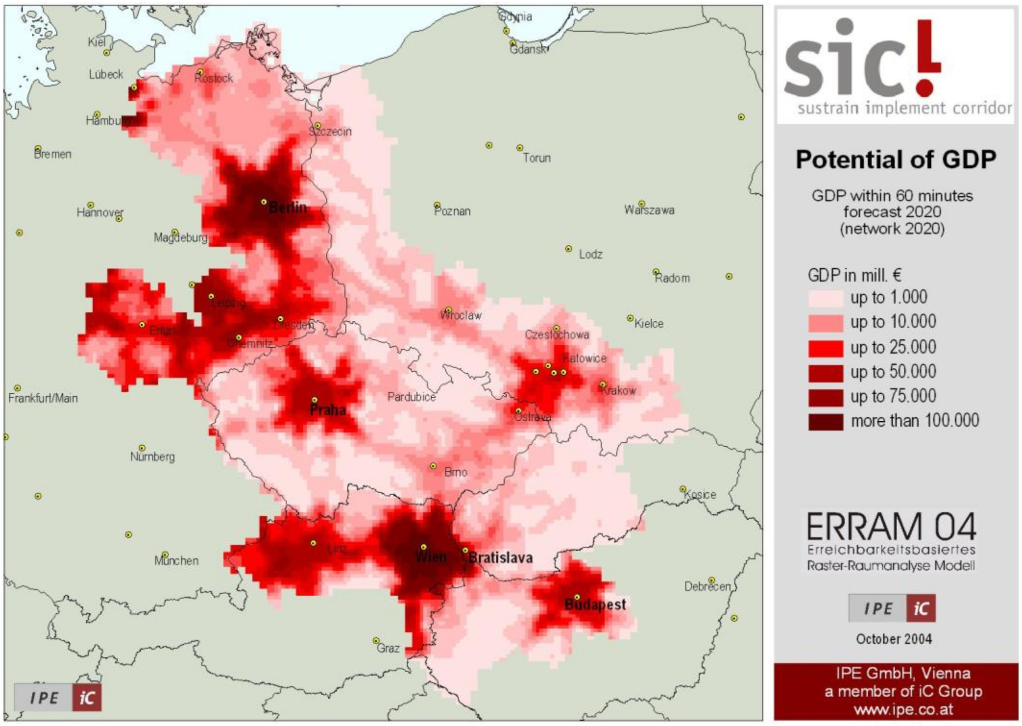

Abb. 8: SIC!: BIP innerhalb von 60 Minuten im MIV 2020 (Quelle: IPE)

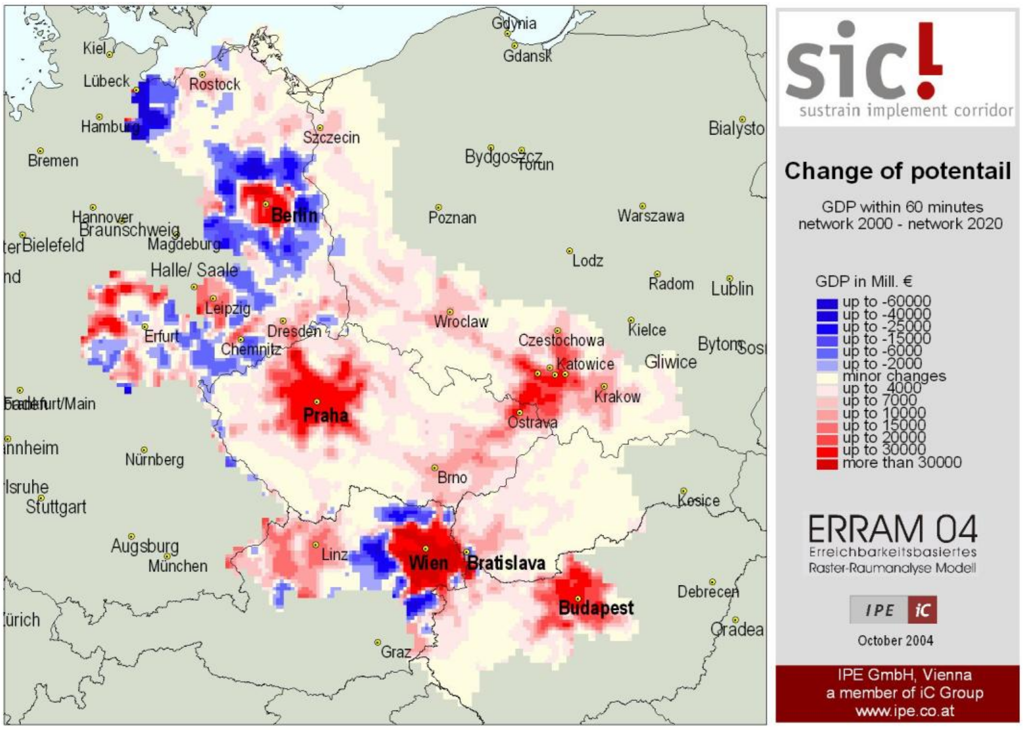

Abb. 9: SIC!: Änderung des BIP innerhalb von 60 Minuten im MIV 2000 bis 2020 (Quelle: IPE)

7.2 Projekt „IMONODE“

Abb. 10 zeigt für die bestehende Bahn-Infrastruktur das Bevölkerungspotenzial innerhalb von 60 Minuten. Abb. 11 zeigt die Änderungen dieses Potenzials durch den Bau von Semmering- und Koralmtunnel. ERRAM kann so durch den Vergleich der Potenzialänderungen zum Variantenvergleich herangezogen werden. Im Projekt IMONODE wurde für ERRAM ein Raster mit unterschiedlichen Rasterweiten (5, 10 und 20km) erstellt.

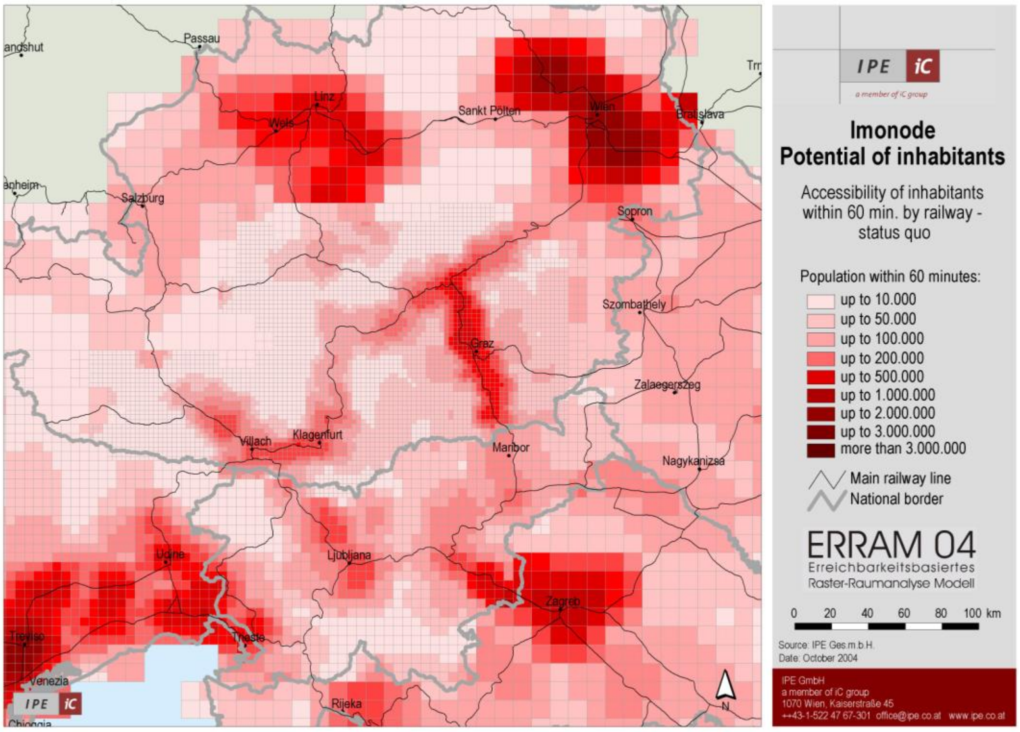

Abb. 10: SIC!: Änderung des BIP innerhalb von 60 Minuten im MIV 2000 bis 2020 (Quelle: IPE)

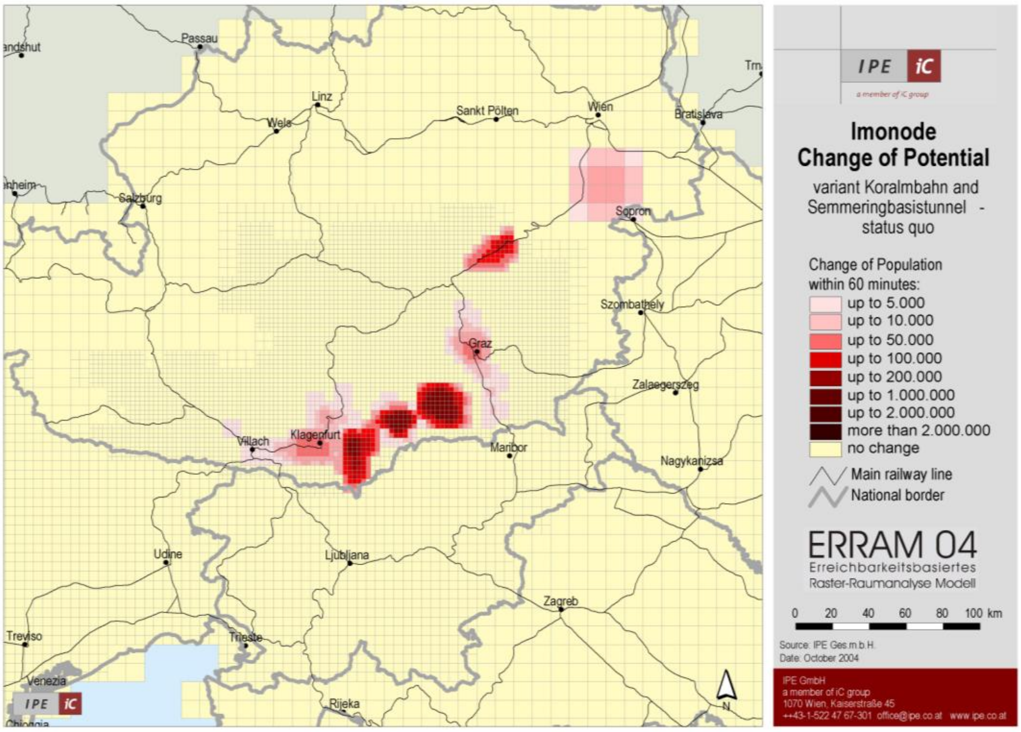

Abb. 11: SIC!: Änderung des BIP innerhalb von 60 Minuten im MIV 2000 bis 2020 (Quelle: IPE)

7.3 Projekt „Synergien im Rahmen der neuen Europaregion“

Im Rahmen des Projekts „Synergien im Rahmen der neuen Europaregion“ wurde ERRAM unter anderem herangezogen, um für den Untersuchungsraum auf Basis der Infrastruktur 2020 die Grenzen der Einzugsbereiche der Flughäfen der Region zu ermitteln (siehe Abb. 12).

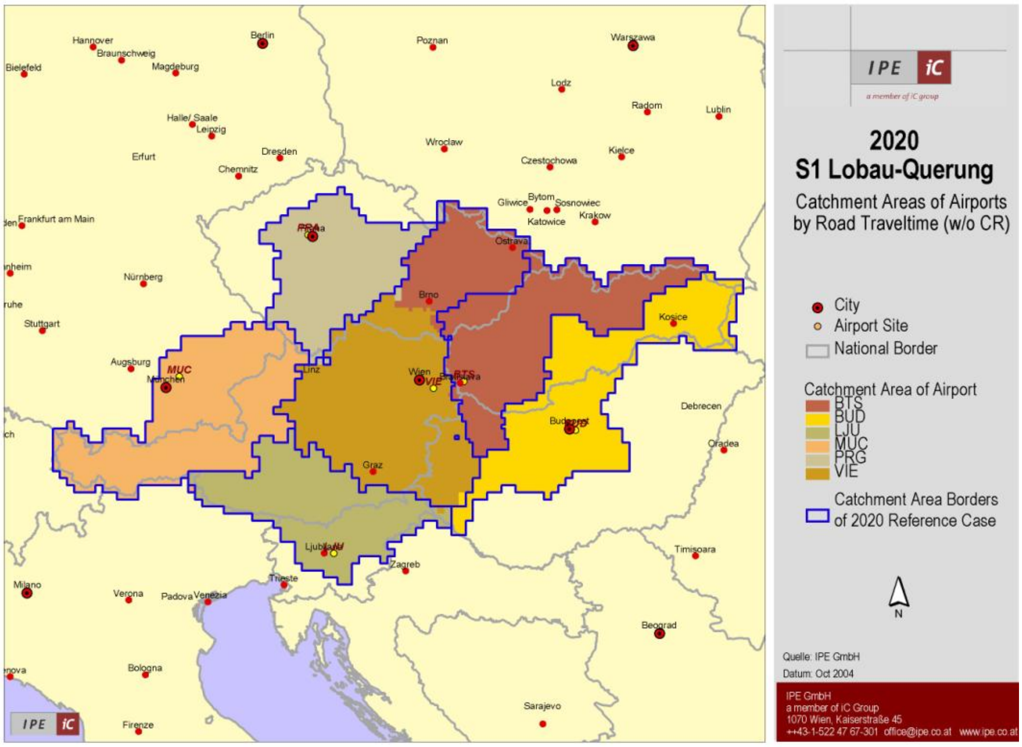

Abb.12: SIC!: Änderung des BIP innerhalb von 60 Minuten im MIV 2000 bis 2020 (Quelle: IPE)

8 ERRAM SOFTWARE

Im Zuge der Projektbearbeitung wurde seitens verschiedener Auftraggeber der Wunsch geäußert, ERRAM Berechnungen auch selbst durchführen zu können. Im Augenblick stellt ERRAM eine wenig benutzerfreundliche Datenbank-Anwendung dar, die nur von Spezialisten bedient werden kann. Derzeit wird jedoch an einer Software gearbeitet, die es ermöglichen soll, dass Auftraggeber nach Abschluss eines ERRAM Projekts selbst mit den Daten weiterarbeiten können.

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Kommunale Raumanalyse mit Nachhaltigkeits-Indikatoren

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1 EINLEITUNG

Raumplanung, Standortplanung und Marktanalyse bedienen sich heute vielfach der methodischen Grundlagen komplexer Indikatoren. Ein wesentliches Hilfsmittel zur planerischen Konkretisierung des Konzeptes der „Nachhaltigkeit“ stellt die Entwicklung und der Einsatz von integrativen raumbezogenen Indikatoren in der Planung dar. Mit Indikatoren-basierter Methodologie wird ein zusätzlicher Informationswert in der Stadtentwicklungsplanung geschaffen, der es ermöglicht, komplexe Sachverhalte und Problembereiche in ihrer zeitlichen Entwicklung zu beobachten.

Nachhaltigkeits-Indikatoren gewinnen in der Raumplanung zunehmend an Bedeutung. Sie sind geeignet die Wirksamkeit von Maßnahmen und Aktionsplänen messen, überprüfen und steuern zu können. Als konkreter Anwendungsbereich kann beispielsweise das Räumliche Entwicklungskonzept der Stadt Salzburg genannt werden, welches derzeit unter Nutzung dieses im gegenständlichen Aufsatz beschriebenen Indikatoren-Methodenkonzeptes erstellt wird. Der bewährte Arbeitsansatz mit Strukturuntersuchung, Raumanalyse und darauf aufgebauter Ziel- und Maßnahmenformulierung wird mit einem „Planungscontrolling“ verknüpft.

2 RAUMPLANUNG IN DER STADT SALZBURG

Auch die Stadt Salzburg konnte - getrieben durch eine immense Wohnungsnachfrage in den Nachkriegsjahrzehnten und einem Bekenntnis zum unbegrenzten Wirtschaftswachstum - der rasanten Siedlungsentwicklung wenig Einhalt gebieten. Großzügige Baulandausweisungen - auch für flächenintensive Einfamilienhausgebiete -, und überdimensionierte Verkehrsprojekte zeichneten diese Periode der ungezügelten Siedlungsentwicklung und des Flächenverbrauches aus.

Eine Trendwende dieser Planungsphilosophie zeichnete sich jedoch ab, als Mitte der 70er Jahre Baulandneuausweisungen in die wertvollen Naturlandschaften im Süden der Stadt Salzburgs bevorstanden. Es drohte die Gefahr, dass Salzburg seinen unvergleichbaren Charakter in der Symbiose von historischer Altstadt und stadtnaher Grünlandbereiche – oft als Salzburger Stadtlandschaft beschrieben – verlieren könnte.

Der Umdenkprozess, vorangetrieben durch eine engagierte Bürgerinitiative, war nicht mehr aufzuhalten. Mit den Grünlanddeklaration, die 1986 vom Gemeinderat beschlossen wurde, konnte ein bedeutsamer Meilenstein gesetzt werden, mit dem klaren Bekenntnis, die Grünlandbereiche zu schützen. Damit wurde dem unkontrollierten Flächenverbrauch ein Riegel vorgeschoben, was dazu führte, dass die weitere Stadtentwicklung nur mehr innerhalb der festgesetzten Bauland-Grünlandgrenzen stattfinden konnte.

Parallel dazu entwickelte sich auch eine neue Verkehrspolitik. Getragen von der Erkenntnis, dass der motorisierte Individualverkehr zu erheblichen Umweltbelastungen beiträgt und die Mobilitätserfordernisse durch dieses Verkehrsmittel alleine nicht zu bewältigen sind, wurde ein verkehrspolitisches Ziel- und Maßnahmenkonzept formuliert (beschlossen vom Gemeinderat 1985), das beispielsweise den Umweltverbund propagiert (Zu-Fuß-Gehen, Radfahren, ÖPNV-Benützung).

2.1 Nachhaltige Stadtentwicklungsplanung

Mit diesen Initiativen wurde der Grundstein für eine nachhaltige Stadtentwicklung geschaffen. Während diese Konzepte jedoch noch als eigenständige Fachkonzepte entwickelt wurden, die auf eine bestimmte Problemstellung abzielten, wurde im Räumlichen Entwicklungskonzept 1994 (Amt für Stadtplanung, 1996) erstmals ein gesamtstädtisches und querschnittsübergreifendes Konzept vorgelegt. Dieses Leitbild folgt bereits deutlich dem Nachhaltigkeitsgedanken. Unter anderem wird als Hauptziel die „Nachhaltige Siedlungsentwicklung“ (Amt für Stadtplanung, 1996, S 18) genannt und wie folgt präzisiert: „Die rasche Errichtung neuen Wohnraumes und Bereitstellung geeigneter Flächen für die Wirtschaft an stadt- und infrastrukturell geeigneten Standorten soll unter Wahrung des Prinzips der Ressourcenschonung (sparsamer Umgang mit Grund und Boden, geringe ökologische Belastung) und des Ausgleiches zwischen den Stadtteilen mit Hilfe des neuen Instruments der Vertragsraumordnung gewährleistet werden. Die besonders belasteten Stadtteile (…) sollen bei Infrastrukturentscheidungen, die zu einer Verbesserung der Lebensqualität führen vorrangig behandelt werden.“

Was sind nun aber „geeignete Standorte“? Was bedeutet „Ressourcenschonung“ oder wie werden „Infrastrukturenscheidungen zur Verbesserung der Lebensqualität“ konkretisiert? Das Amt für Stadtplanung verfolgt nun einen neuen Arbeitsansatz unter Anwendung von Nachhaltigkeits-Indikatoren, um jene exemplarisch angeführten Fragestellungen behandeln zu können.

Die aktuelle Strategie zur Nachhaltigen Stadtentwicklung ist dabei geprägt durch eine konsequente Innenentwicklung. Die Nachverdichtung durch Schließung von Baulücken und die gezielte Ausnutzung der maximal möglichen Baudichten ermöglicht bereits einen erheblichen Gewinn an neuen Flächen für Wohnraum und Betriebsansiedlungen. Als wichtigste Planungshilfe dazu ist ein GIS-gestützter Baulandreservenkataster zu nennen, der seit 1992 geführt wird. Die zweite Strategie sieht vor, durch Umstrukturierung und Aufwertung brachliegender oder minderwertig genutzter Flächen neuen Wohnraum und Betriebsflächen innerhalb des definierten Siedlungsraumes zu schaffen. Ein wesentlicher Aspekt dabei ist die optimale Nutzung vorhandener Infrastruktur bzw. das frühzeitige Erkennen von Defiziten. Die Infrastrukturplanung hat dabei die Forderungen nach Wirtschaftlichkeit sowie nach einer angemessenen qualitativen Versorgungsqualität mit zumutbarer Erreichbarkeit flächendeckend sicherzustellen. Die räumliche Nähe von Wohnen, Versorgung, Bildung, etc. erhöht einerseits die Wahrscheinlichkeit der Nutzung umweltfreundlicher Verkehrsmittel und stärkt andererseits die Wirtschaftlichkeit dieser Einrichtungen am jeweiligen Standort.

Gerade das letztgenannte Kriterium ist angesichts der Budgetnöte der kommunalen Haushalte nicht zu unterschätzen, da kostenintensiven Infrastruktur-Neuerrichtungen (in Verbindung mit Baulandneuausweisungen) zugunsten einer optimalen Auslastung bestehender Einrichtungen eindeutig der Vorzug zu geben ist.

3 RÄUMLICHE INDIKATOREN

Da das Konzept der „Nachhaltigen Raumentwicklung" allgemeiner Natur und sehr abstrakt ist, bedarf es einer Entwicklung von integrativen Bewertungsverfahren und räumlichen Meßgrößen zur begleitenden Beobachtung und Kontrolle von Raumentwicklungs- und Planungsprozessen. In der Agenda 21 (Kapitel 40 - Information zu Entscheidungsfindung) wird explizit die Entwicklung und Anwendung von Messgrößen gefordert (vgl. Dietrichs, B., Fritsche A. und F. Ismaier, 2000). Die räumliche Referenz - der Raumbezug - ist für die Operationalisierung eines integrativen Konzeptes nachhaltiger Entwicklung von großer Bedeutung. Je nach Aussageziel gibt es differenzierte Anforderungen an die Bezugsebene. Die zu wählende räumliche Bezugsebene von Indikatoren ist von der Verfügbarkeit von Datengrundlagen sowie vom jeweiligen Aussageziel abhängig. Raumplanerische Entscheidungen auf regionaler und lokaler Ebene erfordern jedoch räumlich explizite und möglichst disaggregierte Indikatoren. Ziel ist eine schrittweise räumliche und zeitliche Konkretisierung „Nachhaltigen Raumentwicklung" durch räumliche Indikatoren.

Für die Kommunikation komplexer räumlicher Sachverhalte und raumbezogener Entwicklungen bedarf es „technischer Wahrnehmungshilfen", die die Zustände und Entwicklungen räumlicher Strukturen „sichtbarmachen" (vgl. Dietrichs, B., Fritsche A. und F. Ismaier, 2000). Indikatoren als „proxy variables" für nicht direkt oder nur mit unverhältnismäßig hohem Aufwand erfassbare Faktoren haben die Funktion als Messgröße charakteristische Aussagen über definierte Sachverhalte bereitzustellen. Diese stehen für nicht direkt messbare Faktoren und werden meist aus allgemein verfügbaren Maßzahlen zusammengesetzt, um regionale Vergleiche wie auch zeitliche Längsschnitte zu ermöglichen. Je nach ihrer Definition vermitteln Indikatoren unterschiedliche Informationen und erfüllen somit verschiedene Funktionen. Im gegenständlichen Beitrag geht es vor allem um die Messung räumlicher Zustände (Zustandsindikatoren - indicator of state) in ihrer zeitlichen Entwicklung (EntwicklungsIndikatoren - indicator of progress). Ziel des Einsatzes von Indikatoren ist es, die Kommunikations-Komplexität zu reduzieren und ein näherungsweises Abbild der Realität zu erzielen.

Indikatoren als Messgröße und Bewertungsgrundlage für raumbezogene Entwicklungen gewinnen sowohl auf lokaler, regionaler als auch auf internationaler Ebene zunehmend an Bedeutung. Um signifikante Aussagen im Sinne der Nachhaltigkeit zu erhalten bedarf es für die thematischen Hauptbereiche der Nachhaltigkeit - Soziales, Ökologie, Ökonomie - der Auswahl eines ganzen Bündels von Indikatoren bzw. eines integrativen Indikatorensystems. Die im gegenständlichen Beitrag angesprochene Thematik der Versorgung mit Gütern des täglichen Bedarfes ist integrativer Bestandteil eines Bewertungsverfahrens das mit Indikatoren-basierter Methodologie Entscheidungsunterstützung in diversen Anwendungsgebieten leistet. Weitere Themenbereiche des multikriteriellen Bewertungsverfahrens sind u.a. Öffentlicher Personennahverkehr, Kinderbetreuung, Pflichtschulen und Naherholung.

Für die Beurteilung der Zielereichung von Planungsprozessen stellen räumliche Indikatoren ein zentrales Element dar. Es gibt jedoch keine definierten Zielgrößen sowie keine konkrete Definition für Nachhaltigkeit auf lokaler Ebene. Somit fehlen in der Regel eindeutige Nachhaltigkeitsziele an welchen sich Planung und Politik orientieren können. Hierfür bietet sich der Vergleich (Benchmark) zu anderen Städten an, um die Entwicklung einer Stadt oder Region zu messen.

3.1 Raumbeobachtung

Ziel und Aufgabe der indikatorengestützten Raumbeobachtung ist die systematische Beobachtung und Auswertung räumlicher Zustände in ihrer zeitlichen Entwicklung. Solche Entwicklungsprozesse sind in der Regel nur *„sehr eingeschränkt sinnlich erfahrbar"* (Siedentop, 1998). Durch die Beschreibung räumlicher Prozesse - Bsp.: Entwicklung der wohnortnahen Versorgungsqualität mit Gütern des täglichen Bedarfes - wird ein zusätzlicher planungsrelevanter Informationswert geschaffen. Planungsziel ist die Ableitung eines Planungs-Handlungsbedarfes aus den Erkentnissen der laufenden Raumbeobachtung.

Indikatoren als Bewertungsmethode der räumlichen Entwicklung stellen bedeutende Richt- und Orientierungswerte für die raumbezogene Planung dar. Entwicklungsziele (Sollwerte) einer nachhaltigen Stadtplanung können quantifiziert und Aussagen zu räumlichen Entwicklungen *„Entspricht die Entwicklung den städtischen Zielvorstellungen?", „Wenn es Versorgungslücken gibt, wo treten diese auf?"* - präzisiert werden.

Durch die laufende Erfassung und Auswertung raumrelevanter Entwicklungen sowie den daraus gewonnen Erkenntnissen können raumrelevante Entwicklungen bzw. Risken rechtzeitig erkannt und zielorientierte Handlungsvorschläge für eine zukunftsorientierte und sachgerechte Kommunalplanung und Politik abgeleitet und entwickelt werden. Insofern gewinnt die Stadt- und Raumforschung als Aufgabe der angewandten Stadt- und Verkehrsplanung an grundlegender Bedeutung, nicht zuletzt auch um das Konzept der Nachhaltigkeit verstärkt zu implementieren.

Das nun folgende Fallbeispiel zeigt den Planungsablauf beginnend mit einer Strukturuntersuchung, einem Monitoring der räumlichen Entwicklung sowie darauf aufgebauter Steuerungsmaßnahmen zur nachhaltigen Stadtentwicklung auf.

4 FALLBEISPIEL: NAHVERSORGERSTANDORTE – WOHNUNGSNAHE VERSORGUNGSQUALITÄT

Der anhaltende Konzentrationsprozess im Einzelhandel verursacht in der Regel verstärkte räumliche Disparitäten bei der Versorgung mit Gütern des täglichen Bedarfes. Durch die zunehmende Bevorzugung individual-verkehrsorientierter Nahversorgungsstandorte gegenüber wohnungsnahen Lagen, besteht die Gefahr der Verschlechterung der wohnortnahen Versorgung mit Gütern des täglichen Bedarfes. Dem Rückzug des Handels aus der flächenhaften Versorgung sind vor allem die darauf angewiesenen Bevölkerungsschichten (weniger mobile Personen) ausgesetzt, vor allem wird jedoch beträchtlicher Einkaufsverkehr generiert. In Planungen sollte neben der ökonomischen Verträglichkeit (Verkaufsfläche, Branchenmix, etc.) insbesonders auch die flächenhafte Versorgungssituation der Wohnbevölkerung berücksichtigt werden (Prinz 2003).

Aus siedlungsgeographischen, sozialen und verkehrsplanerischen Überlegungen ist die Stadtplanung bestrebt, eine optimale Versorgung mit Gütern des täglichen Bedarfes im direkten Wohnumfeld sicher zustellen. Hierfür findet in regelmäßigen Zeitabständen eine Modellierung der Versorgungsqualität unter Berücksichtigung der fußläufigen Erreichbarkeit sowie der standortbezogenen Angebotsqualität (Voll- bzw. Teilversorger) statt. Abbildung 1 stellt den flächenhaften Indikator: Nahversorgung – Versorgungsqualität der räumlichen Verteilung der Wohnbevölkerung (Einwohner mit Hauptwohnsitz je ha) gegenüber. Ziel der indikatorengestützten Versorgungsanalyse für Güter des täglichen Bedarfes ist es, unterversorgte bzw. schlecht versorgte Bereiche zu lokalisieren und unter Einbeziehung möglichst kleinräumiger Strukturinformationen zu quantifizieren. Die Grundlagen der Analyse der wohnungsnahen Versorgung mit Gütern des täglichen Bedarfes sind in Prinz (2003) ersichtlich.

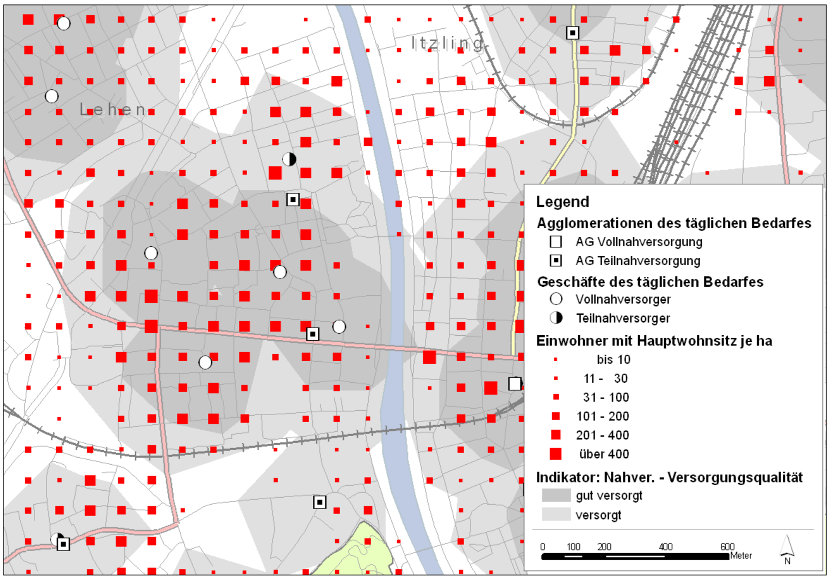


Abb.1: Wohnortnahe Versorgungsqualität mit Gütern des täglichen Bedarfes 2002

Die wechselseitige Betrachtung der Versorgungsqualität mit den betroffenen Einwohnern ist u.a. Grundlage für eine Formulierung von Maßnahmen für eine bedarfsorientierte Infrastrukturplanung. Die Stadtentwicklungsplanung ist jedoch daran interessiert im Planungsprozess Entwicklungsziele einer vorrausschauenden Raumentwicklungspolitik „aktiv" zu berücksichtigen. Von großem planerischem und öffentlichem Interesse ist die Thematik der Raumbeobachtung im äußerst dynamischen Lebensmitteleinzelhandel. Wie wirkt sich der fortschreitende Konzentrationsprozess im Lebensmitteleinzelhandel auf die flächenhafte Versorgungsqualität der Wohnbevölkerung aus?

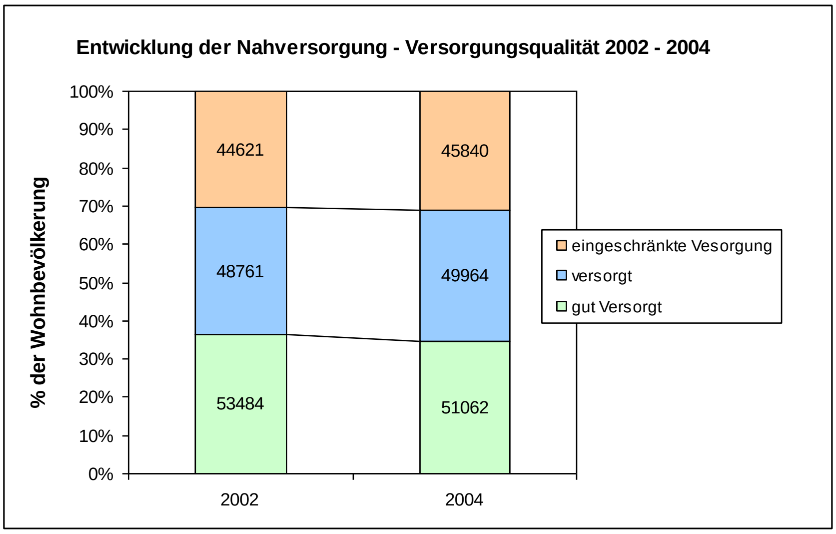


Abb.2: Indikator - Nahversorgung / Versorgungsqualität in der Stadt Salzburg (zeitlicher Vergleich 2002 – 2004)

Die ausgewerteten Analysen zur Beurteilung der wohnungsnahen Versorgungsqualität aus den Jahren 2002 und 2004 ergeben eine geringfügige Abnahme der wohnortnahen Versorgungsqualität mit Gütern des täglichen Bedarfes in der Stadt Salzburg. Quantitative Aussagen zur Entwicklung der Versorgungsqualität in der Stadt Salzburg in Bezug zur Wohnbevölkerung sind in Abb. 2 wiedergegeben.

Vom planerischen Interesse ist neben der quantitiven Aussage zur Entwicklung der Versorgungsqualität der explizite Raumbezug von Indikatoren. Dadurch können Trends nicht nur in Globalzahlen gefasst sondern auch räumlich lokalisiert werden. Im Stadtteil Lehen im Bereich des Stadtwerkeareals ist beispielsweise eine Verringerung der Versorgungsqualität feststellbar.

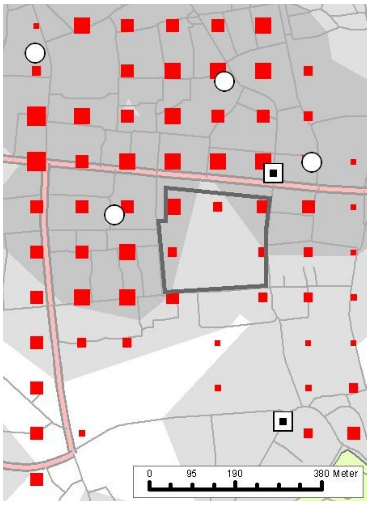
4.1 Projektentwicklung – "Stadtwerkeareal"

Das sogenannte „Stadtwerkeareal", welches im Rahmen des Stadtteilentwicklungskonzeptes „Entwicklungskorridor Lehen" aktuell bearbeitet wird, ist ein Musterbeispiel für den Planungsansatz unter Anwendung des Nachhaltigkeitskonzeptes. In einem moderierten Planungsverfahren wird mit Planungsfachleuten, Anrainern und Investoren ein neue städtebauliche Lösung für das Areal dieser ehemaligen Verwaltungs-und Betriebszentrale des städtischen Energieversorgers gesucht. Das rund 4 ha große Areal wird derzeit extensiv betrieblich genutzt. Angedacht ist eine Nachnutzung in Form einer urbanen Mischnutzung mit 300 – 500 Wohneinheiten, Büros und Geschäften sowie öffentlich zugänglichen Freiflächen. Als konkretes Planungsziel ist dabei in erster Linie die Bereitstellung neuen Wohnraums zu nennen. Dabei kommt die Handlungsstrategie der Innenentwicklung voll zum Tragen. Sowohl durch Umstrukturierung (Wohnnutzung statt Betriebsareal) als auch durch eine maßvolle Nachverdichtung soll neuer, kostengünstiger (Miet)Wohnungsbau enstehen. Im Sinne der sozialen Verantwortung wird dabei ein wichtiger Beitrag für die Wohnungssuchenden geleistet. Der ökologische Aspekt kommt dabei nicht zu kurz. Vor den Hochbaumaßnahmen wird noch eine umfassende Altlastensanierung durchgeführt. Die Verbauung selbst soll sich auf 50% des Areals beschränken um genügend Freiflächen mit öffentlicher Zugänglichkeit zu gewährleisten. Beim Verkehrskonzept ist eine völlige Verkehrsfreimachung an der Oberfläche vorgesehen. Aufschließung und Versorgung sollen unterirdisch erfolgen. Die hervorragende Anbindung und Erreichbarkeit mit den Verkehrsmitteln des Umweltverbundes ist ein weiteres Qualitätsmerkmal dieses innenstädtischen Entwicklungsgebietes. Das Entwicklungsgebiet zeichnet sich also bereits durch eine gute Infrastrukturausstattung aus. Eine umfassende Raumanalyse muss sich aber auch mit raumwirksamen Auswirkungen von Planungsvorhaben sowie möglichen Entwicklungschancen auseinander setzen.

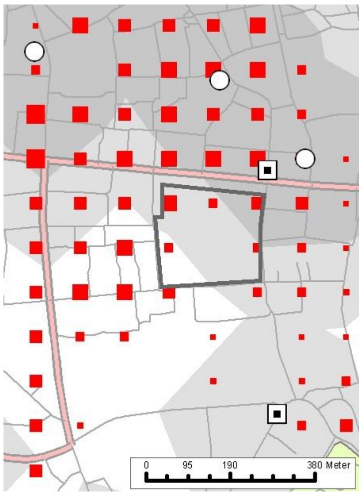
Die indikatorengestützte Beobachtung der Entwicklung der wohnortnahen Versorgungsqualität mit Gütern des täglichen Bedarfes zeigt aktuell eine Verringerung der wohnortnahen Versorgungsqualität im Bereich des Stadtwerkeareals (Abb. 3). Diese resultierte durch die Schließung eines Lebensmittelmarktes in der Sparkassenstrasse.

Indikatoren stellen transparente Entscheidungshilfen dar, sowohl für die Bewertung verschiedener Planungsalternativen wie auch als Controllinginstrument für die Evaluierung durchgeführter Projekte. Um die raumwirksamen Auswirkungen von Planungsmaßnahmen (Zuweisung von Flächennutzungen, etc.) im Bereich des Stadtwerkeareals zu bewerten, werden die Auswirkungen eines potenziellen Nahversorger-Standortes in der Rossegerstrasse hinsichtlich der flächenhaften Versorgungsqualität modelliert. Weiters erfolgt die Berechnung von Potenzialen der ortansässigen Nachfrage. Die indikatorengestützten Auswertungen zu den räumlichen Darstellungen (Abb. 3) sind in Tabelle 1 wiedergegeben. Die quantitativen Auswertungen beziehen sich auf den in Abb. 3 dargestellten Raumauschnitt (insgesamt wohnen 10.122 Einwohner in diesem skizzierten Bereich).

Skizze 1: Situation Stadtteil Lehen

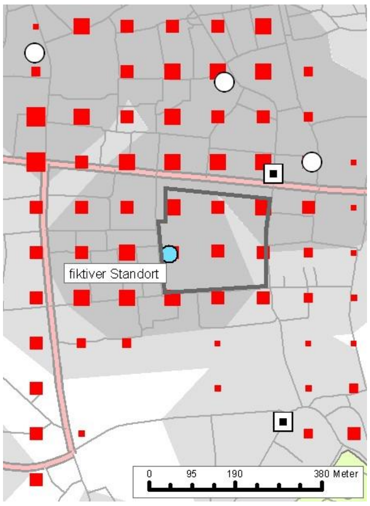


Skizze 2: Versorgungsqualität 2002



Skizze 3: Versorgungsqualität 2004

Abb.3: Wohnortnahe Versorgungsqualität mit Gütern des täglichen Bedarfes im Stadtteil Lehen



Skizze 4: Versorgungsqualität mit potenziellen Standort Gaswerkgasse

Indikator	Skizze 2	Skizze 3	Skizze 4
gut versorgt	8161	5417	7542
versorgt	1613	2772	2196
eingeschränkt versorgt	348	1933	384

Tab. 1: Indikator - Nahversorgung / Versorgungsqualität im Untersuchungsgebiet (siehe Skizze 2 – 4)

Über 6.000 Einwohner mit Hauptwohnsitz wohnen im nahen fußläufigen Einzugsbereich (bis zu 500 m) des potenziellen Vollversorger-Standortes (Skizze 4) in der Rossegerstrasse. Die Konkurrenzsituation mit anderen existierenden Standorten wurde bei den Berechnungen nicht berücksichtigt. Von kommunalen Interesse ist die Modellierung der Auswirkung potenzieller Standorte auf die flächenhafte Versorgungsqualität. Die indikatorengestützte Auswertung ergibt eine signifikante Erhöhung der Versorgungsqualität „gut versorgt" für 2125 Bewohner (von 5417 auf 7542)! Nur mehr 384 Bewohner sind dem Indikator „eingeschränkt versorgt" hinzuzurechnen.

Hinzu kommt ein zusätzliches Einwohnerpotenzial durch die Nachnutzung des Stadtwerkeareals in Form einer urbanen Mischnutzung mit 300 – 500 Wohneinheiten. Dieses Potenzial wurde im Rahmen einer Szenarienberechnung auf die Einwohner-Hektarraster-Zellen (Skizze 4) aufaggregiert. Dieses Potenzial ist in den quantitativen Auswertungen (Tab. 1) noch nicht eingerechnet.

5 ZUSAMMENFASSUNG UND AUSBLICK

Mit den gewonnenen Erkenntnissen können, ausgehend von generellen Aussagen zum Räumlichen Entwicklungskonzept bis hin zur Erstellung des Masterplans sowie zur flächenspezifischen Zuweisung von Nutzungen im neu zu erstellenden Flächenwidmungs- und Bebauungsplan fundierte Planungsaussagen und Festlegungen getroffen werden. Natürlich soll auch die ökonomische Dimension dieser Problemstellung nicht unerwähnt bleiben, da auch Investor und Betreiber des Nahversorgers hinsichtlich der Standortplanung und wirtschaftlichen Betriebsführung verbesserte Grundlageninformationen vorfinden und somit auch der integrative Ansatz des Nachhaltigkeitsgedankens aus wirtschaftlicher Perspektive erfüllt wird.

Ziel ist das Indikatoren-basierte Verfahren sowohl methodisch als auch inhaltlich weiterzuentwickeln, um raumwirksame Auswirkungen zukünftiger Flächenwidmungen sowie Maßnahmen zur Steuerung nachhaltiger Raum- und Infrastrukturplanung transparent bewerten zu können.

6 QUELLENVERZEICHNIS

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SUPERNOVA - Simulationsmodell zur Untersuchung der PERsonenverkehrsNachfrage bei Optimierung des VerkehrsAngebots

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1 PROJEKTIDEE

Um die Planungskompetenz beim Personenverkehr der Österreichischen Bundesbahnen entscheidend auszubauen, wurde Ende 2002 die Entscheidung getroffen, ein Planungs- und Bewertungstool basierend auf einem eigenen österreichweiten Nachfragesimulationsmodell aufzubauen. Vorrangiges Ziel war es, kurzfristig und ohne Abhängigkeit von externen Stellen neu entwickelte Angebotskonzepte bezüglich ihrer Kundenwirkung evaluieren zu können. Der Projektname **SUPERNOVA** leitet sich auch genau aus diesem Hauptziel ab, steht er doch für „**S**imulationsmodell zur **U**ntersuchung der **PER**sonenverkehrs**N**achfrage bei **O**ptimierung des **V**erkehrs**A**ngebots".

Da das Modell als Eingangsgrößen unter anderem auch die Daten aus der elektronischen Fahrplanauskunft enthält, kann es darüberhinaus auch noch als geografisches Informationssystem genutzt werden. Somit entstand, gleichsam als „Abfallprodukt", im Zuge von SUPERNOVA auch die umfassendste räumliche Darstellung des öffentlichen Verkehrsangebots in Österreich.

2 ENTWICKLUNG DES MODELLS

Das Projekt SUPERNOVA wurde im Oktober 2002 gestartet, der Abschluss mit Überleitung des Tools in die Linientätigkeit der Personenverkehrs AG erfolgte termingerecht Anfang 2005. Bereits vor dem Projektstart zeigte sich die Erwartung des Managements an SUPERNOVA, relativ kurzfristig erste Bewertungsergebnisse liefern zu können. Demgegenüber stand die vergleichsweise lange Bearbeitungsdauer, die für die Erstellung eines Verkehrsmodells unabdingbar ist. Somit musste softwareseitig auf ein praxiserprobtes Produkt zurückgegriffen werden, und auch bei den Eingangsdaten bediente man sich in der ersten Phase bereits vorhandener Datengrundlagen.

2.1 Softwareeinführung und Modellentwicklungsphase 1

2.1.1 <u>Einführung der Software VISUM bei ÖBB Personenverkehr</u>

Grundlage des Modells bildet die Planungssoftware VISUM der Firma PTV AG aus Karlsruhe. Entscheidend für die Wahl dieses Produkts war, wie bereits erwähnt, dessen bereits langjährige Anwendung bei einer Vielzahl von Verkehrsunternehmen. Auch die ständige Weiterentwicklung durch ein umfangreiches Entwicklerteam gab den Ausschlag zugunsten von VISUM.

Praktisch gleichzeitig mit der Softwareimplementierung wurde das beim BM für Verkehr, Innovation und Technologie (BMVIT), Abteilung I/K 4 betriebene Verkehrsmodell Österreich (VMÖ), welches ebenfalls auf VISUM basiert, übernommen. Für dieses, im Rahmen des Bundesverkehrswegeplans in den Jahren 1993-1998 erarbeitete (und im Rahmen des ÖBB-Projekts „NEMO" auf den Stand 2002 aktualisierte) Verkehrsmodell hatte der ÖBB Personenverkehr durch die Bereitstellung von Kalibrationsdaten das Recht auf Nutzung der Daten erworben. Da das VMÖ jedoch für viele Fragestellungen in einem Verkehrsunternehmen zu grob erschien, wurden bei den ÖBB (teilweise wiederum in enger Kooperation mit dem BMVIT) eine Reihe von Adaptierungen sowie Verfeinerungen vorgenommen.

2.1.2 <u>Verfeinerung der Verkehrszellen</u>

Basis für die Verkehrszellen innerhalb Österreichs bilden die politischen Gemeinden. Im Ausland sind in den Nachbarländern im grenznahen Raum NUTS3-Regionen, mit zunehmender Entfernung von Österreich jedoch größere Einheiten als Verkehrszellen definiert. Für einzelne Teilräume in Österreich, insbesondere bei Gemeinden mit großer Fläche und gleichzeitig hoher Bevölkerungsdichte musste eine Splittung vorgenommen werden. Dies betraf in erster Linie die Landeshauptstädte, jedoch auch einzelne Gemeinden im Wiener Umland. Das Ergebnis nach der Zellenverfeinerung war ein Modell mit rund 2600 Verkehrszellen, davon 2400 im Inland und 200 im Ausland.

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2.1.3 Detaillierung des ÖV-Fahrplanangebots

Im VMÖ wurde zwar das ÖV-Angebot auf der Schiene, nicht jedoch im Busverkehr, ausgewiesen. Die Abbildung erfolgte vereinfacht, das heißt in zu Taktlinien aggregierten Angeboten je Strecke. Dieser Detaillierungsgrad war für Fragestellungen der Infrastrukturplanung im BMVIT vollkommen ausreichend. Da das Modell beim ÖBB Personenverkehr jedoch überwiegend zur Abtestung von geplanten Fahrplanmaßnahmen dient, ist hier als Ausgangsbasis der reale Fahrplan des Bestandes (also das an einem definierten Stichtag in einer Fahrplanperiode vom Kunden abrufbare Zugsangebot) unbedingt erforderlich. Daher wurde mittels einer von der PTV angebotenen Schnittstelle zu HAFAS (Anmerkung: Software zur elektronischen Fahrplanauskunft) das komplette Zugsangebot für Österreich (inklusive grenzüberschreitender Verkehre) nach VISUM importiert. Für Österreich relevante Verkehre im Ausland wurden in weiterer Folge (stark vereinfacht) manuell ergänzt. Somit besteht in der SUPERNOVA Modellphase 1 das ÖV-Angebot aus knapp 5000 Linien (davon rund 4900 Einzelkurse und 100 Taktlinien).

Zuvor wurde durch Ergänzung einiger neu eröffneter Haltestellen die Vollständigkeit aller Haltepunkte in Österreich sichergestellt, im Ausland wurden in Abhängigkeit von der Verkehrszellenstruktur nur die wichtigsten Bahnhöfe abgebildet.

2.1.4 Überprüfung der Netzzugänge

Um das Verkehrssubstrat einer Zelle in das Netz (mIV und ÖV) einspeisen zu können, ist in VISUM für jede Zelle die Definition zumindest je einer Anbindung für IV und ÖV an einen Knoten erforderlich. Diese Anbindungen können über räumliche Abfragen automatisch generiert werden, was bezüglich des mIV im Regelfall zu brauchbaren Ergebnissen führt, wenn zuvor sichergestellt wurde, dass die (im Modell auf einen Punkt komprimierte) Zelleninformation etwa im Gemeindeschwerpunkt (gemessen an der räumlichen Verteilung der Bevölkerung) liegt. Für den ÖV empfiehlt sich allerdings das manuelle Anlegen der Anbindungen, da bei Existenz mehrerer Haltestellen in einer Zelle nur so sichergestellt ist, dass auch wirklich die jeweils korrekte (= meistfrequentierte) Haltestelle als Netzzugangsknoten dient.

2.1.5 Anpassung der Umlegungsparameter

Für die Ermittlung des Widerstandes und die Netzumlegung im ÖV dient im VMÖ ausschließlich die Reisezeit (Summe aus den Fahrzeiten in den Zügen sowie höhergewichteter Zugangs-, Abgangs-, Warte- und Umsteigezeiten). Im mIV hingegen wird auch die Kostenkomponente bei der Widerstandsermittlung berücksichtigt. Für die Angebotsplanung eines Verkehrsunternehmens sind jedoch auch weitere Faktoren wesentlich, die im Modell mitberücksichtigt werden mussten.

Zum einen beeinflusst die Frage des Tarifs (und damit indirekt die zurückzulegende Entfernung) massiv die Routenwahl. So werden zeitkürzere Verbindungen, die eine Verlängerung der Fahrtstrecke bedingen, vom Kunden aufgrund des höheren zu entrichtenden Fahrpreises in der Regel nicht angenommen. Würde man diesen Umstand vernachlässigen, so käme es in VISUM zu sogenannten „backtracks“: der Reisende wählt zwischen zwei Knotenbahnhöfen eine schnelle Zugsverbindung, und fährt dann ein Stück auf der gleichen Strecke zurück, um zu seinem Zielbahnhof zu gelangen.

Zum anderen ist die Qualität des Rollmaterials („Fahrzeugkomfort“) in den Umlegungsparametern abzubilden. Aus den Kundenzufriedenheitsanalysen des ÖBB Personenverkehrs liegen Bewertungen der verschiedenen Wagentypen (z. B. Doppelstock-Wendezug, ÖBB-EC-Reisezugwagen, Talent-Triebwagen, …) gemäß Schulnotenprinzip vor, die durch Transformation zu fahrzeugspezifischen Widerstandswerten umgerechnet wurden. Diese Widerstandswerte finden nun – freilich gegenüber der Reisezeit nur sehr gering gewichtet – in den Umlegungsparametern Berücksichtigung. Somit kann der (in der Realität ebenfalls messbare) Effekt abgebildet werden, dass bei Einführung eines neuen Fahrzeugs eine Verwanderung hin zu Zügen mit besserem Rollmaterial erfolgt.

2.1.6 Aktualisierung der Verkehrsbeziehungsmatrizen und Abbildung von Tagesganglinien der Nachfrage

Aus dem VMÖ lagen die Quell-Ziel-Matrizen für fünf Verkehrszwecke vor:

- Erwerbspendler
- Ausbildungspendler
- Geschäftsreise

Freizeit

Einkauf/private Erledigung

Die Aktualität der Bestandsmatrizen (Jahr 1998) war bei der Modelleinführung im Rahmen von SUPERNOVA Anfang 2003 nicht mehr ausreichend gegeben, wodurch eine Aktualisierung erforderlich wurde. Diese wurde im ÖV durch Kalibrierung an aktuellen Fahrgastzähldaten des Jahres 2002 aus dem Zählsystem **MOFAS** (**MO**dulares **FA**hrgastErfassungs**S**ystem) der ÖBB ermöglicht, wobei hier das VISUM-Modul „VStromFuzzy" zur Anwendung gelangte. Dadurch war sichergestellt, dass die Umlegungsergebnisse im Bestand Netzbelastungen ergaben, die mit den realen Zählergebnissen übereinstimmten.

Um auch die Auslastung der einzelnen Züge auf einer Strecke der Realität anzunähern, war weiters die Implementierung von spezifischen Tagesganglinien für die einzelnen Nachfragesegmente erforderlich. Diese wurden aus der Haushaltsbefragung 1995 (im Rahmen des Bundesverkehrswegeplans) ermittelt. Für die korrekte Abbildung der Lastrichtung bei den Erwerbspendlern (Wege Wohnen – Arbeiten in der Früh, Wege Arbeiten – Wohnen am Abend) wurde diese Matrix in eine Hin- und Rückwegsmatrix unterteilt. Die Aufteilung der Wege auf die beiden Matrizen erfolgte anhand des Pendlersaldos der Quell- und Zielgemeinde je Relation. Analog wurde auch bei den Ausbildungspendlern verfahren.

2.1.7 Kennzahlen von SUPERNOVA nach Abschluss der Entwicklungsphase 1

Nach Fertigstellung der Anpassungsarbeiten am VMÖ Mitte Mai 2003, mit denen gleichzeitig auch die Modellentwicklungsphase 1 abgeschlossen werden konnte, wies das Datenmodell von SUPERNOVA folgende Kennzahlen auf:

15.200 Knoten (davon 14.300 Straßenknoten und 1.900 Bahnhöfe bzw. Haltestellen)

33.000 Kanten (davon 6.500 Schienenabschnitte und 26.500 Straßenabschnitte)

5050 ÖV-Linien der Bahn (davon 4950 Einzelkurse und 100 Taktlinien) gemäß eines Stichtags des Fahrplans 2003

2600 Verkehrszellen (2400 in Österreich und 200 im Ausland)

14 Verkehrsbeziehungsmatrizen (je 7 für ÖV und mIV)

Mit dem auf Basis der Modellphase 1 betriebenen Planungs- und Bewertungstool wurden bis Ende 2004 rund 30 verschiedene Projekte bzw. Maßnahmenbündel mit insgesamt 120 Varianten bewertet. Dies entspricht (bei Berücksichtigung der Urlaubszeiten) einer durchschnittlichen „Auslastung" von zwei Bewertungsrechnungen pro Woche.

2.2 Modellentwicklungsphase 2

Parallel zu den laufenden Bewertungsrechnungen mit SUPERNOVA aus Phase 1 wurde im Herbst 2003 mit der SUPERNOVA-Entwicklungsphase 2 begonnen, die eine völlige Neukonzeption des Datenmodells vorsah. Eine wesentliche Anforderung, die mit dem Modell aus Phase 1 nicht erfüllt werden konnte, war die Abbildung der zum damaligen Zeitpunkt noch getrennt als BahnBus und Postbus betriebenen Busverkehre der ÖBB Personenverkehrs AG. Diese wiederum erforderte eine Verfeinerung des Straßennetzes, um das korrekte Routing der Buslinien zu ermöglichen. Weiters erfolgte eine Neuerstellung der Verkehrsbeziehungsmatrizen auf Grundlage der Pendlererhebung im Rahmen der Volkszählung 2001.

Aus dem Anspruch, auch weiterhin ein einziges Modell für ganz Österreich zu betreiben, bei gleichzeitig enormer Erhöhung des Detaillierungsgrades, wurden während dieser Projektphase sowohl hard- als auch softwareseitig die Grenzen des technisch Machbaren ausgereizt. Die detaillierte Beschreibung der auftretenden Probleme finden sich bei den einzelnen Punkten der Modellentwicklung.

2.2.1 Neuerstellung des Netzmodells

Grundlage für das neue Netzmodell bildete die digitale Karte der Firma NAVTEQ, wie sie auch für On-Board-Naviagtionssysteme verwendet wird. Der ursprüngliche Plan war, die Vektorgrafik aus NAVTEQ unverändert zu übernehmen. Die Anzahl der Knoten (rund 1 Million) und Kanten (rund 2 Millionen) hätte jedoch die in VISUM mit vertretbarem Aufwand bearbeitbare Netzgröße deutlich überschritten. Daher wurde folgende Vereinfachungen vorgenommen:

Schienennetz:

Vereinfachung der Gleisdarstellungen in Bahnhöfen (Löschung paralleler Kanten)

Elimination von Verschub- und Güterbahnhöfen

Beseitigung von topologischen Fehlern (mehr als 2 Kanten zwischen zwei Knoten)

Straßennetz

Elimination von Kanten der niedrigsten Straßenkategorie (in der Regel Wald- und Forstwege)

Löschung zweiarmiger Zwischenknoten und dadurch Fusion hintereinanderliegender Kanten gleicher Kategorie

Beseitigung von topologischen Fehlern (mehr als 2 Kanten zwischen zwei Knoten)

Auf das bereinigte Netz wurden anschließend die bei den ÖBB vorliegenden geocodierten Bahnhöfe und Haltestellen für Schiene und Bus eingepasst und mittels VISUM-Fangalgorithmus mit dem Basisnetz verschnitten. In Österreich wurden dabei die Haltestellen aller in der Fahrplanauskunft der ÖBB hinterlegten öffentlichen Verkehrsangebote berücksichtigt, also auch städtische Buslinien, Straßenbahnen und U-Bahnlinien sowie Buslinien privater Betreiber.

Für das Ausland wurden nur die Bahnhaltestellen übernommen. Diese wurden derart ausgedünnt, dass pro Verkehrszelle in der Regel nur der wichtigste Bahnhof im Modell zur Abbildung gelangte. Das Straßennetz im Ausland wurde weitgehend unverändert aus dem VMÖ übernommen.

Ergebnis war ein Netzmodell mit rund 290.000 Knoten (davon 24.000 Haltestellen) und 700.000 Kanten.

2.2.2 Import der Fahrplandaten aus HAFAS

Eine wahre technische Herausforderung stellte der vollständige Import aller in den Fahrplansystemen der ÖBB (HAFAS und Infopool) hinterlegten ÖV-Fahrten dar. Die etwa 47.000 Einzelkurse mussten schrittweise aufbereitet werden, da das Importprogramm für VISUM nicht für derartige Datenmengen ausgelegt ist. Da man beim Importieren der Daten immer wieder an die Grenzen der von VISUM verarbeitbaren Dateigrößen stieß, konnte dieser Arbeitsschritt erst nach einiegn Anpassungen durch die Entwicklerfirma erfolgrich abgeschlossen werden.

2.2.3 Definition der Netzzugänge und Umsteigemöglichkeiten zwischen Haltestellen

Anders als in der Modellphase 1, wo als ÖV-Angebot nur die Zugsfahrten hinterlegt waren und in der Regel pro Zelle nur eine Haltestelle als Netzzugang definiert werden musste, war nun aufgrund des komplexen Busnetzes eine weit aufwändigere, manuell durchzuführende Festlegung der Netzzugänge erforderlich. Da in vielen Fällen die verschiedenen ÖV-Linien je Zelle keine einzige gemeinsame Haltestelle aufweisen, mussten je nach Situation bis zu zehn Haltestellen für eine einzige Zelle als Einfüllpunnkte für das Verkehrssubstrat ausgewählt werden. Für eine sinnvolle Auswahl war nicht nur die Entfernung zum Siedlungsschwerpunkt maßgeblich, sondern ganz entscheidend auch die Anzahl der an dieser Haltestelle ankommenden und abfahrenden Kurse zu berücksichtigen.

Ebenso stellte sich die Frage nach der Abbildung der Übergänge zwischen den Haltestellen (z. B. Bahnsteig – Bahnhofsvorplatz), um das korrekte Umsteigeverhalten modellieren zu können. Hier wurde auf die in der Fahrplanauskunft enthaltenen Umsteigemöglichkeiten inklusive der dort festgelegten Dauer der Umsteigewege zurückgegriffen. Diese mag zwar an manchen Punkten zu hoch erscheinen, bringt jedoch den Vorteil mit sich, dass somit ein österreichweit einheitliches System angewandt wird und daher keine regionalen Verzerrungen zu befürchten sind. Außerdem konnte so der manuelle Editieraufwand auf ein Minimum reduziert werden.

2.2.4 Neuerstellung der Verkehrsbeziehungsmatrizen

Wesentliche Grundlage für die Neuerstellung der Quelle-Ziel-Matrizen bilden die Pendlermatrizen der Statistik Austria, die aus der Auswertung der Volkszählung 2001 resultieren. Diese wurden anhand der Angabe der Befragten zum überwiegend benutzten Verkehrsmittel der IV- oder ÖV-Matrix zugeordnet, und dies jeweils für Erwerbs- und Ausbildungspendler. Die nur für die „Hinwege" vorliegenden Pendlermatrizen wurden anschließend symmetrisiert, um die „Heimwege" ebenfalls abbilden zu können.

Nach den ersten Testumlegungen und einem Vergleich mit den aus MOFAS vorliegenden Zähldaten erwiesen sich diese Zahlen jedoch als zu hoch. Daher wurde beschlossen, die im Rahmen des Projekts

Verkehrsprognose 2025+ des BMVIT erstellten Matrizen zu verwenden. Für die übrigen Fahrtzwecke (Geschäfts-, Freizeit-, Erledigungsverkehr) wurde ebenfalls diese Datenquelle herangezogen.

Die Tagesganglinien wurden aus dem Modell der Phase 1 übernommen.

2.2.5 Netzumlegung und Kalibration

War es nach einer Reihe von Netzvereinfachungen zwar nunmehr problemlos möglich, alle ÖV-Kurse auf dem Netz zu routen, so stellte die Berechnung einer ÖV-Umlegung eine neue technische Hürde dar. Bei einer Laufzeit von etwa 20 Stunden für einen kompletten Umlegungsvorgang in VISUM überstieg die Belastung des Arbeitsspeichers den von Windows XP unterstützten Grenzwert von 3 GB. Erster Ansatz zur Lösung dieses Problems war die der Aggregation von Einzelkursen zu Taktlinien im Busverkehr. Dies führte naturgemäß zum Verlust einer Reihe von Informationen, die vor allem beim Editieren von Planfällen erheblichem Mehraufwand geführt hätten. Daher entschied man sich, eine nochmalige Ausdünnung des Straßennetzes vorzunehmen, indem alle nicht von ÖV-Linien befahrenen Straßen mit lediglich lokaler Erschließungsfunktion innerhalb eines Siedlungsgebiets aus dem Netz entfernt wurden. Dadurch konnte die Anzahl der Knoten und Kanten nochmals erheblich reduziert werden, was sich schließlich auch – und das war entscheidend – im Speicherplatzbedarf für die VISUM-Versionsdatei auswirkte.

Nach dieser Maßnahme konnten die ÖV-Matrizen erfolgreich umgelegt werden. Die Kalibration an den Zählwerten erfolgte anders als bei der Entwicklungsphase 1 nicht mit dem Tool VStromFuzzy der PTV, sondern nur durch Anpassung der Umlegungsparameter und Widerstände beim Netzzugang.

2.2.6 Kennzahlen von SUPERNOVA nach Abschluss der Entwicklungsphase 2

Seit dem Abschluss der Entwicklungsphase 2 zum Jahresende 2004 weist das in SUPERNOVA hinterlegte Netzmodell folgende Eckdaten auf:

110.000 Knoten (davon 86.000 Straßenknoten und 24.000 Bahnhöfe bzw. Haltestellen)

250.000 Kanten (davon 15.000 Schienenabschnitte und 235.000 Straßenabschnitte)

47.000 ÖV-Linien auf Basis von Einzelkursen gemäß eines Stichtags des Fahrplans 2004

2600 Verkehrszellen (2400 in Österreich und 200 im Ausland)

14 Verkehrsbeziehungsmatrizen (je 7 für ÖV und mIV)

Per Jahresbeginn 2005 ist dieses Modell nun Grundlage für alle Variantenbewertungen bei der ÖBB Personenverkehrs AG mit SUPERNOVA. Mit seinen Dimensionen gehört SUPERNOVA dadurch zu den größten Modellen, die gegenwärtig mit VISUM weltweit betrieben werden. Die ÖBB Personenverkehrs AG ist in dieser Hinsicht somit weltweit einer der führenden Anwender dieser Software.

3 EINSATZGEBIETE VON SUPERNOVA

3.1 Bewertungsmethodik

Um die Ergebnisse der mittels SUPERNOVA angestellten Bewertungsrechnungen verstehen zu können, muss zunächst die zugrundeliegende Methodik erläutert werden.

SUPERNOVA entspricht grundsätzlich dem klassischen 4-Stufen-Ansatz von Verkehrsmodellen. Die Stufen 1 (Erzeugung), 2 (Verflechtung) und 3 (Verkehrsmittelwahl) laufen allerdings nicht direkt im Modell ab, da als Grundlage für den Nullfall bereits vorhandene verkehrsmittelspezifische Quell-Ziel-Matrizen eingehen, die außerhalb von SUPERNOVA erzeugt werden.

Die Berechnung der Fahrtenmatrizen für die einzelnen Planfälle erfolgt basierend auf der Software VISEM/MUULI der Firma PTV. Im Zuge der Netzumlegung werden je Verkehrsmittel die Widerstandsmatrizen für Null- und Planfall erzeugt. Diese werden in einem Modal-Split-Modell gegenübergestellt, wo ausgehend von den Fahrtenmatrizen des Nullfalls für ÖV und IV über verkehrszweckspezifische Elastizitäten die Veränderung der relationsweisen Fahrtenanzahl je Verkehrsmittel berechnet wird. Auf diese Weise bewirken Maßnahmen zur Verbesserung des ÖV-Angebots eine Steigerung des Fahrgastaufkommens bei gleichzeitiger Reduktion der PKW-Fahrten. Wird das Angebot auf einer Strecke hingegen konsolidiert, so führt dies zu einem Rückgang der ÖV-Nachfrage und – vice versa – zu einem Anstieg der Personenfahrten auf der Straße.

Als Ergebnis liefert SUPERNOVA schließlich zwei wesentliche Informationen:

- Netzgrafiken zeigen räumlich differenziert die Veränderung der Reisendenbelastung im ÖV-Netz sowie im Straßennetz zwischen Nullfall und Planfall (bzw. zwischen mehreren Planfällen).
- Ergebnistabellen ermöglichen Aussagen über die Veränderung bestimmter Kennzahlen im Netz, sowohl bezüglich des ÖV-Angebots (ÖV-Fahrzeugkilometer, ÖV-Fahrzeugstunden, etc.) als auch der Nachfrage (beförderte Personen, Ein-/Aus-/Umsteiger, Personenkilometer, Pkw-Kilometer, Pkw-Stunden, etc.). Diese Ergebnisse sind in unterschiedlichen Aggregationsniveaus abrufbar, vom Einzelkurs bis hin zur Globalaussage für das Gesamtnetz.

Die ökonomische Bewertung der Ergebnisse erfolgt wiederum außerhalb von SUPERNOVA. Wesentliche Inputparameter für die Kostenermittlung je Variante sind die Fahrzeugkilometer sowie –stunden, die mit spezifischen Kostensätzen bewertet werden. Die Ermittlung der Tariferlöse erfolgt anhand der Personenkilometer (bewertet mit Erlössätzen, gegebenenfalls differenziert nach Fahrtzwecken).

Die hier dargestellte Wirtschaftlichkeitsbewertung stellt nur den grundsätzlichen Ablauf dar. Je nach Anforderung wird das Bewertungsschema weiter verfeinert, indem z. B. die Deckelung von Fahrgeldeinnahmen, etwa infolge vertraglicher Vereinbarungen in Verkehrsverbünden, berücksichtigt wird.

3.2 Kurz- und mittelfristige Angebotskonzepte (Fahrplanmaßnahmen)

SUPERNOVA ist seit seiner Einführung Grundlage für alle wesentlichen Angebotsveränderungen in der ÖBB Personenverkehrs AG. Das Spektrum der bis anhin bewerteten Projekte und Maßnahmen reicht von kurzfristigen Fahrplanänderungen (für die jeweils nächste Fahrplanperiode) bis hin zu langfristigen Infrastrukturprojekten und visionären Konzepten.

Im folgenden sind ohne Anspruch auf Vollständigkeit einige „Bewertungsobjekte“ angeführt und zum Teil näher beschrieben.

3.2.1 Angebotskonzept Power 2005

Parallel zur Einführung von SUPERNOVA lief bei den ÖBB das Leistungssteigerungsprogramm „Power 2005“, dessen Kernstück im Personenverkehr ein neu gestaltetes Angebotskonzept mit Gültigkeit ab dem Fahrplanwechsel im Dezember 2004 darstellte. Im Rahmen dieses Angebotskonzeptes, das Maßnahmen im Fern- und Nahverkehr in ganz Österreich beinhaltete, wurden mit SUPERNOVA etwa 45 Einzelmaßnahmen(-varianten) bezüglich ihrer Wirkung bewertet.

Ein Großteil der erwarteten Ergebniswirkung (Summe der Effekte aus Senkung der Betriebskosten und Steigerung der Erlöse) wurde durch Maßnahmen erzielt, die zuvor mittels SUPERNOVA einer objektiven Beurteilung unterzogen wurden.

3.2.2 Sonstige kurz- und mittelfristige Fahrplankonzepte

Weiters wurde SUPERNOVA unter anderem für die folgenden Projekte als Bewertungstool eingesetzt:

- Beurteilung des Fahrplans 2004 bezüglich Reisezeitveränderungen
- Schienenverkehrskonzept Tirol 2009
- Schienenverkehrskonzept Kärnten 2007
- Schienenverkehrskonzept Oberösterreich 2007
- Schienenverkehrskonzept Steiermark 2007
- S-Bahn-Konzept Wien 2007
- Attraktivierung der Fernverkehrsverbindung Wien – Venedig 2005
- Attraktivierung der Fernverkehrsverbindung auf der Achse Prag – Linz – Graz – Ljubljana 2007

3.3 Langfristige Angebotskonzepte (Infrastrukturprojekte)

3.3.1 Verbindung Wien – Bratislava

Im Fahrplan 2004 werden zwischen Wien und Bratislava insgesamt 55 Zugverbindungen pro Werktag angeboten. Diese Züge verkehren auf unterschiedlichen Achsen: von Wien Südbahnhof nach Bratislava Petrzalka via Bruck an der Leitha sowie von Wien Südbahnhof nördlich der Donau via Marchegg nach Bratislava Hauptbahnhof. Die Fahrzeiten betragen 46 Minuten mit dem IC bzw. 60 Minuten mit dem Eilzug nach Bratislava Petrzalka oder 69 Minuten mit dem Euregiozug nach Bratislava Hauptbahnhof via Marchegg und sind somit im Vergleich zum Individual- oder Busverkehr überaus attraktiv.

Auf Grund der zu erwartenden Zunahme der Personenfahrten zwischen den Ballungsräumen Wien und Bratislava wird nun intensiv an einer weiteren Attraktivierung des Schienenverkehrsangebots zwischen diesen unmittelbar benachbarten Hauptstädten gearbeitet. Dazu sind Infrastrukturausbaumaßnahmen nötig, deren Bedarfsnachweis seitens ÖBB Personenverkehr unter anderem durch die Bewertung diverser Angebotskonzepte mittels SUPERNOVA erbracht wurde.

Unter anderem wurden folgende Varianten geprüft:

- Allgemeine Verdichtung des Verkehrs
- Beschleunigung der Verbindungen durch Infrastrukturausbau
- Wirkung eines Zentralbahnhofs in Wien auf die Schienenverkehrsnachfrage in Richtung Bratislava/Slowakei und die sich dadurch ergebenden Verknüpfungserfordernisse

Die Fahrplanmodelle sind modulartig aufgebaut, da die Infrastrukturmaßnahmen zu unterschiedlichen Zeitpunkten verkehrswirksam werden. So wird einerseits die jeweils bestehende Infrastruktur angebotsseitig sinnvoll genützt, andererseits kann durch die vorliegenden Untersuchungen durch den Betreiber ein Impuls zur optimalen Reihung der Infrastrukturmaßnahmen gesetzt werden.

3.3.2 City-S-Bahn Linz

Zur Verbesserung der Verknüpfung des heutigen Endpunkts der Mühlkreisbahn in Linz, dem Bahnhof Urfahr, mit dem Linzer Hauptbahnhof, wurden verschiedene Varianten untersucht. Heute verbindet die Straßenbahnlinie 3 diese beiden Bahnhöfe, was für den von der Mühlkreisbahn kommenden Reisenden, der auf dem Netz der ÖBB weiterfahren möchte, ein zweimaliges Umsteigen erforderlich macht.

Zur Auswahl standen die als City-S-Bahn bekannte Verlängerung der Mühlkreisbahn in einem Bogen durch das östliche Stadtgebiet von Linz bis zum Hauptbahnhof (inklusive der Errichtung neuer Haltestellen zur besseren Erschließung des Stadtgebiets) sowie die Einstellung der Mühlkreisbahn durch den ÖBB Personenverkehr und die ersatzweise Verlängerung der Straßenbahnlinie 3 bis nach Rottenegg. In diesem Fall wäre eine Bedienung im nördlichen Streckenabschnitt (Rottenegg – Aigen Schlägl) mit Bussen vorgesehen.

Auf Basis der zugrundeliegenden Fahrpläne wurde die verkehrliche Wirkung aller Alternativen (Beibehaltung Status-Quo, City-S-Bahn, Verlängerung Straßenbahn) untersucht. Als Variante mit dem größten zu erwartenden Fahrgastzuwachs ging die City-S-Bahn aus der Untersuchung hervor. Das Ergebnis bildete u. a. die Basis für die in weiterer Folge von den politischen Entscheidungsträgern getroffenen Entscheidung zugunsten der City-S-Bahn.

3.3.3 Sonstige Infrastrukturprojekte

Weiters wurde SUPERNOVA unter anderem für die folgenden Projekte als Bewertungstool eingesetzt:

- Bahnhof Wien (Durchbindung der EC-Züge und Eilzüge von der Süd- auf die Ostbahn)
- Reaktivierung der ÖBB-Strecke Lambach – Laakirchen – Gmunden

3.4 Verkehrsplanerische Visionen

Auch die Wirkung von Überlegungen, die zum heutigen Stand eher als visionär eingestuft werden müssen, lassen sich mittels SUPERNOVA beurteilen. In diese Rubrik fallen u. a.:

- Direktverbindung Tulln – St. Pölten – Kirchberg/Pielach (Umspurung der Mariazellerbahn auf Normalspur)

Direktverbindung St. Pölten – Waidhofen/Ybbs (Umspurung der Ybbstalbahn auf Normalspur)

4 AUSBLICK

4.1 Modellverfeinerungen

4.1.1 Verkehrszellenverfeinerung im Inland auf Zählsprengelebene

Für die meisten der bisherigen Fragestellungen an SUPERNOVA reichte die Zellenstruktur auf Basis der Gemeindegrenzen aus, um valide Aussagen treffen zu können. Dennoch wird mit zunehmender Intensität des Einsatzes und den bereits heute spürbar steigenden Anforderungen externer Stellen (Besteller, Verbünde) immer mehr die Notwendigkeit deutlich, das Modell zumindest selektiv in kleinere räumliche Einheiten untergliedern zu können. Vor allem im innerstädtischen Bereich oder aber bei sehr großflächigen Gemeinden in den Ballungsräumen ist aufgrund der hohen Dichte des ÖV-Angebots eine Verfeinerung der Verkehrszellen auf lange Sicht unumgänglich.

Die Voraussetzungen hierfür sind seitens Modellierung des Verkehrsangebots bereits heute gegeben, bildet SUPERNOVA doch mit rund 47.000 Haltestellen ja ohnehin flächendeckend das detaillierte Angebot im ÖV ab. Auch bei den Nachfragedaten sind – zumindest für den Pendlerverkehr – aus der Volkszählung 2001 bereits Matrizen auf Basis der Zählsprengel vorhanden. Die räumliche Verortung der Zählsprengel in SUPERNOVA ist ebenso bereits bei der bisherigen Modellentwicklung erfolgt.

Bei der Umstellung der Zellenstruktur im Inland würde sich die Zahl der Verkehrszellen von 2400 Gemeinden auf knapp 9000 Zählsprengel erhöhen (Faktor 3,75). Die Anzahl der theoretischen Fahrtrelationen hingegen würde um den Faktor 14 anwachsen, und gerade im Gemeindebinnenverkehr sind die meisten der theoretisch möglichen Relationen auch tatsächlich mit Fahrten besetzt.

Da das Modell jedoch bereits heute an die Grenzen der Hard- und Software stößt, ist eine Bearbeitung solcher Datenmengen wohl in naher Zukunft nicht möglich. Es kann jedoch davon ausgegangen werden, dass durch den Softwareentwickler Mittel und Wege gefunden werden, zukünftig auch mit solchen Datenmengen problemlos arbeiten zu können.

4.1.2 Detaillierung der Auslandszellen für lokale Fragestellungen in den Nachbarländern

Da mittelfristig auch der Einsatz von SUPERNOVA für Auftraggeber aus den (vorwiegend östlichen) Nachbarstaaten geplant ist, werden sich die Anforderungen an die Modelldetaillierung auch in diesem Fall erhöhen. Die gegenwärtige Zellenstruktur (in der Regel NUTS3-Ebene) wird dann zumindest auf Gemeindeebene verfeinert werden müssen.

Die digitalen Kartengrundlagen dafür sind problemlos erhältlich, ebenso ist das ÖV-Angebot (Bahnhöfe/Haltestellen sowie Einzelzugsfahrten) für die Schiene aus HAFAS bei der Personenverkehrs AG europaweit verfügbar. Größtes Problem bei dieser Fragestellung ist die Verfügbarkeit der Nachfragedaten in den potentiell zu modellierenden Räumen. Selbst bei intensiver Zusammenarbeit mit den lokalen Institutionen (Statistische Ämter, Gebietskörperschaften) ist offen, ob die Daten in der benötigten Form und mit der aus Österreich gewohnten Qualität) überhaupt vorliegen.

Über die Kooperation mit Planungsgesellschaften, die bereits heute in diesen Märkten tätig sind, können hier wohl am schnellsten brauchbare Resultate erzielt werden.

4.2 Neue Anwendungsmöglichkeiten

4.2.1 Einnahmenaufteilung mit SUPERNOVA

Ein völlig neues Anwendungsfeld von SUPERNOVA ist die Unterstützung bei der Aufteilung der Fahrkartenerlöse auf die Unternehmensbereiche Fern- und Nahverkehr. Da nur ein sehr geringer Anteil der verkauften Fahrkarten in Verbindung mit einer Platzkarte erworben wird, kann a priori keine Aussage getroffen werden, mit welchem Zug der Reisende tatsächlich seine Fahrt unternimmt. Da jedoch künftig eine Zuscheidung der Einnahmen sogar auf einzelne Züge erforderlich wird, muss diese Verteilung – will man nicht permanent aufwändige Erhebungen durchführen – modellgestützt erfolgen.

Grundidee ist die Verteilung der verkauften Fahrkarten, für die Ausgangs- und Endpunkt in der Regel bekannt sind, in Abhängigkeit vom Widerstand der alternativen Zugsverbindungen analog zu den Fahrten der Verkehrsbeziehungsmatrizen. Die Eignung von SUPERNOVA zur Einnahmenaufteilung wird im Laufe des Frühjahrs 2005 untersucht, und über einen dauerhaften Einsatz für diese Fragestellung nach der Testphase entschieden.

4.2.2 Simulation von Anschlusssituationen in Knotenbahnhöfen

Durch Transfer der Daten in die Simulationssoftware VISSIM kann plakativ die Abstimmung der einzelnen Zugs- und Busfahrten in ÖV-Knoten dargestellt werden. Abgesehen von der grafischen Ausgestaltung ist der Manipulationsaufwand sehr geríng, da der Ablauf der Simulation ja auf dem in SUPERNOVA ohnedies vorgehaltenen Fahrplan basiert. Dadurch wird es für den Betrachter möglich, Angebotsveränderungen gleichsam zu erleben, und die heute notwendige Interpretation von Tabellen- und/oder Bildfahrplänen durch fachlich weniger versierte Entscheidungsträger sollte dann endgültig der Vergangenheit angehören.

5 ZUSAMMENFASSUNG UND SCHLUSSFOLGERUNGEN

Mit dem Planungstool SUPERNOVA ist die Personenverkehrs AG für die Herausforderungen im liberalisierten ÖPNV-Markt bestens gerüstet. Der Know-How-Vorsprung in den Belangen der Verkehrsplanung gegenüber anderen Verkehrsunternehmen wird in Form von SUPERNOVA nun auch für die Besteller von Verkehrsdienstleistungen eindeutig sichtbar. Auch außerhalb Österreichs stößt SUPERNOVA auf immer stärkeres Interesse, was eine Reihe von Anfragen ausländischer ÖV-Unternehmen zur Kooperation beweist. Die zentrale Rolle von SUPERNOVA bei der Angebotsgestaltung in der Personenverks AG ist somit jedenfalls garantiert.

reviewed paper

Geostatistische Simulationsverfahren als Werkzeug der Quantifizierung der Unsicherheit geologischer Untergrundmodelle für die Stadtplanung

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1 EINLEITUNG

In verstärktem Maße werden Informationen über den geologischen Untergrund für die Stadtplanung benötigt. Dies resultiert einerseits aus der zunehmenden Verlagerung von Infrastruktureinrichtungen (z. B. Verkehrsanlagen u. ä.) in den Untergrund als Folge der Schonung innerstädtischer Freiflächen, andererseits auch aus der Projektierung zunehmend komplexer werdender Bauwerke (Hochhäuser etc.) mit erhöhtem Erkundungsbedarf.

Dank der Ableitung ursprünglich für die Exploration mineralischer Rohstoffe konzipierter Verfahren und deren Implementation in Geographische Informationssysteme ist es nun möglich, dreidimensionale Modelle des Untergrundes eines geplanten Projektes zu erstellen, die bei Verwendung von Schichtmächtigkeiten als geologisch oder bei Verwendung von physikalischen (oder aus Ihnen abgeleiteten) Bodeneigenschaften als geotechnisch bezeichnet werden. Zwar liefern die dabei verwendeten sogenannten Kriging-Verfahren ein im wesentlichen objektives Bild der geologischen Gegebenheiten, jedoch unterschätzen sie stets die Heterogenität der Parameter und deren Einfluss auf das Ergebnis.

Hinzu kommt, dass das Kriging nur eine mögliche Realisation des geologischen Prozesses abbildet. Auch unterliegt das visualisierte Ergebnis sowohl einer Unsicherheit aufgrund der natürlichen Variabilität, gepaart mit der nur punktuellen Kenntnis durch Bohrungen und Sondierungen, als auch einer Unbestimmtheit hinsichtlich der subjektiven und oft nicht vollständig dokumentierten Parameterwahl bei der Erstellung des Modells.

Die geostatistischen Simulationsverfahren liefern nun eine beliebig hohe Zahl weiterer und gleich wahrscheinlicher Realisationen, so dass dann lokale Häufigkeitsverteilungen an jedem Schätzgitterpunkt aufgestellt werden können. Auf dieser Basis können die getroffenen Modellannahmen bewertet und die mit ihnen einhergehende Unsicherheit quantifiziert werden. Diese Ergebnisse können signifikante Auswirkungen auf die Wahl von Bauverfahren, auf Sanierungsentscheidungen in der Umweltgeologie oder auf die Platzierung zukünftiger Erkundungs- oder Messstellen haben.

In dem Beitrag sollen sowohl die Notwendigkeit zur Anwendung solcher Verfahren aufgezeigt als auch beispielhafte Anwendungen demonstriert werden.

2 ZUR NUTZUNG GEOLOGISCHER UNTERGRUNDMODELLE

Mit der zunehmenden Verbreitung Geographischer Informationssysteme (GIS) und geeigneter Visualisierungstechniken gehört es zum Handwerkszeug der Ingenieurgeologie, dreidimensionale Modelle geologischer Strukturen zu erzeugen. Dabei wurden vielfach aus anderen Bereichen der angewandten Geowissenschaften Methoden übernommen und für spezifische Fragestellungen adaptiert.

Die Hauptaufgabe einer jeden geologischen Modellierung stellt die Bestimmung der räumlichen Verteilung geologischer Parameter dar. Im Falle der stets notwendigen Interpolation an bisher nicht erkundeten Stellen erfolgt durch diese Modelle daher eine räumliche Prädiktion. Nach der Entwicklung der hierzu verwendeten Schätzverfahren für die Belange des Bergbaus in den 1950er und 1960er Jahren (vgl. Matheron 1963), ihrer baldigen Anwendung auch auf Projekte der Erdöl- und -gasexploration sowie ihrer Verwendung zur Charakterisierung von Umweltbedingungen im letzten Jahrzehnt des 20. Jahrhunderts werden diese Methoden in jüngerer Zeit auch für baugeologische und geotechnische Zwecke herangezogen.

Für die Stadtplanung in besonderem Maße relevant ist der durch bautechnische Zwecke beanspruchte flache Untergrund, da die meisten lastabtragenden Strukturen und viele Infrastruktur- und Versorgungseinrichtungen innerhalb der oberen 50 m lokalisiert sind (Rosenbaum & Turner 2003). Dieser bereits in Kap. 1 beschriebene Trend wird sich sicherlich zukünftig noch stärker ausprägen. Hinsichtlich seiner Eigenschaften unterscheidet dieser Bereich sich jedoch erheblich von den bisherigen Anwendungsdomänen geologischer Modelle, wie etwa dem Bergbau. So ist etwa dieser Bereich Produkt einer Vielzahl geologischer Prozesse und zudem vielfältigen anthropogenen Einflüssen ausgesetzt. Auch ist für bautechnische Zwecke eine höhere Auflösung unerlässlich, die ein dichteres Erkundungsnetz und eine Vielzahl unterschiedlicher Untersuchungen erforderlich machen. Im einzelnen sind für bautechnische Zwecke zu gewinnen:

geologische Daten über Tiefe, Ausdehnung und Dicke der Schichten, die in zweidimensionalen Modellen interpoliert und dann gestapelt dargestellt werden können;

bodenphysikalische Daten (Wichte, Wassergehalt etc.) und geotechnische Eigenschaften (Kohäsion, Reibungswinkel etc.), die beide einer dreidimensionalen Abhängigkeit unterliegen;

Informationen über das Verhalten des Baugrundes bei Veränderung der Grundwasser- oder der Spannungsbedingungen (Steifemodul, Elastizitätsmodul etc.).

Es existieren mittlerweile computergestützte Systeme, um diese ausgesprochen heterogenen Daten zusammenfassend darzustellen. Empirische oder deterministische Modelle erweisen sich dabei oft als unzureichend bzw. als nicht anwendbar, sofern diese Daten nicht nur dargestellt, sondern auch zu einer Prädiktion herangezogen werden sollen. Eine geostatistische Schätzung, die für dieses Problem eine objektive Lösung anbietet, ist mithin erforderlich (vgl. Kap. 3). Auch hierfür existieren zahlreiche Programme. In verstärktem Maße jedoch ist die Benutzung derartiger Systeme auch durch Nicht-Geologen zu beobachten – eine Entwicklung, die seitens der Software-Produzenten durch Voreinstellungen bei der Varianten- und Parameterauswahl und durch vereinfachte

Benutzerführungen teilweise sogar forciert wird. Zukünftige Nutzer von Untergrundmodellen sind demnach auch Bauträger, Raumplaner, Versicherungen und Behörden (vgl. Evans 2003).

Das führt indes auch dazu, dass diese Verfahren oftmals „eingesetzt [werden], ohne die dafür notwendigen fachlichen und mathematischen Rahmenbedingungen zu prüfen." (Jäkel 2000). Häufige Folge sind Fehlinterpretationen. Nur unter Berücksichtigung aller mathematischen und geologischen Ausgangs- und Rahmenbedingungen jedoch hat eine solche Modellierung Erfolg in dem Sinne, dass sie plausibel und reliabel ist. Gerade in Kombination mit der immer noch weiter zunehmenden Darstellungsfähigkeit der Modelle durch die Programme birgt dies ernste Probleme. So wird der unbedarfte Benutzer die Darstellung für eine vollständige Wiedergabe der Realität halten, jedoch handelt es sich hierbei nicht um eine Repräsentation derselben, sondern lediglich um eine auf den vorhandenen Daten basierende Interpretation unter Verwendung der in den Programmen implementierten Rechenverfahren!

Dieser Aspekt ist als einer der wesentlichen Kritikpunkte durch Rosenbaum & Turner (2003) benannt worden. Daneben ist auch aufgeführt worden, dass viele der neueren Methoden zur Modellierung des geologischen Untergrundes zwar eine verbesserte Interpolation anstreben, hinsichtlich der stets verbleibenden Unsicherheit jedoch sowohl deren Quantifizierung als auch ihre effektive Darstellung innerhalb des Modells nicht ermöglichen bzw. nicht hinreichend berücksichtigen.

Zukünftig wird auch die Versicherungswirtschaft ein erhöhtes Interesse an geologischen Untergrundmodellen und ihrer Unsicherheit bekunden (Culshaw 2003), da in Abhängigkeit von spezifischen geologischen Parametern geologische Prozesse stattfinden, die eine Schadensfolge bewirken können. Beispielhaft sind die Austrocknung und das Quellen für Tone zu nennen, die Lösung von Gips und Kalkgesteinen, das Schwellen von Anhydrit, langanhaltende Setzungen auf stark organischen Böden oder auch der Zusammenbruch flachliegender bergmännischer Hohlräume, etwa in Bereichen mit Braunkohlevorkommen. Das Risiko eines solchen Schadensfallens ist mit den bisherigen Methoden nicht ausreichend genau abzuschätzen und erfordert die Quantifizierung der Unsicherheit des Modells. Der Bedarf hierzu ergibt sich auch aus der Einführung neuer bautechnischer Normen und Regeln, die zu einer Abkehr von der konservativen Bauweise führen sollen, um bspw. die kostenrelevante Überdimensionierung einer Gründung zu vermeiden.

Das ursprüngliche Ziel einer geologischen Modellierung, Daten zu visualisieren, wird mehr und mehr verdrängt durch den Bedarf, objektive Entscheidungen aus ihnen abzuleiten (Nasser *et al.* 2003). Geologische Modelle dienen damit nicht mehr nur dem wissenschaftlichen Erkenntnisgewinn per se, sondern vielmehr auch als Ausgangsbasis für Berechnungen und als Grundlage von Parameterstudien.

Im folgenden Kapitel 3 soll die geostatistische Schätzung vorgestellt werden, die zwar vielfach bereits zur Modellierung herangezogen wird, eine Quantifizierung der verbleibenden Unsicherheit jedoch nicht ermöglicht. Dabei ist es auch Ziel, die Unterschiede zur geostatistischen Simulation (Kap. 4) herauszustellen.

3 GEOSTATISTISCHE SCHÄTZUNG

3.1 Ablauf der geostatistischen Schätzung

Die in der Geologie auftretenden Phänomene stellen kontinuierlich variierende Parameterfelder dar. Da sie aufgrund der nur punktuellen Erkundung nicht vollständig bekannt sind, bedient man sich einer stochastischen Beschreibung, mittels derer man sie als Ergebnis einer Zufallsfunktion betrachten kann. Da der geologische Untergrund aus ökonomischen Gründen nur punktuell oder nadelstichartig beprobt wird, kann es nur eine finite Anzahl von Messpunkten geben, die innerhalb gewisser Entfernungen voneinander ähnliche Werte aufweisen (Autokorrelation). Die bekannten Werte bezeichnet man als regionalisierte Variable. Die regionalisierte Variable kann als eine Realisation des Zufallsprozesses betrachtet werden (Wackernagel 2003). Die Realität ist zwar eindeutig festgelegt, jedoch eben nicht oder nur an sehr wenigen Stellen bekannt. Demnach handelt es sich nicht um eine „potentielle Unbestimmtheit" (Bandemer 1993) als Ausdruck der Unsicherheit über den Ausgang eines stochastischen Experimentes, sondern eher um die Unkenntnis der eindeutig bestimmten Realität.

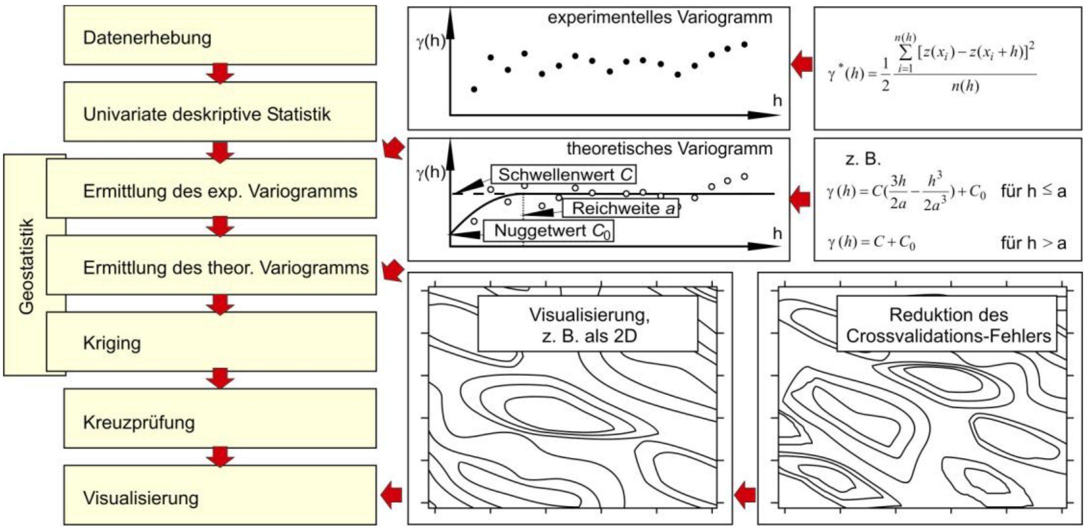

Abb. 1: Schematischer Ablauf der geostatistischen Schätzung

Unter den Voraussetzungen von Ergodizität und Stationarität (vgl. Deutsch & Journel 1997, Chiles & Delfiner 1999) kann mittels der Kriging-Verfahren eine Interpolation an den unbeprobten Lokationen erfolgen (Abb. 1). Dabei werden zunächst im Rahmen der

Variographie die Unterschiede eines bestimmten geologischen Parameters zwischen zwei Punkten jeweils gleicher Abstände berechnet und gegen die Entfernung aufgetragen. An dieses experimentelle Variogramm ist das theoretische Variogramm durch Auswahl einer Funktion aus einer Familie explizit dafür geeigneter Modelle anzupassen. Dieses theoretische Variogramm wird im wesentlichen durch das Zahlentripel der Parameter Schwellenwert C, Reichweite a und Nuggetwert C_0 typisiert, die in charakteristischer Weise Einfluss auf das Ergebnis der Interpolation haben.

Das anschließende Kriging führt schließlich nun zur Interpolation der Werte an allen Punkten des Schätzgitters. Zur Schätzung des Wertes an jedem einzelnen Gitterpunkt bedient es sich aller innerhalb der durch die Reichweite des Variogramms bestimmten Ellipse liegenden Messwerte, weist diesen in Abhängigkeit von der Variogrammfunktion entsprechende Gewichte zu und bestimmt so einen flächenhaft gewichteten Mittelwert. Schließlich sind die erhaltenen Daten in der Kreuzprüfung (Stone 1974, Dubrule 1983, Davis 1987, Myers 1997) zu validieren. Neben den Standardwerken der geostatistischen Literatur, die sich zumeist jedoch dem Bergbau widmen, finden sich auch einige Beispiele, die diese Verfahren zur Modellierung des flachen städtischen Untergrunds nutzen (Marinoni 2000, Pfleiderer & Hofmann 2004).

3.2 Bewertung

Vorteil einer Anwendung des Krigings zur Erstellung von Untergrundmodellen ist die Berücksichtigung aller zur Verfügung stehenden Informationen (Datenwerte, Mittelwerte, Varianz) sowie der räumlichen Struktur, die hier durch Erstellung des Variogramms und dem darauf basierenden gewichteten Einfluss der Messpunkte Eingang in die Berechnung findet. Beim Kriging handelt es sich zudem um einen optimalen Schätzer im Sinne von Lindner & Kardel (2000) und Bortz (2004), da das Verfahren keine systematische Über- oder Unterschätzung an den zu interpolierenden Punkten vornimmt und diejenige Lösung anbietet, die den geringsten Schätzfehler aufweist, der hier außerdem beim Kriging gleichzeitig berechnet wird. Auch handelt es sich bei den Kriging-Verfahren um exakte Interpolationen, da sie bei Schätzung von bereits bekannten Punkten dessen Wert wiederum reproduzieren. Zudem kann nachgewiesen werden, dass bei einer Erhöhung von Datenanzahl und Datendichte die Interpolation gegen die Realität konvergiert.

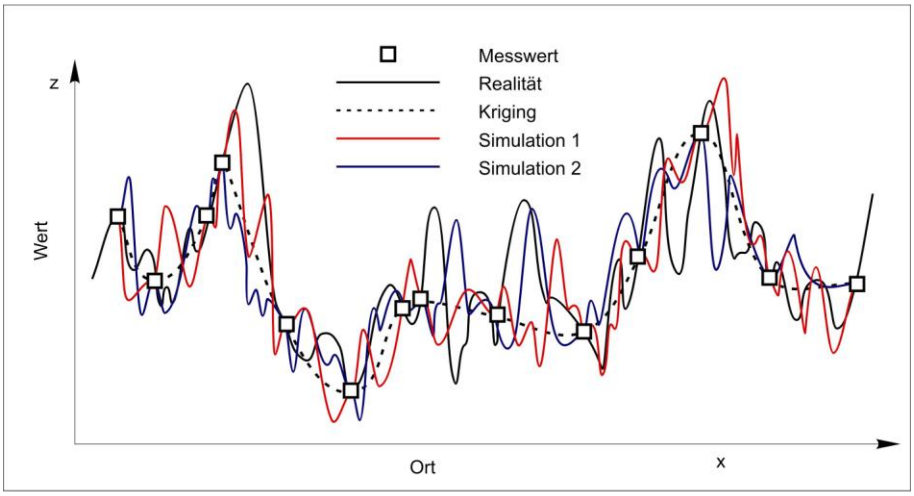

Abb. 2: Auswirkung der Verwendung der kleinsten Schätzvarianz als Ursache für den smoothing effect

Die bereits genannte Erzeugung desjenigen Modells mit der geringsten Schätzvarianz wirkt sich jedoch sehr nachteilig aus, da sie automatisch zu einer starken Glättung des Parameterverlaufes führt. Abb. 2 zeigt dieses als *smoothing effect* bekannte Phänomen. Im übrigen kann gezeigt werden (Armstrong 1998), dass es sich bei der durch das Kriging erzeugten Interpolation um den glattesten Kurvenverlauf aller derjenigen Zufallsfunktionen handelt, die durch die Messwerte verlaufen. In der Darstellung könnte es sich beispielsweise um den Verlauf der Mächtigkeit einer Schicht oder um deren Unterkante entlang eines geologischen Profils handeln. Die wahre, aber unbekannte Realisation des Parameters in der Natur hingegen weist eine viel höhere Variabilität auf. Diese ist zunächst ebenfalls unbekannt, kann jedoch mittels der geostatistischen Simulationsverfahren ermittelt werden.

3.3 Zur Unsicherheit geologischer Untergrundmodelle

Zur Erkundung des Baugrunds werden Messungen, Beobachtungen und Untersuchungen mit verschiedensten direkten und indirekten Methoden durchgeführt, die mit unterschiedlicher Genauigkeit Informationen über den Untergrund liefern. Im Wesentlichen sind hier je nach Aufschlussverfahren *hard data* zu unterscheiden von *soft information*, die noch einer Interpretation bedürfen bzw. aus denen sich erst nach Anwendung von Rechenvorschriften weiterverarbeitbare Werte ableiten lassen. Für die Behandlung qualitativer, halbquantitativer oder kategorialer Daten sind dafür unterschiedliche Verfahren notwendig. Letztlich entsteht eine insgesamt sehr heterogene Datenbasis. Eine gemeinsame Verwertung aller vorliegenden Daten in einem Modell ist daher zwangsläufig mit Unzulänglichkeiten verbunden.

Einen noch signifikanteren Einfluss auf das Ergebnis der Modellierung hat die Variabilität der geologischen Materialien und Strukturen. Die Ursachen der Variabilität bzw. Heterogenität des geologischen Untergrundes liegen in den verschiedenen lateral, vertikal und temporal unterschiedlich stark, teilweise interagierend über lange Zeiträume und in verschiedenen Maßstäben wirkenden geologischen Prozessen. Neben diesen komplexen multivariablen Prozessen ist der für bautechnische Zwecke relevante obere Teil der Erdkruste aufgrund der Verwitterung und wegen der weichen, locker gelagerten quartären Sedimente und auch aufgrund des anthropogenen Einflusses ungleich schwieriger zu behandeln als etwa tiefere Schichten.

4 GEOSTATISTISCHE SIMULATIONSVERFAHREN

4.1 Überblick

Jedes Modell stellt nur eine Interpretation seiner Eingangsdaten dar und wird zusätzlich durch das Basiswissen des Benutzers über geologische Rahmenbedingungen und Prozesse beeinflusst. Doch auch aus diesen mithin unsicheren Modellen lassen sich sinnvolle Entscheidungen ableiten, sofern die Unsicherheit quantifiziert werden kann (Kunstmann & Kinzelbach 1998). Für praktische Anwendungen hängt es mehr noch von dieser Unsicherheit, die mit der Interpolation von Werten einhergeht, als vom Wert selbst ab, welche Entscheidung getroffen wird und ob überhaupt eine Entscheidung getroffen werden kann oder ob noch weitere Erkundungsmaßnahmen erforderlich sind.

Für diesen Zweck lassen sich die geostatistischen Simulationsverfahren einsetzen. Dabei handelt es sich um eine Vielzahl verschiedenster Methoden mit teils nur schwer zugänglichen theoretischen Grundlagen. Grundsätzlich sind konditionierte und nicht-konditionierte Simulationen zu unterscheiden. Für beide Gruppen indes gilt, dass sie die ersten beiden Momente der Häufigkeitsverteilung der Stichprobe (Varianz und Mittelwert) und Aussagen zur Autokorrelation, die aus dem Variogramm abzulesen sind, reproduzieren. Die Verfahren bieten damit zum Krigingergebnis alternative Realisationen der Zufallsfunktion mit den gleichen statistischen Eigenschaften (repräsentiert durch das Histogramm) und gleicher räumlicher Struktur (repräsentiert durch das Semivariogramm) an. Soll eine konditionierte Simulation durchgeführt werden, so müssen die Messwerte bekannt sein und zusätzlich in die Rechnung eingehen. Der Nachteil der auf ein Minimum reduzierten Variabilität des Krigings wird dabei umgangen.

Simuliert werden können sowohl Eigenschaften, die qualitativ erfasst werden, wie etwa Lithologie und Mineralogie, als auch Variablen, die quantitativ behandelt werden, wie etwa bodenphysikalische Parameter (Dichte, Wassergehalt etc.) und geotechnische Parameter (Spitzendruck etc.).

Es existieren nur sehr wenige Programme, die überhaupt die Durchführung geostatistischer Simulationen ermöglichen. Die dem Benutzer abverlangten theoretischen Grundlagen für eine problemadäquate Auswahl und eine korrekte Anwendung der Methoden sind ausgesprochen vielfältig und umfangreich. Damit ist das Problem der Integration der modellimmanenten Unsicherheit in Geo-Informations-Systems im Sinne von Rosenbaum & Turner (2003) als eine der zukünftigen Kernaufgaben noch weit von einer Lösung entfernt.

Im folgenden sollen zwei bekannte und bereits in vielen Bereichen erfolgreich angewandte Methoden der geostatistischen Simulation näher beschrieben werden. Eine Prüfung auf Anwendbarkeit auch auf baugeologische Fragestellungen fehlt indes noch. Für die Beispiele werden Schätzgitter verwendet, die beispielsweise der Vorhersage von Mächtigkeiten einer Schicht dienen sollen. Auf diesen Schätzgittern sei nur eine sehr geringe Anzahl von Knotenpunkten mit der jeweiligen Mächtigkeit durch Bohrungen bekannt, so dass eine Interpolation erforderlich wird.

Für weitere Verfahren und ihre detaillierten mathematischen Grundlagen sei auf Goovaerts (1997), Lantuéjoul (2002), Armstrong & Dowd (1994) und Armstrong *et al*. (2003) hingewiesen.

4.2 Sequentielle Simulationen

Gemeinsames Merkmal der Sequentiellen Simulationsverfahren ist, dass sie entlang eines zufällig festgelegten Weges das gesamte Schätzgitter abarbeiten. Bei ihnen handelt es sich in der Regel um konditionierte Verfahren, d. h., sie führen zu einer Reproduktion der bereits bekannten Messpunkte. Wichtigste Verfahren sind die Sequentielle Gauß'sche Simulation (SGS), die eine Gauß'sche Normalverteilung der Daten voraussetzt, und die Sequentielle Indikatorsimulation (SIS) (Journel & Alabert 1989, Gomez-Hernandez & Srivastava 1990), die keinerlei Voraussetzungen bezüglich der Datenverteilung hat, weshalb sie als nichtparametrisch bezeichnet wird. Mit letzterem Verfahren lassen sich auch schiefe oder multimodale Verteilungen effektiv simulieren und untersuchen. Die SIS wird daher sehr häufig eingesetzt, da die theoretische Verteilung der Daten ja stets unbekannt ist, sondern lediglich ein geringer Teil, der durch das Histogramm der Stichprobe repräsentiert wird.

Bei der SIS (Abb. 3) wird zunächst der vorhandene Datensatz durch eine Reihe von Indikatoren in eine Anzahl von Klassen zerlegt. Anschließend werden für die einzelnen Klassengrenzen Indikatorvariogramme aufgestellt. Sodann wird ein Zufallspfad festgelegt, der sicherstellt, dass alle Gitterpunkte genau einmal besucht werden. Ein anschließendes Kriging an jedem der Punkte entlang des Zufallspfades unter Verwendung aller aufgestellten Variogramme führt dann zu geschätzten lokalen Verteilungsfunktionen. Aus diesen wird ein zufälliger Wert gezogen und dem Gitterpunkt zugewiesen. Bei Fortschreiten entlang des Zufallspfades werden die bereits simulierten Werte wie echte Datenpunkte behandelt, dem Konditionierungsdatensatz hinzugefügt und ebenfalls zur Schätzung herangezogen.

Nachdem auf diese Weise das gesamte Gitter abgearbeitet worden ist, kann das Ergebnis visualisiert werden. Jedes Ergebnis stellt eine Realisation dar; weitere Realisationen ergeben sich durch Wahl eines anderen Zufallspfades. Auf diese Weise kann eine hohe Zahl von Realisationen, die auch eine statistische Auswertung ermöglicht (bspw. 100 oder 1000 Realisationen), erstellt werden. Anschließend kann für jeden einzelnen Knotenpunkt des Schätzgitters eine lokale Werteverteilung aus allen durchgeführten Realisationen ermittelt werden. Hieraus lässt sich die Varianz als Maß für die mögliche Streubreite bestimmen.

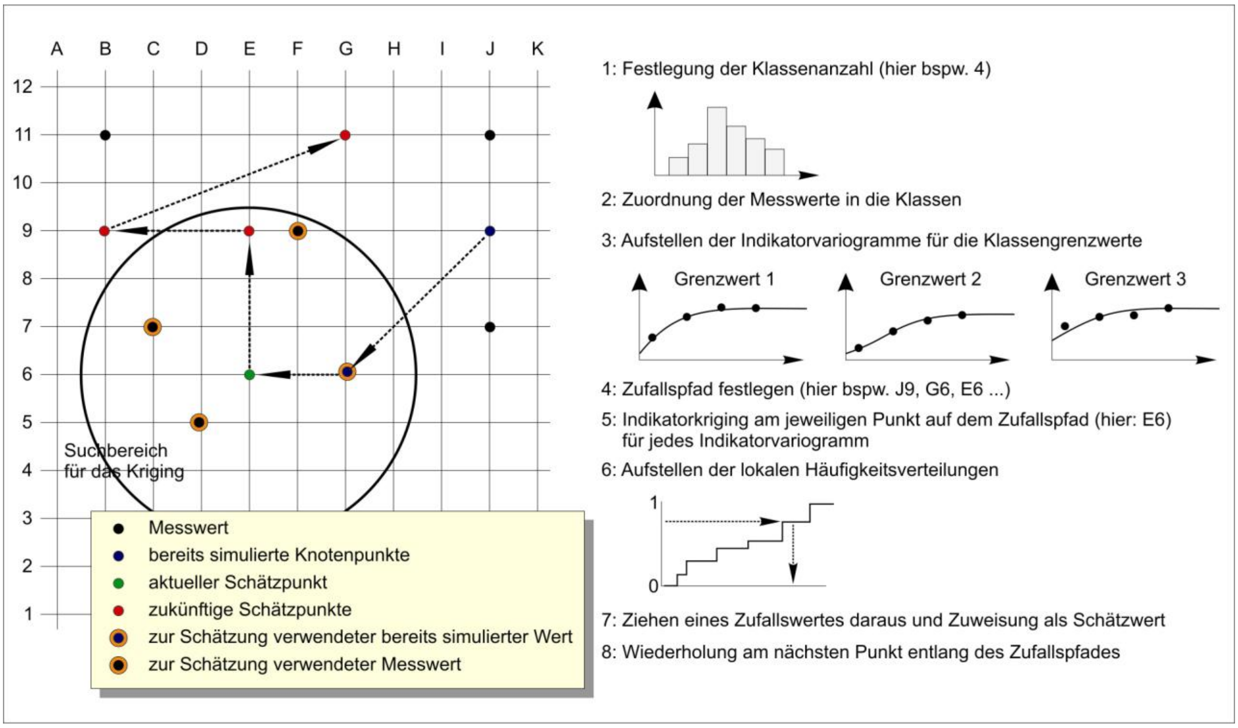

Abb. 3: Prinzip der Sequentiellen Simulation am Beispiel der Sequentiellen Indikatorsimulation (SIS)

4.3 Simulated Annealing Methoden

Die Simulated Annealing Methoden gehen im wesentlichen auf Journel (1992) zurück und stellen eine zweite große Gruppe weit verbreiteter geostatistischer Simulationsverfahren dar. Bei ihnen handelt es sich eher um Optimierungsalgorithmen, deren Ablauf in Abb. 4 schematisiert dargestellt ist. Auch hier steht am Anfang die Ermittlung der empirischen Häufigkeitsverteilung der vorhandenen Messwerte, an die dann eine theoretische Verteilung angepasst werden kann. Im einfachen Falle handelt es sich hierbei wiederum um Mächtigkeiten einer Schicht, so dass sich die Aufgabe auf ein zweidimensionales Problem reduziert. Aus der theoretischen Verteilung werden nun entsprechend der Anzahl der freien, durch die Messpunkte noch nicht belegten Knotenpunkte des Schätzgitters Werte ausgewählt und zufällig auf diese verteilt. Somit wird auch bei diesem Verfahren sichergestellt, dass jede einzelne Realisation eine vollständige Reproduktion des Histogramms bewirkt.

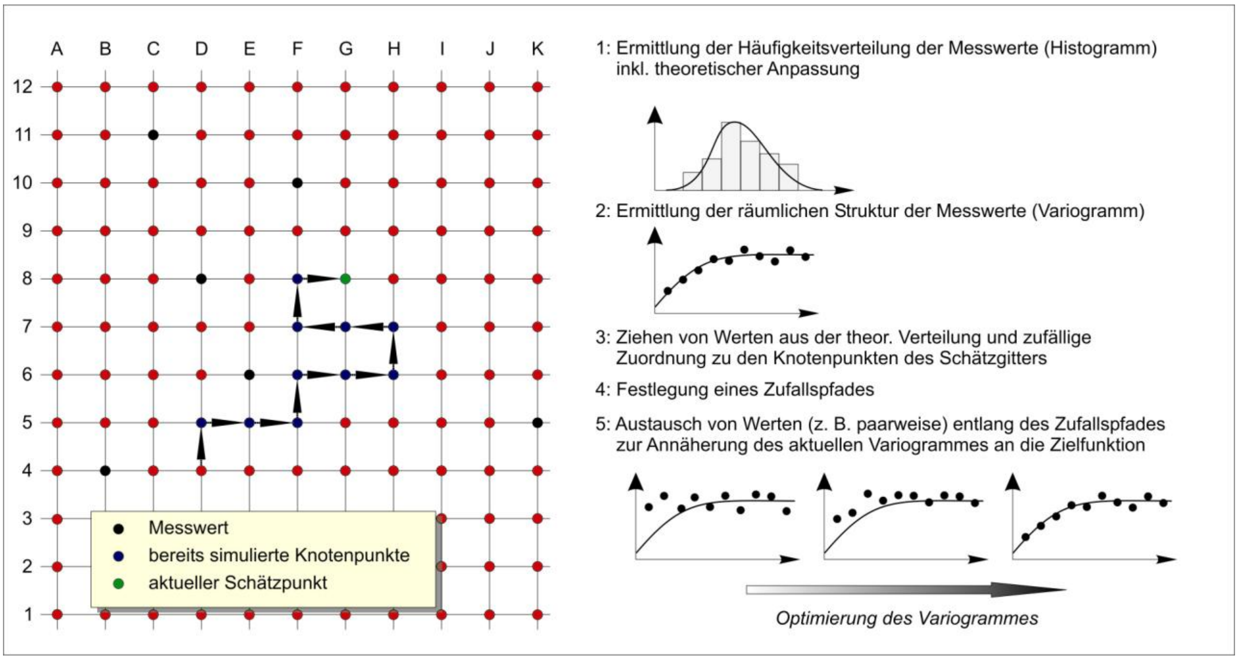

Abb. 4: Schematische Darstellung der Verfahrensweise bei Simulated Annealing Algorithmen

Die Erstellung des empirischen Variogramms unter Verwendung dieser zufälligen Anordnung offenbart natürlich zunächst keine räumliche Struktur (Abb. 4, Punkt 5, linkes Variogramm), sondern lediglich eine zufällige Schwankung um den Schwellenwert (vgl. Abb. 1). Daraufhin sind sämtliche Datenpunkte erneut anzuordnen, so dass sich das empirische Variogramm aller Knotenpunkte der Zielfunktion, die hier durch das theoretische Variogramm der Messwerte gegeben wird, annähert. Dabei werden am einfachsten entlang eines Zufallspfades Datenpaare ausgetauscht und erneut das Variogramm berechnet. Sofern dieser Austausch eine

Annäherung an die Zielfunktion bewirkt hat, wird weiterverfahren. Durch diesen Algorithmus nähert sich schließlich das empirische Variogramm der Zielfunktion an. Verschiedene Erweiterungen des Verfahrens und Varianten sind bei Goovaerts (1997) nachzulesen. Dieser Optimierungsprozess kann gestoppt werden, wenn der Unterschied zwischen Zielfunktion und berechnetem Variogramm hinreichend klein ist. Die einzelnen Austauschprozesse werden als *swap* bezeichnet; ihre notwendige Anzahl ergibt sich aus der Größe des betrachteten Gebietes, der Auflösung, die ihrerseits durch die Anzahl der Gitterknoten gegeben ist, der verwendeten Variante des Verfahrens sowie dem speziellen Abbruchkriterium.

Nach Erzeugung einer derart optimierten Anordnung ist auch hier das Variogramm vollständig reproduziert worden. Mithin stellt diese simulierte Realisation ebenfalls ein mögliches Ergebnis der Zufallsfunktion dar. Weitere Realisation ergeben sich bei diesem Verfahren durch Ziehung anderer Zufallswerte aus der theoretischen Verteilung der Messwerte. Auch hier wird deutlich, dass jede Realisation einzigartig ist, da die Werte zufällig gezogen und zufällig platziert werden, jedoch letztlich die statistischen Eigenschaften einer jeden Realisation mit denen der Stichprobe übereinstimmen. Damit bietet jede Realisation eine Alternative zur Kriging-Oberfläche (vgl. Abb. 2). In Analogie zu der in Abschnitt 4.2 beschriebenen Vorgehensweise lassen sich hier mehrere Realisationen durchführen, die dann statistisch zu untersuchen sind.

5 ZUSAMMENFASSUNG UND SCHLUSSFOLGERUNGEN

5.1 Anwendbarkeit und Nutzung der geostatistischen Simulationen

Der geologische Untergrund stellt aufgrund seiner Genese ein sehr komplexes System dar. Jeder Versuch seiner Modellierung ist mit einer Vielzahl von Unsicherheiten behaftet, deren Ursachen ausgesprochen vielfältig sind. Maßgeblicher Faktor jedoch ist die geogene Heterogenität, deren Kenntnis nie vollständig sein kann, sondern stets durch den Erkundungsaufwand bestimmt wird. Die Krigingverfahren stellen bei einer durch den Bearbeiter zu veranlassenden Aufführung der verwendeten Kriterien bei Variographie und Kriging (und deren jeweiliger Begründung!) zwar intersubjektiv nachvollziehbare Methoden dar, zeigen jedoch verfahrensbedingt stets einen übermäßig stark geglätteten Verlauf des betrachteten Parameters.

Die geogene Variabilität ist damit maßgeblicher Faktor für die Gesamtunsicherheit eines Modells. Subjektive Einflüsse bei der Wahl der Modellierungsmethoden und der Durchführung derselben treten dabei in den Hintergrund. Diese Unbestimmtheit als Auswirkung der Unkenntnis der Realität ist durch die geostatistische Simulation zu erfassen und zu quantifizieren. Hierbei handelt es sich um eine sehr umfangreiche und vielschichtige Methodensammlung, die bisher für die Baugrunderkundung noch nicht eingesetzt wird. Dessen ungeachtet erscheinen bestimmte Anwendungsszenarien besonders vielversprechend.

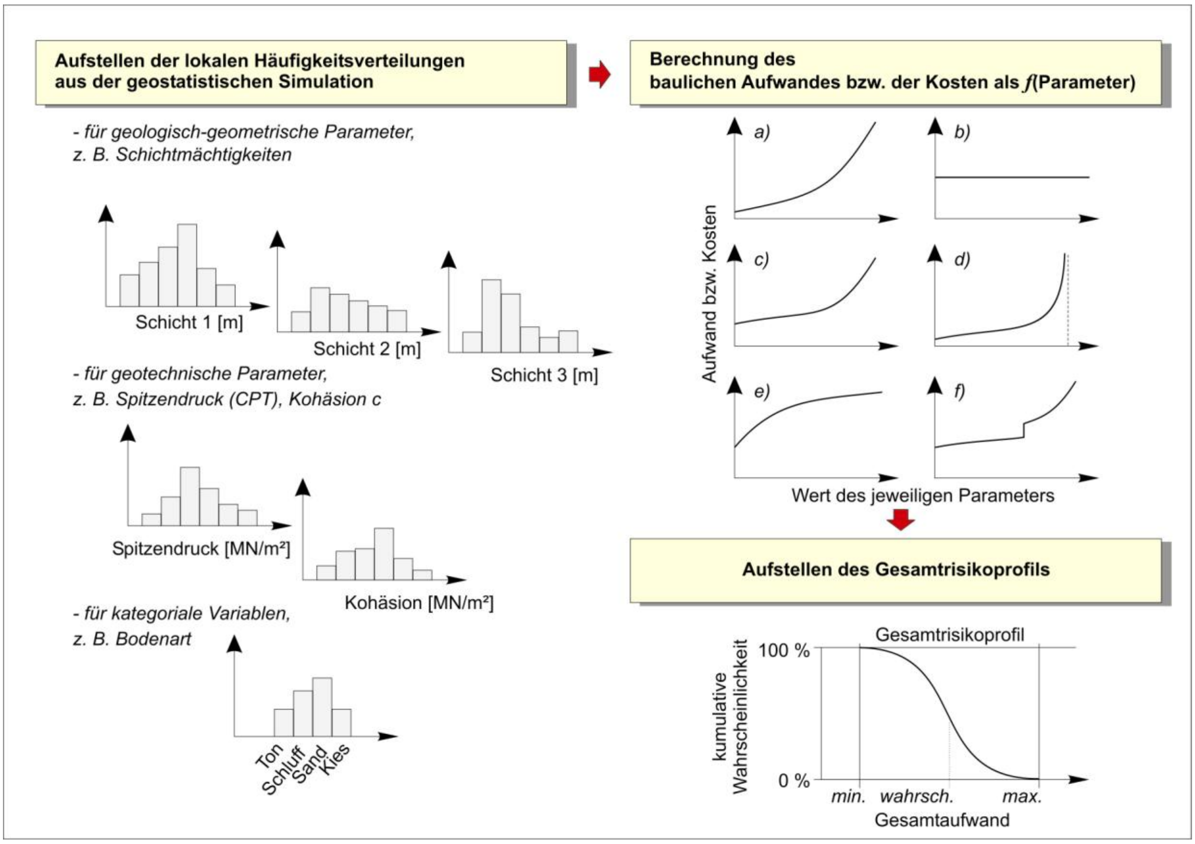

Abb. 5: Schema der Integration der geostatistischen Simulation in ein Entscheidungssystem auf Basis eines Gesamtrisikoprofils

Die geostatistischen Simulationsverfahren sind für verschiedenste Fragestellungen anwendbar, bspw. welche Bodenarten mit welcher Wahrscheinlichkeit an einem Punkt vorkommen können. Auch kann untersucht werden, welche quantitativen Eigenschaften der Boden besitzt. Häufigste Fragestellung dürfte jedoch die nach den Schichtmächtigkeit sein. So ist es mit Hilfe der geostatistischen Simulation möglich, die Wahrscheinlichkeiten zu berechnen, mit der ein bestimmter Wert eines geologischen oder geotechnischen Parameters überschritten wird. Dies ist zwar auch mit dem Indikatorkriging (Deutsch & Journel 1992) möglich, wobei der gekrigte Wert unmittelbar die Wahrscheinlichkeit anzeigt. Anwendung findet dies zum Beispiel bei Marinoni (2000) bei der Beschreibung von Schichtmächtigkeiten. Jedoch zeigen bereits Menz & Wälder (2000), dass unter Verwendung der Simulation anstelle des Kriging dessen Nachteile deutlich überwunden werden können.

Basierend auf den Ergebnissen der Simulation kann auch die Planung eines komplettem Messnetzes vorgenommen oder die Lage zukünftiger Mess- oder Probenahmeorte bestimmt werden. Die optimale Anordnung einzelner Messstellen kann nach verschiedenen Kriterien optimiert werden. Dabei kann auch iterativ verfahren werden, indem das Ergebnis einer jeden Probe dem Datensatz hinzugefügt wird, um dann erneut eine Simulation durchzuführen. Alternativ können auch die Lokationen für eine ganzen Untersuchungskampagne festgelegt werden.

Da im Verlauf der geostatistischen Simulation jede einzelne Realisation des betrachteten Parameters eine gleichwahrscheinliche Alternative darstellt, können bei entsprechend hoher Anzahl Realisationen (N = 100 oder 1.000), die lokalen Häufigkeitsverteilungen zur Durchführung von Risikosimulationen genutzt werden. Ein verallgemeinertes Schema, wie es beispielsweise bei einer Bauwerksgründung Verwendung finden könnte, stellt Abb. 5 dar. Hierfür werden zunächst die relevanten Parameter durch separate geostatistische Simulationen untersucht. Im Beispiel sind dies die Mächtigkeiten der mit dem Bauwerk in Wechselwirkung stehenden Schichten 1 bis 3 sowie die für die Wahl des Gründungsverfahrens relevanten geotechnischen Parameter, hier bspw. Spitzendruck und Kohäsion. Auch das Auftreten der Bodenart als kategoriale Variable kann mittels der geostatistischen Simulation untersucht werden. Durch Anwendung der einschlägigen technischen Regeln zur Gewährleistung von Standsicherheit und Gebrauchstauglichkeit des Gebäudes lassen sich für jeden untersuchten Parameter Funktionen aufstellen, die die Abhängigkeit des notwendigen baulichen Aufwandes vom jeweiligen Parameterwert zeigen. Diese Funktionen sind deterministischer Natur und durch die Berechnungsverfahren in den o. g. technischen Vorschriften bedingt. Als Ergebnis kann ein Gesamtrisikoprofil aufgestellt werden, das die geogen bedingte, lokal mögliche Streubreite eines jeden Parameters und die darauf basierenden spezifischen ökonomischen Abhängigkeiten koppelt und in einer Kurve zusammenfasst. Somit ergeben sich ein minimaler, ein maximaler und ein wahrscheinlicher Fall für den Gesamtaufwand bei der hier betrachten Bauwerksgründung.

Darauf basierend ist abzuwägen, ob mit einem für die wahrscheinlichste Kombination der Parameterwerte geeigneten Gründungsverfahren unter Inkaufnahme eines verbleibenden, aber eben genau quantifizierten Restrisikos begonnen werden soll und das Verfahren unter Umständen im Verlaufe der Arbeiten bei Auftreten anderer als der prognostizierten Baugrundcharakteristika eventuell umzustellen ist. Alternativ kann entsprechend nacherkundet werden, sofern das Risiko weiterhin als zu hoch angesehen wird.

Jede Kopplung der durch die Simulation erhaltenen stochastischen Verteilungen mit sich anschließenden deterministischen Modellen führt zu einer verbesserten Planung. Entsprechende Beispiel aus der Hydrogeologie finden sich bei Ptak (1993), Kunstmann & Kinzelbach (1998) und Schafmeister (1998).

Als denkbare typische Beispiele aus der Baugeologie sind etwa die Abschätzung von Aushubvolumina, von Gründungstiefen von Dichtwänden und die Ermittlung des Grundwasserzustromes zu Baugruben zu nennen. Praktische Anwendungen fehlen hier bislang.

5.2 Bewertung

Wie alle geostatistischen Methoden benötigen auch die Simulationen eine hohe Datenzahl und eine hohe Datendichte, die kaum jemals innerhalb eines einzelnen bauprojektspezifischen Untersuchungsgebietes vorhanden sein dürfte. Vielmehr eignen sie sich daher für größere innerstädtische Bereiche, die durch mehrmalige Untersuchungskampagnen als relativ gut erkundet gelten können.

Die Anwendung der geostatistischen Simulation erfordern eine hohen Wissensstand des Bearbeiters bei der Modellierung hinsichtlich der theoretischen Grundlagen und ihrer prinzipiellen Anwendbarkeit auf das jeweilige Projekt. Die Problemadäquatheit der Methoden stellt dabei ein wesentliches Kriterium dar. Ein unerfahrener Bearbeiter vermag zwar unter Umständen durchaus, eine geostatistische Simulation durchzuführen, jedoch vermag er nicht, die Wahl der Methode und ihrer speziellen Variante zu begründen. Auch ist das Ergebnis einer Plausibilitätskontrolle zu unterziehen, wofür die Kenntnis der geologischen Rahmenbedingungen unabdingbar ist.

Nachteilig wirkt sich indes die geringe Verfügbarkeit entsprechend geeigneter Software aus. Implementiert sind derartige Funktionen nur in sehr wenigen speziellen Programmen, für die zumeist ein sehr hoher Kaufpreis zu zahlen ist. Darüber hinaus sind diese aufgrund der für die einzelnen Verfahren verfügbaren Varianten und Methoden nur umständlich bedienbar und erfordern auch hierfür ein zusätzliches umfangreiches Basiswissen.

5.3 Ausblick

Zwar lassen sich auch mit den genannten Verfahren fehlende Informationen über den geologischen Untergrund nicht kompensieren, jedoch bieten sie interessante und vielversprechende Möglichkeiten, die unvermeidliche Unsicherheit bei der Modellierung zu quantifizieren. Zukünftig wird dies neben der reinen Visualisierung stark an Bedeutung gewinnen. Die Verantwortung bei der Erstellung eines auf der geostatistischen Simulation fußenden geologischen Untergrundmodells bleibt jedoch beim Bearbeiter und ist wegen der vielfältigen Interaktionsmöglichkeiten sogar noch um einiges größer als bei den Kriging-Verfahren.

Daher ist eine Anwendung der Verfahren durch Experten anzustreben, um sicherzustellen, dass problemadäquate Methoden auswählt und in korrekter Weise angewendet werden. Der auch durch die hohe Verfügbarkeit entsprechender Software mitverursachte Trend zur Nutzung der Kriging-Methoden durch neue Benutzerschichten ist zwar nicht mehr umzukehren, eine parallele Entwicklung bei der Simulation sollte jedoch vermieden werden und scheint mittelfristig durch die fehlende Software gebannt.

Anhand Daten aus dem Berliner Raum, über die bereits bei Marinoni (2000) und Gau & Tiedemann (2004) berichtet wurde, sollen zukünftig einige Simulationsverfahren erprobt und hinsichtlich ihrer Anwendbarkeit auf ingenieurgeologische Fragestellungen bewertet werden. Darüber hinaus soll der Nutzen der durch die Simulation realisierten Verteilungen als Input-Parameter für Risiko-Untersuchungen zur Wahl von Gründungsmethoden und zur Erzeugung optimaler Messnetze untersucht werden.

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reviewed paper

‚Kultivierung von Kultur- und Wissensräumen‘ - Nachhaltige Prozesse Kultivieren statt vergeblich Ideal-Zustände Planen

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ABSTRACT

Der Wandel von der Industrie- zur Wissensgesellschaft stellt, ähnlich dem von der Agrar- zur Industriegellschaft, einen säkularen Wandel dar. Erklärungsmodelle und Werkzeuge sind weitgehend noch solche tradierter Planung, die selbst überholt ist. Soll Zukunft nachhaltig wahrgenommen werden, sind adäquate Strategien und tools zu entwickeln. In der Generierung von Kulturlandschaften der Wissensgesellschaft sehen wir einen dazu geeigneten Weg.

1 EINFÜHRUNG

Die Welt unserer Stadtregionen und Kulturlandschaften ist in der Transformation zur Wissengesellschaft keineswegs irreal geworden – ihre beschleunigte Dynamik macht nur die schwindende Eignung der industriegesellschaftlichen Planungskonzepte und Erklärungs-modelle offensichtlich. Unsere Vorstellungen von „Stadt“, die Wissenschaften über „Stadt“ und die Disziplinen, die sich mit Planung und Management von Städten beschäftigen, sind wesentlich in der Industriegesellschaft entstanden und durch diese geprägt.

Wissen und Information als treibende Kräfte und neue Wertschöpfungsformen verändern die Lebens-, Arbeits-, Mobilitäts- und Freizeitstile in Städten und Regionen. Bisherige, industriegesellschaftliche Metabolismen, Raum- und Nutzungsmuster samt agrargesellschaftlicher Relikte werden von neuen Strukturen der Wissensgesellschaft überlagert, überformt und abgelöst. Dennoch sind viele Raumordnungsmodelle und Leitbilder, so auch ganz wesentlich die nationale Nachhaltigkeitsstrategie in Deutschland, noch in industriegesellschaftlichen Denkweisen, z.B. dem Postulat der Nutzungstrennung oder räumlicher Zentralität, verhaftet. Gleichzeitig entsteht Neues – weder in den Modellen vorgesehen noch von der Planung erkannt. Es wäre aber dringlich und zunehmend die Bedeutung neuer Triebkraftkonstellationen (Abnahme von Arbeit und Energieeinsatz) und Wertschöpfungen (zunehmende Wissensbasierung, Nano- und Biotechnologie) zu antizipieren. Mit diesen Veränderungen gehen auch neue Standortvorzüge einher: So scheint in San Diego nicht nur mehr Sonne als in Wien, es hat auch mehr Humankapital (vgl. Biotechnologie). Mit dem paradigmatischen Ansatz, Siedlungen als Kultur- und Wissensräume in Stadt und Land zu *kultivieren*, sollen statt tradierter, auf ideale Zustände gerichteter Planung die gesamten Lebenszyklen von Nutzungen gemanagt werden. Um den „time-lag“ von der Wahrnehmung stattfindender Veränderungen zum handlungsorientierten Planen überzeugender Lösungen so gering wie möglich zu halten, gilt es, den Wandel auch kategorial zu begleiten.

2 VON DEN PROZESSEN

Die durch die neuen Kräfte und Einflußfaktoren aufscheinende Komplexität läßt die Möglichkeiten einer Erfassung mittels tradierten Modellierungen fast unmöglich erscheinen – und das ist gut so.

Eine Dekonstruktion über nahezu 200 Jahre vertraut gewordener Paradigmen und Konzepte zeigt einen hohen Ideologieanteil, der den notwendigen klaren Blick auf die Fakten und Realitäten nahezu verdeckt. Zwar haben sich von den funktionalistischen Modellannahmen der gegliederten Stadt und der Nutzungstrennung (Jahrzehnte wurde an der Entmischung gearbeitet) in den 90er Jahren flexiblere Konzepte wie das „muddling through“ (Lindblom) und der darauffolgende „perspektivische Inkrementalismus“ (Ganser) gelöst, doch zeigt sich häufig planerische Ohnmacht angesichts der Veränderungsprozesse, etwa der durch technologische Innovationen grundlegend veränderte Raum-Zeit-Verhältnisse (vgl. Venturi). Auch öffentlicher Raum wandelt sich: so öffnen sich „Verbotene Städte“ der Industriegesellschaft zu attraktiven Standorten.

Eine Phasierung industriegesellschaftlicher Stadtentwicklung mit je eigenen Kultur- und Metabolismus-Mustern von

den ‚Fossilen Optionen‘ (ab 1815) über

die ‚Hochindustrialisierung‘ und Hochurbanisierung (ab 1871)

den Funktionalismus (Zwischenkriegszeit)

bis zur Konsumgesellschaft (bis 1989)

samt des mit dem Begriff der ‚Informationsgesellschaft‘ belegten Übergangs zur Wissensgesellschaft

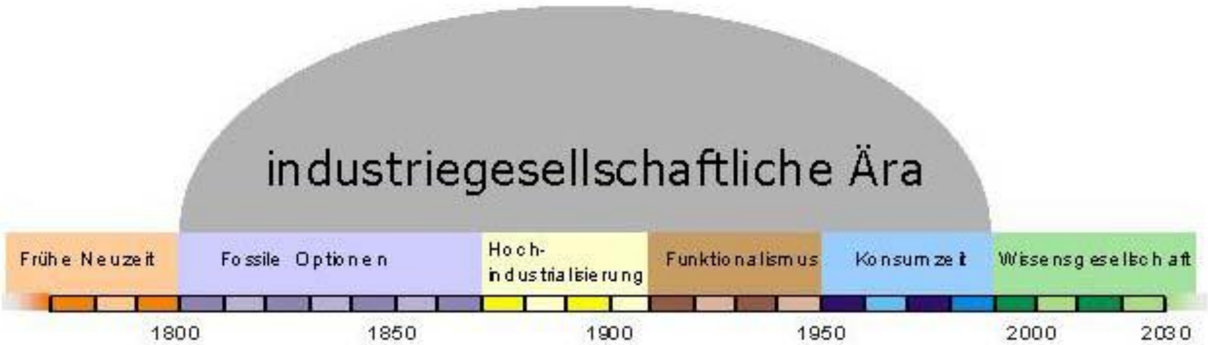

Abb. Phasen industriegesellschaftlicher Stadtentwicklungen und die vergleichende Betrachtung der ‚Lebensstadien' von Siedlungstrukturen und Theorien ermöglichen die notwendige Differenzierung von Evolutionen und Sukzessionen von Siedlungsgebilden in der industriegesellschaftlichen Ära. Für nutzbare Modellierungen werden Implementierungen industriegesellschaftlicher Stadt-Biographien und Klassifizierungen von Stadttypen erforderlich, wie sie aus der Distanz der Wissensgesellschaft heraus leichter möglich geworden sind. Einzubeziehen sind auch bisher kaum thematisierte Raumstrukturen wie alte Industriedörfer oder moderne Land-Industrien (vgl. Automobilcluster in der Steiermark oder die Firma Claas in Harsewinkel). Allerdings ist vor allem die „traditionelle Unfähigkeit unserer Disziplin, Voraussagen zu machen, die dann auch eintreffen" (Venturi) zu überwinden.

„Stadt" als Ziel? Nahezu während der gesamten industriegesellschaftlichen Ära ist die (verdichtete) Großstadt als negativ, im heutigen Vokabular als nicht nachhaltig gesehen worden. Soll jetzt allein die Angst vor der Veränderung von Flächennutzungen die Menschen vom Gegenteil überzeugen? Industriegesellschaftliche Infrastrukturen, Wertschöpfungs- und Organisationsprinzipien haben unser „Bild der Stadt" so gravierend beeinflußt, daß spezifisch „Städtisches" und „Urbanes" als in der Regel marginale Teilmenge der in mehreren Eingemeindungsschüben entstandenen heutigen Verwaltungseinheiten namens „Stadt" als in diesen ubiquitär vorhanden angenommen wird. Ohne Zweifel wird Neues umso schmerzhafter, „je länger versucht wird, die traditionellen Schwerkraftmodelle und Hierachien beizubehalten" (Venturi).

Ersatzweise wird immer häufiger der Fokus auf Architektur und Baukultur gelegt, statt Siedlungsräume (ob als ‚Stadt' oder ‚Suburbanisierung') als in Lebenszyklen sich entwickelnde Bedeutungsschichten und Identifikationsräume wahrzunehmen. Dagegen lassen sich in der künstlerischen und kulturwissenschaftlichen Landschaftswahrnehmung, insbesondere zur Industrielandschaft – nach der Industrie (siehe z.B. bei Hauser, Becher) aber auch seitens der Unesco mit Welterbestätten wie Zollverein im Ruhrgebiet oder die Industrielandschaft Derwent Valley in England Tendenzen zur Ästhetisierung der Industrielandschaft und die Adelung alter, ‚abgelaufener' Industrien als ‚Industriekultur' beobachten.

Neben „Shrinking Cities' und Demographischem (Schirrmacher) laufen vor dem Hintergrund der sich abzeichnenden degressiven Entwicklung in den ‚alten' Industrieländern räumliche Umverteilungsprozesse zunehmend unsystematisch-zufällig ab, muten anarchisch an – das ist das Gegenteil von Planung, wie wir sie aus Zeiten des Wachstums und einer wohlfahrtsstaatlichen Fördermoral kennen. In anderen Weltregionen wie in Dubai oder Shanghai sehen wir optimistisch- Überholendes, gesteuert von anderen Planungsvorstellungen. Doch lösen Projektentwicklungen und nutzungsbegleitende Managementstrategien zunehmend tradierte Formen der Planung ab. Deren Primat des kurzfristig ökonomischen Benefits bietet jedoch keine Gewähr für Nachhaltiges.

Bemerkenswerterweise scheinen neue Handlungsansätze zunächst in den aktuellen Managementstrategien für Firmen durch. Diese finden über Umwege wie kommunales Projektmanagement (z.B. durch McKinsey) auch wieder Eingang in die Stadtplanung, tragen aber möglicherweise zu deren Marginalisierung bei.

Vom zu langsamen Wandel der Kategorien. Sogar in der Forschung liegt der Fokus noch auf „Bewahrung". Das deutsche Forschungsministerium wird 2005 im neuen Förderschwerpunkt „Forschung für die Reduzierung der Flächeninanspruchnahme und ein nachhaltiges Flächenmanagement (REFINA)" eine „Trendwende" anstreben, dabei aber weiterhin Siedlungsflächen pauschal als nicht nachhaltig verurteilen. ‚Flächensparen' und ähnliche Konzepte ignorieren alle bisherigen Leistungen nachhaltiger Siedlungsentwicklung und ökologischen Bauens. Dies, obwohl das Konzept der Nachhaltigkeit in weiten Teilen nicht wirklich zukunftsorientiert ist, da nur industriegesellschaftliche Syndrome korrigieren wollend – dies gilt auch auch für Rio + 10 bis hin zum Umgang mit Konversionsflächen. Auch die Krise auf dem Immobilienmarkt hat nicht zuletzt damit zu tun, daß noch immer in "Büroflächen" statt in zeitgemäßen Wertschöpfungsformen gedacht wird. Die Modi der Wissensproduktion haben sich mit dem Übergang zur Wissensgesellschaft nicht zufällig verändert.

Entkleidet man die Siedlungszukzessionen um die offensichtlich der Industriegesellschaft immanenten Wahrnehmungsfilter, ergeben sich vor dem Hintergrund säkularer Trends durchaus interessante Handlungsoptionen für städtische Zukünfte in der Wissensgesellschaft.

3 KULTIVIEREN

Mit Kulturlandschaften wurden durch Arbeit aus der ursprünglichen Natur neue Qualitäten erzeugt, die etwa als ‚ökologischer Fußabdruck' völlig unzureichend beschrieben sind. Kulturlandschaften mit hohem Nachhaltigkeitspotential finden wir sowohl im besiedelten Bereich wie im Agrarland – aber auch dort machen erst die eingebetteten Siedlungen (siehe Toskana, Wachau oder das ‚Alte Land' nahe Hamburg) die Landschaft zur Kulturlandschaft! Eine Vielzahl von nachhaltigen Siedlungsprojekten steht dafür, dass Flächeninanspruchnahme keineswegs „mit dramatischen ökologischen Funktionsverlusten verbunden" (Dt. Umweltrat) ist. Mehr noch: Die rechtskonforme Umsetzung des deutschen Baugesetzbuches oder dre EU-UVP-Richtlinien lassen gar keine Nicht-Nachhaltigen Nutzungen mehr zu.

Heute erfolgen Kultivierungen zunehmend durch nachhaltige Investitionen von sozialem und Wissenskapital, also durch scheinbar imaterielle, wissensbasierte Wertschöpfungen. Arbeit, die auf Wissen und Verständnis beruht, braucht andere Strukturen als die der Fabriken. Der Park von La Villette dient seit den 80er Jahren des vergangenen Jhdts. als Pionier für postindustrielle Raumtypen, aber auch der Emscherpark kann mit dem Konzept der Einbettung von Siedlungen und Infrastrukturen in einen Regionalpark als Pionierphase einer neuen Raumordnung gesehen werden. Zur Qualität der Raumkultivierungen tragen keineswegs nur physische Strukturen und gesellschaftliche Stoffwechsel bei, auch symbolische Aufladungen und in Kultiviertem erlebbare ‚kondensierte Zeit', die nur sehr begrenzt planbar sind, führen zu positiven Besetzungen.

Wie kann heute kultiviert werden? Anregungen kommen aus der Sukzessionstheorie: zunächst entstehen wissensgesellschaftliche Innovationsinseln, diese bilden bei positiven Verlauf Archipele, auf dieser Grundlage können schrittweise ubiquitäre Wissenskulturlandschaften herausgebildet werden. Wie schon bei agrarischen Landnutzungen zu beobachten, verlaufen die Prozesse weder mit Sicherheit gerichtet noch führen sie ohne Kultivierungsleistungen zu Kulturlandschaften.

In Beispielen wird dies veranschaulicht:

mit positivem Vorzeichen: das MuseumsQuartier in Wien, die Transformation von Zürich West, der Channel Hamburg südlich der Elbe, das Sulzer-Areal in Winterthur, oder die Universitäts- und Forschungslandschaft von Boston/Harvard. Sie werden nicht ohne Gründe als Modell urbaner Innovationen gesehen;

mit negativem Vorzeichen sind die Wissenschaftsstadt Adlershof in Berlin oder der neue Campus der TU München in Garching zu nennen.

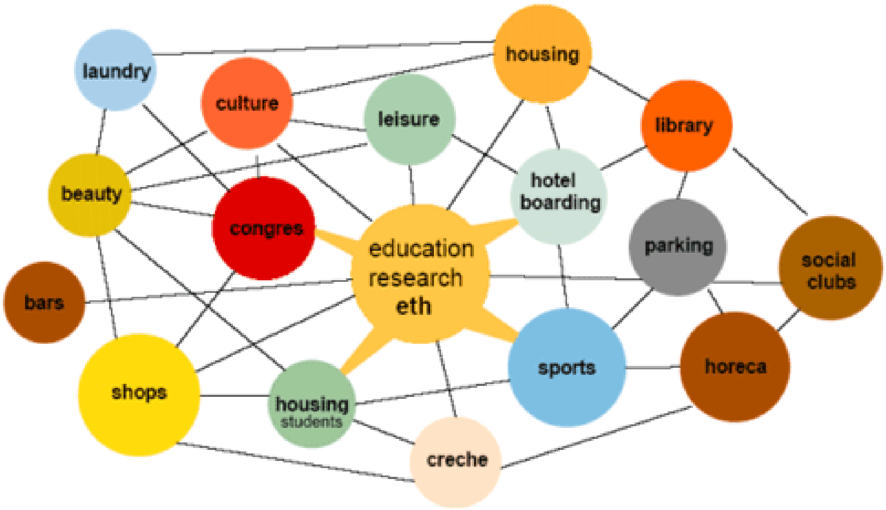

Abb. Zürich Science-City

Nicht ‚flächensparende Nutzungsweisen‘ sind innovativ, sondern nachhaltig kultivierende! Zum Erreichen einer solchen nachhaltigen Kultivierung bietet sich an, Nutzungen zu mischen statt sie zu trennen. Schon nach dem geltenden Planungsrecht verbessert sich die Umwelt- und ökologische Qualität im Siedlungsbereich zunehmend. Lernende Nachhaltigkeits-Kulturen zeichnen sich durch die prinzipielle Offenheit für neue Nutzungskonzepte und Technologien aus. Wenn wir zukunftsfähig sein wollen, müssen wir Zukunft auch zulassen, künftige Technologie-Lebenszyklen kultivierend einphasen können. Lebendige urbane Quartiere, gartenstadtartige Siedlungen oder Dörfer des 21. Jhdts., deren Bewohner neuartige Erwerbsbiografien aufweisen, sind gleichermaßen Elemente von StadtRegionen als Kulturlandschaften. So lassen sich auch alte Kulturlandschaften durch Folgesukzessionen zukunftsfähig machen (statt sie zu Romantisieren), vor allem aber in den industriell devastierten Räumen neue entwickeln.

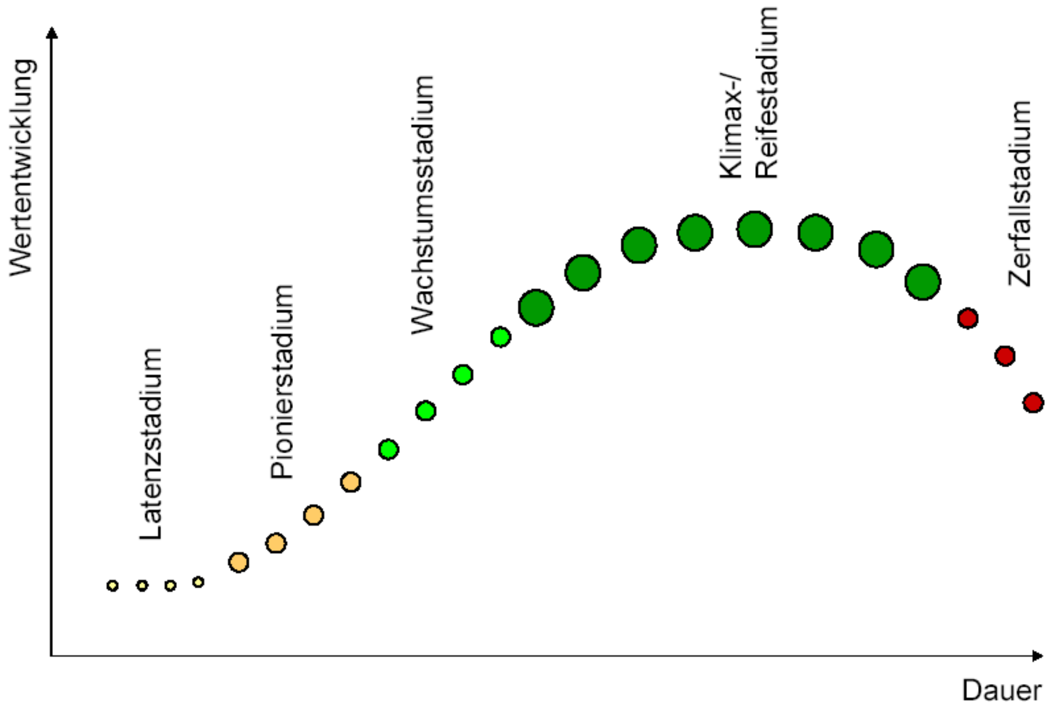

Abb. Lebenszyklen

Nachhaltigkeit als Innovationstreiber – es gibt vielfältige Perspektiven für die Stadtentwicklung in unseren reifen StadtRegionen jenseits des kaum innovativen Flächensparens. Wie im als nachhaltigem Biotech-Quartier angelegten Stadtteil Helsinki-Vikki oder am Kronsberg in Hannover: die Nutzungskultur ist das Wichtige, nicht ein obskurer „Versiegelungsgrad“. Die auch ohne spezifische Planungen in vielen reifen Siedlungsarealen identifizierbaren Nutzungskulturen erwachsen vermehrt aus vielfältigen Varianten postindustriellen Ressourcenmanagements.

4 FÜR EIN KULTIVIERUNGS-PARADIGMA

Hier setzt das als wissensgesellschaftliche Lösung konzipierte, auf Evolution und prozessualer Innovation basierende Kultivierungs-Paradigma an:

Statteiner Beschränkung auf bloße Nutzungswidmungen, die die eigentlich interessanten Entwicklungsphasen wie Pionierstadium, Wachstum oder Reifung ignorieren, schlagen wir die Entwicklung von Nutzungstypen bzw. -mustern wie „Integrierte Standorte“, „Wissens- und Kulturmilieus“ und insbesondere „Regional- bzw. @Parks“ vor. Die Entwicklung solcher Nutzungstypen bzw. -muster gilt es als Kultivierungsprozeß durch geeignete Werkzeuge wie den SynArealScorer© zu unterstützen.

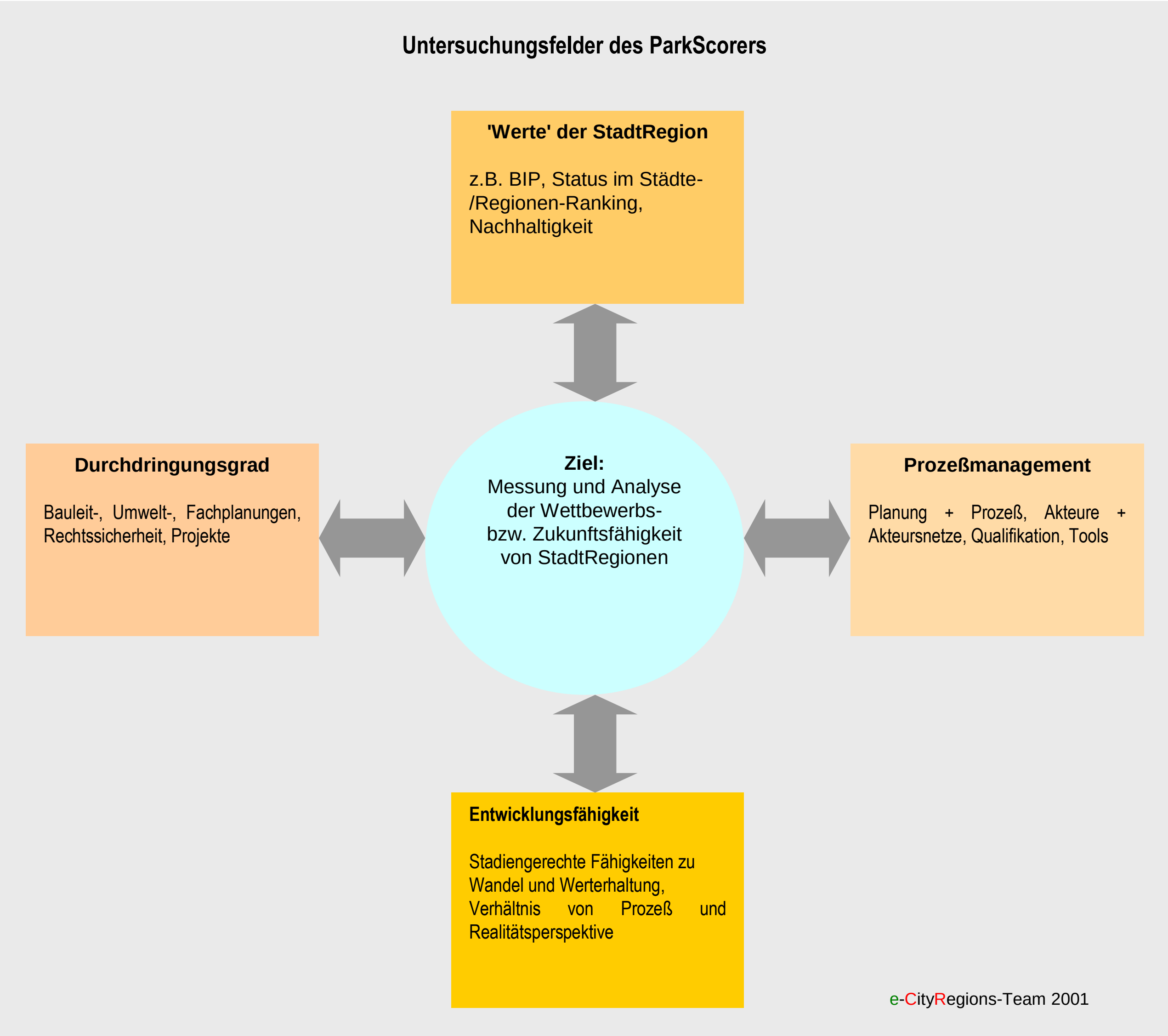

Abb. ParkScorer

So können Lebenszyklen nicht nur modelliert, sondern nachhaltig beeinflußt und die jeweiligen Klimaxstadien als eigene Prozesse optimiert werden. Dies schließt ein:

Die jeweils prägenden Triebkräfte und Metabolismen zu erkennen: wodurch werden Landschaften geformt/verändert und kultiviert bzw syndromisch verändert?

Aus den veränderten Wertschöpfungen sind Potentiale abzuleiten: Kultivierungen erfolgen, wie in Wissensmilieus und Integrierten Standorten erkennbar, zunehmend durch nachhaltige Investitionen von sozialem und Wissenskapital, also wissensbasierte Wertschöpfungen.

Geeignete Werkzeuge zur Beobachtung von Kultivierungen und deren Management zu entwickeln und damit im Sinne von Mode 2 durch Forschung + Entwicklung Nutzungskulturen als „Realexperimente“ ‚teilnehmend beobachten‘ zu können.

Zunächst sind bereits vorhandene Kultivierungsinseln zu identifizieren, Neue zu schaffen und diese Schritt für Schritt zu vernetzen. Systematische Evaluation von Best Practice, Wettbewerbe um beste Lösungen tragen dazu bei. Beste Lösungen kultivierender Raumentwicklung werden immer, auch und gerade in Zeiten der Globalisierung, regionalspezifische sein. Den professionellen Umgang mit dem Unvorhersagbaren werden Kultivierungsstrategien und modellbasierte tools ermöglichen. Bedeutungsgewinne und -konzentrationen sollten möglichst kontinuierlich durch Nutzer, Akteure und Standortmanagement erzielt werden.

Noch fehlen allerdings der Kulturlandschaftsforschung trotz aufwendiger Programme (siehe Österreich) Theorien, Methoden und Werkzeuge, neuartig-positive Kulturlandschaftsbildungen zu erkennen oder diese gar zu befördern.

5 FAZIT

„Kultivierung“ erlaubt Anpassungsfähigkeit als Nachhaltigkeits-Prinzip: Wir können das Lösungsspektrum des Jahres 2030 oder gar 2050 noch nicht kennen und dürfen also keine Strukturen schaffen, die vom Zeitpunkt ihrer Konzipierung an schon unwideruflich der Überalterung ausgeliefert sind. die nachhaltige Kultivierung von Kultur- und Wissensräumen ist eine Lernstrategie, der allerdings das Bau- und Planungsrecht noch nicht entspricht. Solange der mainstream der ‚Planung‘ aber die damit verbunden Chancen ignoriert, besteht im Gegenteil die Gefahr syndromischer Fehlallokationen, die in kürzester Zeit Sanierungsaufwendungen nach sich ziehen werden.

Die Wissensgesellschaft kann und wird nachhaltige Siedlungs- und Wertschöpfungsstrukturen als Kulturlandschaften hervorbringen. Diese werden durch neue Formen der Wertschöpfung geprägt und vermehrt den besiedelten Raum, ganze Stadtregionen formen. Solche Triebkräfte können vielfältig und regionalspezifisch kultiviert werden.

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Agrarpolitik und Integrierte Planung in Regionen des ehemaligen Eisernen Vorhanges (Referenzregion Österreich – Ungarn)

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1 DAS EU-PROJEKT IRON CURTAIN

Im Rahmen des Forschungsprojektes Iron Curtain (5. EU Rahmenprogramm, Proj. Nr. QLRT-2000_01401) wurden innovative Methoden zur Abschätzung von nachhaltiger, integraler und grenzüberschreitender Regionalentwicklung entwickelt und getestet. In 6 Referenzregionen am ehemaligen Eisernen Vorhang wurde die Regionalentwicklung seit der Grenzöffnung analysiert. Neben dem methodologischen Schwerpunkt des Forschungsprojektes lieferten die empirischen Ergebnisse auch ein interessantes Sample an Problemen, Risiken und Chancen entlang der Nord-Süd Achse von Norwegen bis Griechenland - nach beinahe 40 jähriger künstlicher Trennung von Regionen. Das Projekt wurde Ende 2004 abgeschlossen. Die EU Agrarpolitik mit ihrer Wende zur Unterstützung der ländlichen Entwicklung ist in diesen zumeist ländlich geprägten Regionen eine wichtige Säule der Entwicklungsmöglichkeiten aus unterschiedlichen Gründen: Im Westen des Eisernen Vorhanges waren entweder die Regionszentren von einem Teil ihres Einzugsgebietes abgeschnitten oder die Einzugsgebiete verloren ihr Zentrum und wurden zu peripheren Regionen hinsichtlich regionaler Entwicklung. Im Osten des Eisernen Vorhanges war der Zugang zu einem breiten Grenzstreifen aus Sicherheitsgründen nur beschränkt möglich. Übrig blieb in beiden Fällen zumeist nur die Land- und Forstwirtschaft als wichtigster Wirtschaftsektor. Dieses regionale Vakuum wurde seit Aufhebung des Eisernen Vorhanges mit sehr unterschiedlicher Vehemenz gefüllt. Eine grenzüberschreitend nach gemeinsamen Richtlnien erfolgende Politik wie sie die gemeinsame EU-Agrarpolitik (GAP) vor allem mit der Schiene der ländlichen Entwicklung darstellt, kann daher wesentlich zur Harmonisierung der Entwicklung beitragen. Die Landnutzung in den Referenzregionen des Projektes weist eine zunehmende Intensität von Nord nach Süd auf. Rentierhaltung, Fischerei und Forstwirtschaft dominieren in der russich-norwegischen Region, verschiedene Anteile an Forstwirtschaft, Grünlandnutzung (intensiv und extensiv) und Ackerbau (Getreide) dominieren in den Regionen Deutschland – Deutschland, Deutschland – Tschechien und Östereich – Tschechien. Intensiverer Ackerbau mit Zuckerrüben, Sonnenblumen, Mais, Raps und Weinbau bestimmt die Nutzung in der Referenzregion Österreich – Ungarn. In der südlichsten Region Griechenland – Bulgarien wird am intensivsten und mit ausgedehnter Bewässerung gewirtschaftet (Mais, Baumwolle, Reis, Bohnen, Gemüse), entsprechend groß sind die Probleme in Wasserqualität und -quantität.

2 GEMEINSAME EU-AGRARPOLITIK

Die Gemeinsame Agrarpolitik der EU geht auf die Verträge von Rom 1962 zurück. Die ursprüngliche Absicht lag bei einer effizienteren und stabileren Produktion von Nahrungsmitteln. Preisgarantien, Produktionsanreize und Strukturverbesserungen waren erfolgreich, sodass die EU in den 80 er Jahren des 20. Jahrhunderts mit Überschüssen, hohen Budgetkosten und Verzerrungen am Weltmarkt zu kämpfen hatte. Im Jahr 1992 wurden erste Schritte zu Reformen gesetzt, die mit Subventionskürzungen und Direktzahlungen an die Landwirte eine bessere Marktorientierung der Produktion anstrebten. Diese Betonung wurde mit der Agenda 2000 verstärkt, indem eine 2. Säule der Agrarpolitik, die ländliche Entwicklung, neben den bekannten produktionsgebundenen Förderungen eingeführt wurde. Innerhalb der ländlichen Entwicklung konnten Umweltmaßnahmen, Diversifizierung, Marketing, benachteiligte Gebiete oder Bildungsprogramme gefördert warden und sollten nicht nur den Landwirten sondern dem gesamten ländlichen Raum zu Gute kommen. Die Umsetzung bzw. Akzeptanz dieser 2. Säule differierte in den Mitgliedsstaaten aber beträchtlich. Für die Periode 2000 bis 2006 waren insgesamt 270 Milliarden € für die Marktregulierung und Produktprämien vorgesehen und nur 30 Milliarden € für die ländliche Entwicklung (=10%). Österreich ist der Ausnahmefall, hier gehen 65% in die ländliche Entwicklung und nur 35% in die Marktmaßnahmen, erklärbar durch die naturbedingten Nachteile der österreichischen Landwirtschaft und deren Kleinstrukturiertheit. In Deutschland gehen 90% in die Marktmaßnahmen, in Griechenland beispielsweise 95%. In Tschechien und Ungarn sind für die Jahre 2004 – 2006 rund 30 % der Fördegelder für die ländliche Entwicklung vorgesehen. In der nächsten Periode von 2007 – 2013 soll der EU-weite Durchschnitt Anteil für die ländliche Entwicklung auf 22 % angehoben werden (*EU Kommission Generaldirektion Landwirtschaft, 2004*).

Im Juni 2004 wurde mit der GAP-Reform ein weiterer Schritt in die Richtung Stärkung des ländlichen Raumes unternommen. Die Mehrheit der Subventionen soll nun produktionsunabhängig (entkoppelt) an die Landwirte bezahlt werden, um den Landwirten die Möglichkeit besserer Marktanpassung zu geben. Mit Hilfe der Modulation (Kürzungen der Subvention bei Förderungen über 5.000 € je Betrieb) soll bei den Marktmaßnahmen gespart werden und das freiwerdende Geld in die ländliche Entwicklung umverteilt werden (in Abhängigkeit der landwirtschaftlichen Flächen, des Bruttoinlandsproduktes und der Agrarquote der Mitgliedsstaaten). Damit werden handelsverzerrende Subventionen gekürzt und den Entwicklungsländern mehr Chancen am Weltmarkt für landwirtschaftliche Produkte eingeräumt. Um Produktsicherheit und Tierschutz zu stärken sind die Subventionen an bestimmte Auflagen (sogenannte Cross Compliance) gebunden. In der Realität der Umsetzung gibt es für die Mitgliedssataaten viel Handlungsspielraum. Da in Österreich die zweite Säule der Agrarpolitik schon bisher stark ausgeprägt war, sehr viele Kleinbetriebe existieren und die Umweltstandards auf hohem Niveau liegen - 90 % der landwirtschaftlichen Nutzfläche sind in das Umweltprogramm involviert - werden die Auswirkungen der GAP-Reform nicht gravierend sein. Es gibt Ausnahmen bei der Entkopplung der Prämien für Mutterkühe, zusätzliche Prämien für Energiepflanzen, Eiweißpflanzen, Weizen, Milch und teilweise für Schlachtungen. Nach wissenschaftlichen Untersuchungen (*Bundesministerium für Land- und Forstwirtschaft, Umwelt und Wasserwirtschaft, 2003*) werden die Preise für Getreide vermutlich nur leicht zurückgehen, Nachfrage und Angebot stärker auf den Preis wirken. Bei Rindfleisch wird mehr Preisunsicherheit erwartet aber eine nur leichte Verschiebung der Produktion innerhalb des Sektors. Der Milchpreis wird weiterhin leicht sinken aber infolge der nationalen Milchquoten wird die Produktion stabil bleiben. Auf der Ebene landwirtschaftlicher Betriebe wird das Einkommen leicht zurückgehen, es wird Anreize für eine Verlagerung der Produktion z.B. von Rindermast zu Mutterkuhhaltung geben (*Kirner, L., 2003*). In jenen Ländern, die bisher nicht so stark in der ländlichen Entwicklung engagiert waren, werden die Auswirkungen betächtlicher sein (Wagner, K, *Ströbl, B., 2004*). Ein Abschätzung für die deutsch-

deutsche Referenzregion im Rhöngebiet ergab Senkungen der Förderungen für Ackerflächen auf rund 80% des derzeitigen levels und Steigerungen der Grünlandförderungen auf rund 200%. Infolge des hohen Grünlandanteiles mit extensiver Produktion wird die Referenzregion an Förderungen aus der 1. Säule der Agrarpolitik gegenüber dem jetzigen System gewinnen, zusätzlich auch mehr Geld aus der ländlichen Entwicklungsförderung lukrieren. EU-weit ist insgesamt eine Verlagerung vom Ackerbau zur Grünlandnutzung zu erwarten, eine Extensivierung der Produktion und eine Senkung der Produktionsmengen (*OECD, 2004*).

Die Effekte der GAP sind mit den Effekten der EU-Erweiterung zu kombinieren. Für die neuen Mitgliedsländer wurde ebenfalls ein spezielles ländliches Entwicklungsprogramm geschaffen. Die Direktzahlungen für die Landwirte werden aber nur stufenweise eingeführt und orientieren sich an der gegenwärtigen - relativ niedrigen - Produktion, nicht am Produktionspotential und sind daher kurzfristig nicht stark wirksam. Längerfristig und bei wettbewerbsfähigerer Landwirtschaft sind stärkere Auswirkungen zu erwarten. Allerdings wird auch die Nachfrage in den neuen Mitgliedsländern steigen. Für Österreich werden beispielsweise die Chancen für Qualitäts- und Markenprodukte gut eingeschätzt, (Obst, Wein, Schweinefleisch), die neuen Mitgliedsländer hingegen haben gute Chancen beim Absatz von Obst für die industrielle Verwertung, bei Getreide, Gemüse, Rindfleisch und Geflügel (*Bundesministerium für Land- und Forstwirtschaft, Umwelt und Wasserwirtschaft, 2003*).

3 REFERENZREGION ÖSTERREICH – UNGARN (EISENSTADT – SOPRON)

Die Referenzregion Österreich-Ungarn mit den Städten Eisenstadt und Sopron als zenrale Orte war vor dem ersten Weltkrieg eine Region innerhalb des zu Ungarn gehördenden Gebietes Deutsch-Westungarn mit Sopron als natürlichem Zentrum. Seit 1921 ist dieses Gebiet geteilt, mit strikter Trennung nach dem 2. Weltkrieg. Viele natürliche Verbindungen wurden abgeschnitten, sehr unterschiedliche Strukturen dies- und jenseits der Grenze entwickelten sich. Das Bearbeitungsgebiet umfasst rund 1000 km² mit 32 Gemeinden aus den burgenländischen Bezirken Neusiedl am See, Eisenstadt, Rust, Mattersburg und Oberpullendorf (68.000EW) sowie 13 Gemeinden aus dem Komitat Györ-Moson-Sopron (73.000 EW), siehe Abb. 1.

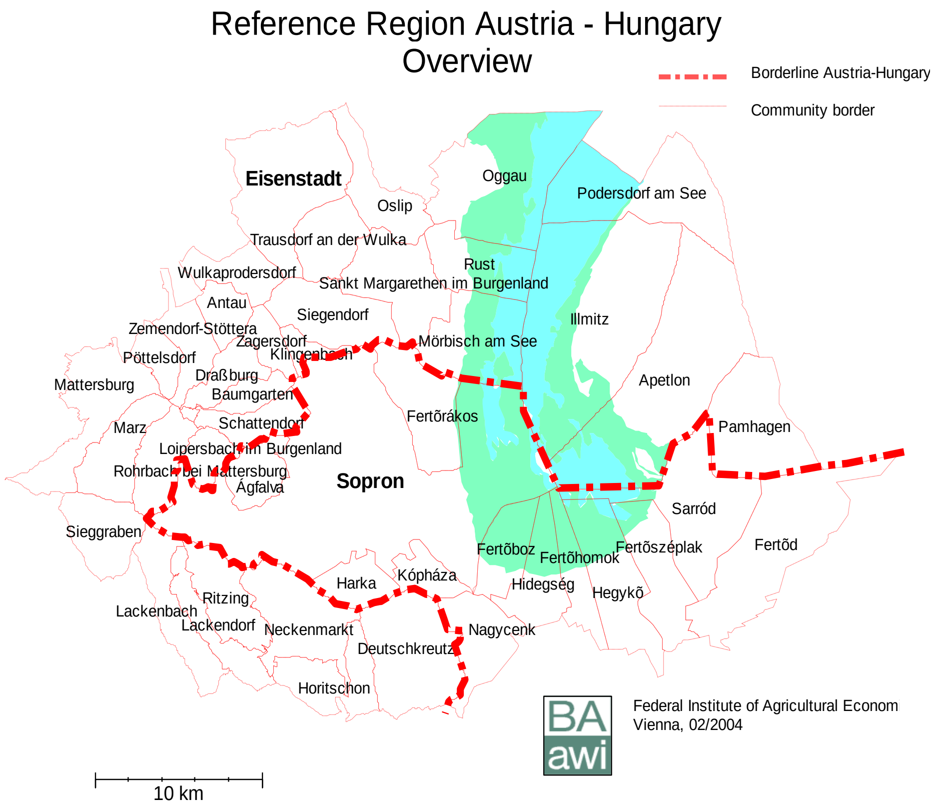

Abb.1: Referenzregion Österreich – Ungarn (*Wagner, K., Ströbl, B., 2004*)

Im Regionalbezug sind eigentlich vier große Funktionsräume zu beachten, der österreichische Teil der Referenzregion (innerhalb Österreichs benachteiligt), der ungarische Teil der Referenzregion (innerhalb Ungarns bevorzugt), sowie jeweils das Hinterland mit der prosperierenden Achse Wien-Wr. Neustadt im Westen bzw. das ungarische Hinterland Soprons im Osten. Die wirtschaftliche Entwicklung dieser 4 Regionen kann als kaskadenförmig von West nach Ost abnehmend beschrieben werden. Innerhalb unserer Referenzregion kann man wiederum drei Teilräume differenzieren, jeweils über die Grenze hinweg mit ähnlichen naturräumlichen Bedingungen und Entwicklungschancen (vgl. Abb. 2). Die Schwerpunkte im westlichen Teilgebiet liegen bei Gewerbe, Industrie, am Südwest- und Südufer des Neusiedler Sees bei Tourismus und Kultur, im östlichen Teilgebiet bei Tourismus und Natur.

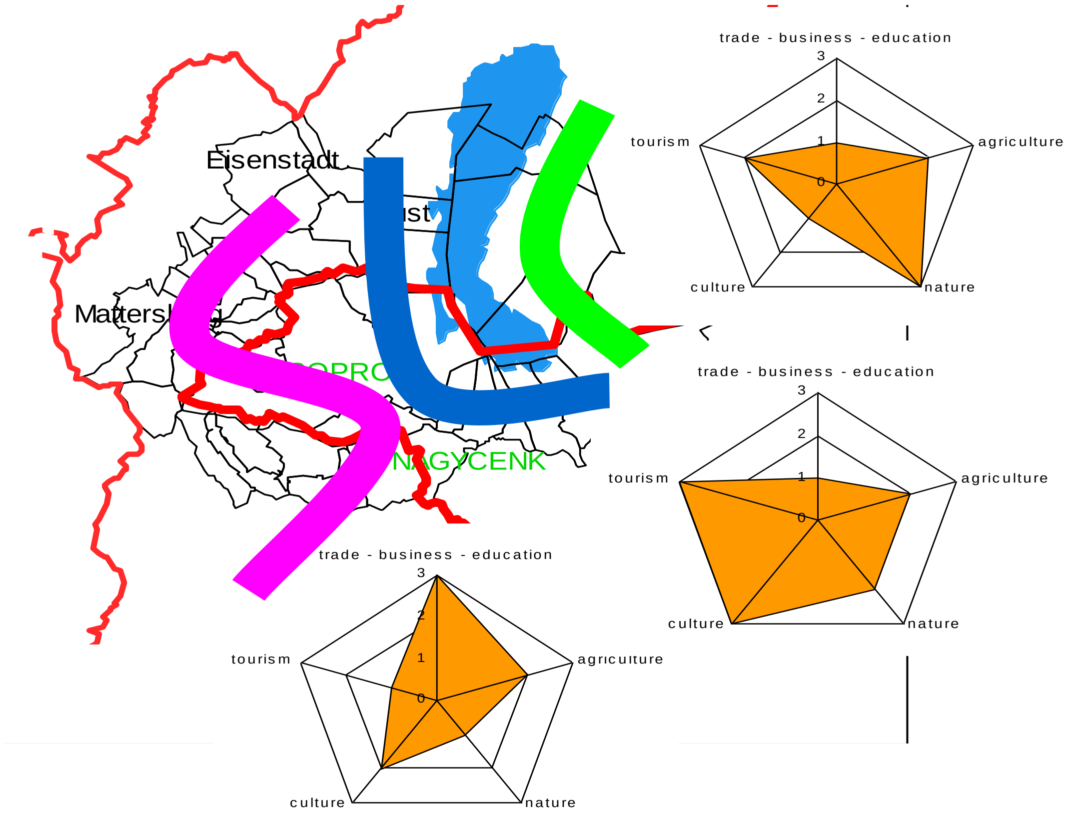

Abb.2: Teilräume der Referenzregion Österreich – Ungarn mit unterschiedlichen Entwicklungsschwerpunkten (*Wagner, K., Ströbl, B., 2004*)

4 LANDWIRTSCHAFTLICHE FUNKTIONEN IN DER REFERENZREGION ÖSTERREICH – UNGARN

Um die Prioritäten der nötigen Entwicklung in der Referenzregion Österreich Ungarn herauszuarbeiten, wurden von der Bundesanstalt für Agrarwirtschaft die Funktionen der landwirtschaftlichen Flächen auf Gemeindeebene in gleicher Weise für das österreichische und ungarische Teilgebiet analysiert. Damit gibt es eine Grundlage für eine grenzüberschreitende integrative Regionalplanung im landwirtschaftlichen Sektor, der bisher nur Lieferant von Flächen für andere, „übergeordnete" Nutzungen war. Durch die gleichwertige Berücksichtigung z.B. der ökologischen Funktionen, der Erholungsfunktionen oder der Ressourcenschutzfunktionen der Landwirtschaft neben der Produktion von Nahrungsmitteln und Rohstoffen wird dem Charakter der integrativen Entwicklung des ländlichen Raumes in der GAP-Reform Rechnung getragen. Das Evaluierunssystem für die Funktionen wurde in einem Interreg IIC Projekt entwickelt (*Greif, F., Pfusterschmid, S., Wagner, K., 2002*) und soll in die örtliche Raumplanung in Niederösterreich implementiert werden. Für das Iron Curtain Projekt wurde nun versucht, die Effekte der landwirtschaftlichen Bodennutzung auf Gemeindeebene zum Zweck der Regionalplanung darzustellen, mit der besonderen grenzüberschreitenden Komponente. Das Verteilungsmuster gibt Informationen zu Stärken bzw. zu Defiziten der Gemeinden in der Entwicklung zu einer nachhaltigen Nutzung. Interessante Aspekte für eventuelle Entwicklungsszenarien ergeben sich durch den direkten Vergleich der österreichischen Gemeinden mit den angrenzenden ungarischen Gemeinden im Raum Sopron – Eisenstadt. Das Evaluierungsschema bezieht folgende Funktionen ein:

Produktion von Nahrungsmitteln und Rohstoffen (Potential aus Boden, Klima, Basis: digitale Bodenkarte)

Resourcenschutz (Erosions- und Auswaschungsrisko aufgrund der Boden- und Klimaparameter in Verbindung mit der gegenwärtigen landwirtschaftlichen Nutzung)

Habitatfunktion (Parzellenstruktur als Indikator für die Diversität der landwirtschaftlichen Kulturlandschaft)

Erholungsfunktion (Parzellenstruktur als Indikator für die Diversität der agraischen Kulturlandschaft in Verbindung mit der Nachfrage nach Erholungsflächen durch Einwohner und Touristen, vgl. Abb. 3)

Raumstrukturfunktion (Länge der Zerschneidungen als Indikator für die Puffer- und Trägerfunktion der landwirtschaftlichen Flächen)

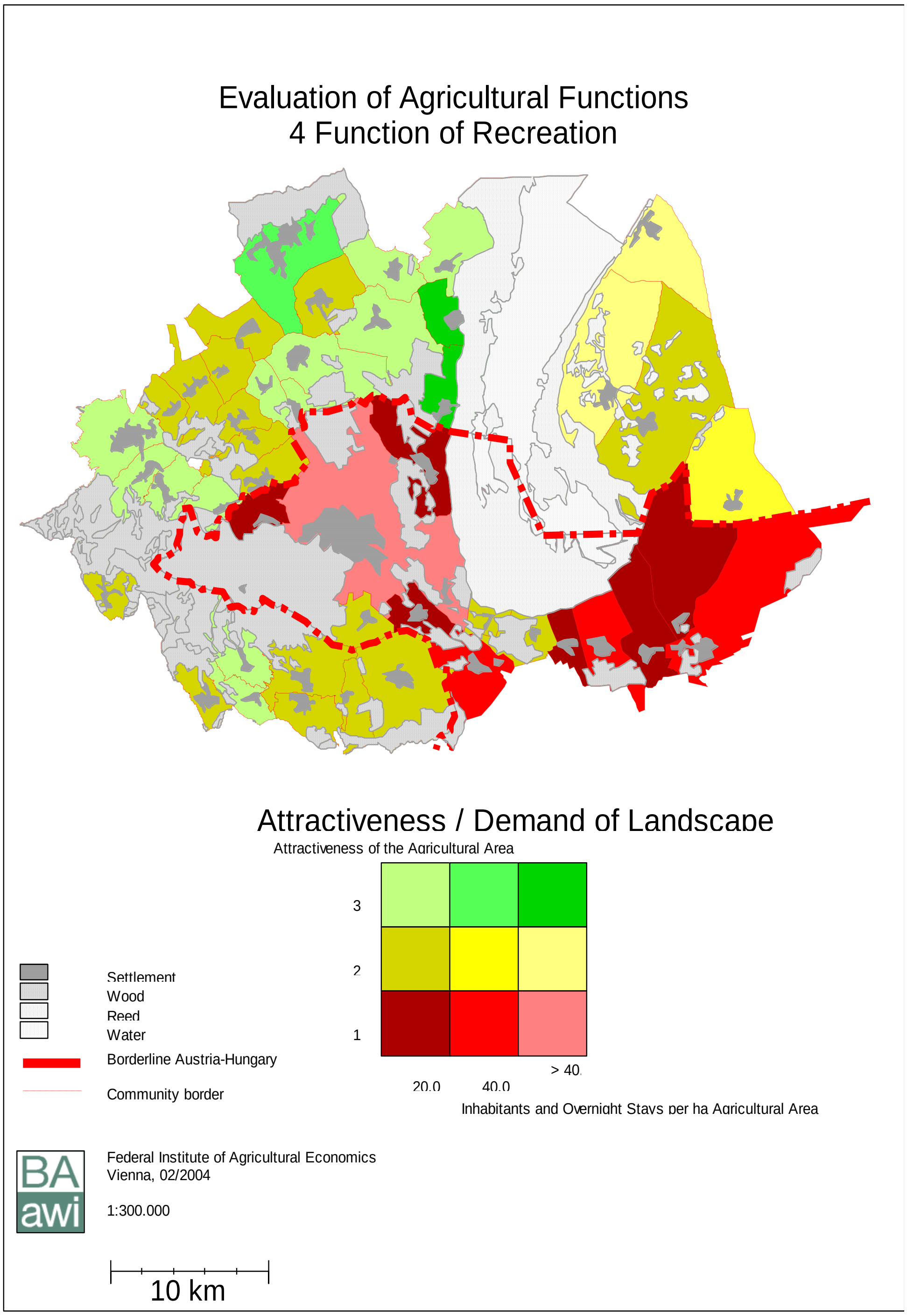

Abb. 3: Bewertung der Erholungsfunktion landwirtschaftlicher Flächen (*Wagner, K., Ströbl, B., 2004*)

In der Gesamtdarstellung (Abb.4) wird der durchgehend sehr hohe Wert der Produktionsfunktion ersichtlich, infolge der günstigen naturräumlichen Voraussetzungen in der Referenzregion. Im Fall der Ressourcenschutzfunktion ist die Verteilung indifferent, hohe Windgeschwindigkeiten und teilweise hohe Grundwasserstände können Probleme verursachen, in Verbindung mit einer weitflächigen Ausweisung von Naturschutzgebieten und sehr hohe Teilnahmen am Agrarumweltprogramm ist die Situation aber wesentlich günstiger als noch vor 20 Jahren. 80% der landwirtschaftlichen Nutzfläche sind im Umweltprogramm erfasst, 5% der Fläche werden biologisch bewirtschaftet. Neben Ersoionsschutzmaßnahmen, Winterbegrünungen und Reduktion von Dünge- und Pflanzenschutzmitteln konnten etliche Acker oder Weinbauflächen in Grünland umgewandelt werden und zum Teil für eine Beweidung gewonnen werden, wodurch die typische Kulturlandschaft erhalten bzw. rekonstruiert wurde. Die Habitatfunktion ist im östlichen Teil des Bearbeitungsgebietes (auch im östlichen Teil der österreichischen Seite) weniger stark ausgeprägt, da die flachen Lagen mit guten Böden eine intensive Bewirtschaftung und Ausräumung der Landschaft einfacher machten. Im westlichen Teil des Referenzgebietes zeigen sich höhere Anteile diverser Strukturen. Ein ähnliches Muster zeigt die Erholungsfunktion. Durch die Verknüpfung mit der Nachfrage durch Touristen bzw. Einheimische nach Erholungsflächen ist zu erkennen, das manche Gemeinden eine sehr attraktive Kulturlandschaft aufweisen und auch zu touristischen Zwecken nutzen, in anderen Gemeinden das Potential vorhanden wäre und in einer dritten Kategorie von Gemeinden die Kulturlandschaft aufgewertet werden müßte, will man touristische Ziele verfolgen. Dies sollte durch die Nähe des Nationalparkes Neusiedler See und vieler kultureller Einrichtungen leicht möglich sein. In der Ausprägung der Raumstrukturfunktion zeigt sich die in vielen Gemeinden bereits sehr intensiv mit Infrastrukturleistungen genutzte Agarlandschaft. In den meisten Gemeinden östlich des Neusiedler Sees sind infolge der höheren Anteile an Landwirtschaftsflächen an der Gesamtfläche und des geringeren Infrastrukturausbaues die Landwirtschaftsflächen noch relativ ungestört.

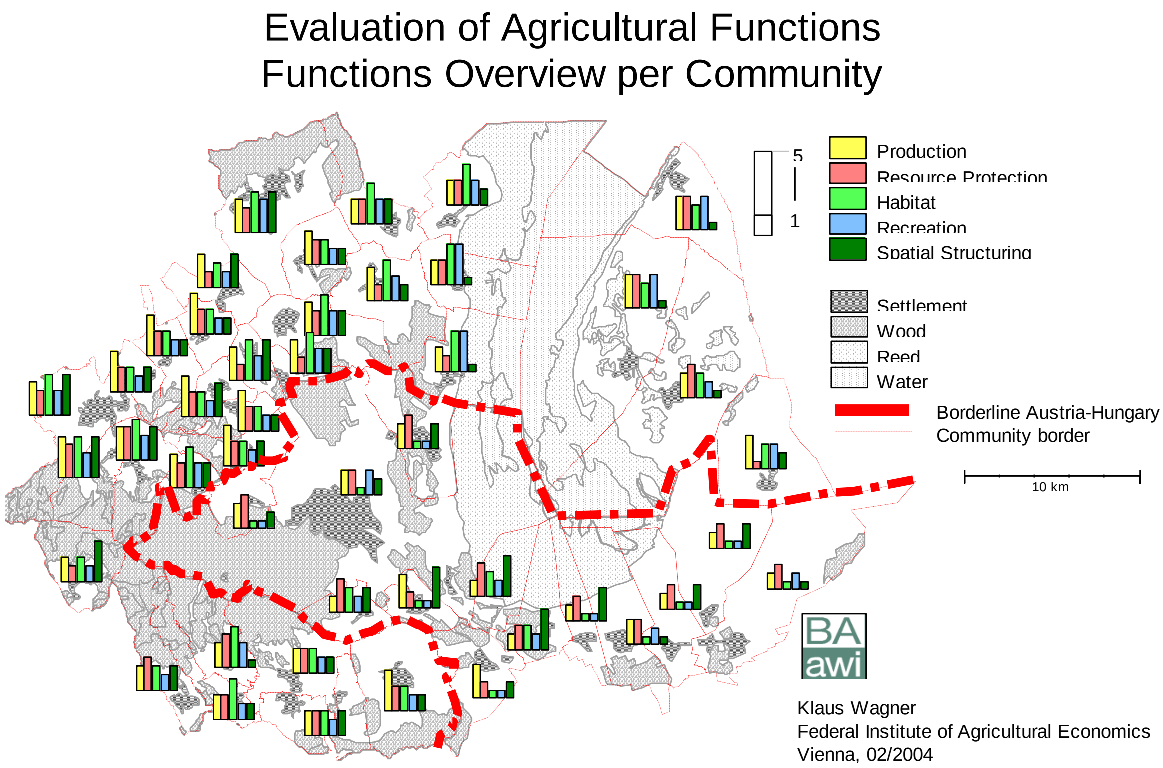

Abb.4: Gesamtbewertung der Funktionen landwirtschaftlicher Flächen (*Wagner, K., Ströbl, B., 2004*)

Abb.5: Ausschnitt aus der Referenzregion Österreich – Ungarn (Ruster Hügelland) (*Wagner, K., Ströbl, B., 2004*)

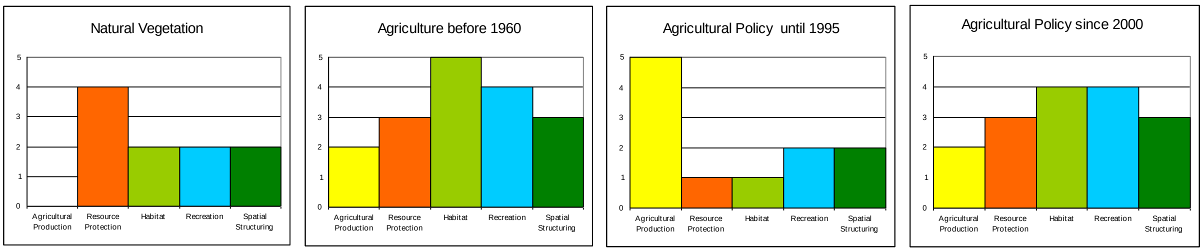

Abb.6: GAP Bewertungsdiagramme (1-4) (*Wagner, K., Ströbl, B., 2004*)

Abbildung 5 (Beispiel aus dem österreichischen Teil der Referenzregion) zeigt sehr deutlich wie sehr die Agrarpolitik auf die Funktionen der Landwirtschaft wirkt. Die natürliche Vegetation besteht in weiten Teilen aus einer Waldgesellschaft (Eichen, Hainbuchen, eingewanderte Robinien), die Funktion des Ressourcenschutzes ist damit weitgehend erfüllt, die Diversität des Lebensraumes ist aber relativ gering und die Attraktivität für die Erholung leidet wegen geringer Zugänglichkeit und Attraktivität der Landschaft (vgl. 1. Diagramm in Abb. 6). Noch vor 30 bis 40 Jahren, zu Zeiten weniger intensiver Landwirtschaft wurden viele dieser Flächen als Hutweiden für die Rinderhaltung genutzt (umgangssprachlicher Name für den Hügel „nackter Berg“, obwohl jetzt zum Großteil mit Wald bewachsen), damit steigt die Habitat- bzw. die Erholungsfunktion an. In den Zeiten der Intensivierung bis in die 90er Jahre des 20. Jahrhunderts wurde die Landschaft jedoch ausgeräumt, Weingärten auch in steilen Lagen und Ackerflächen in den flacheren Lagen angelegt (Getreide, Sonnenblumen) Damit erhöhte sich der Wert der Produktionsfunktion aber auch der Erosions- und Auswaschungsgefahr. Eine Senkung der Habitatfunktion und der Erholungsfunktion ist die Folge (vgl. 3. Diagramm in Abb. 6). In Zeiten abnehmenden Profits und Umstrukturierungen wurden manche Flächen aufgegeben (Verbuschung, Verwaldung), andere weiter intensiviert. Seit der stärkeren Förderung der Umweltbelange hat eine weiterräumige Extensivierung stattgefunden, von der Bewirtschaftung herausgenommene Flächen sowie Landschaftselemente können mit Hilfe von Förderprogrammen gepflegt bzw. offen gehalten werden, was dem derzeitigen Ziel der Kulturlandschaftspflege entspricht, die Biodiversität erhöht sich damit, eine attraktivere Kulturlandschaft sowie eine Sicherung der Zugänglichkeit unterstützt auch den Tourismus. Durch diese Agrarpolitik entsteht ein ähnliches Funktionsmuster wie in Zeiten extensiverer Landwirtschaft (vgl. Diagramme 2 und 4 der Abb. 6).

5 AUSSICHT

Die Analyse der Regionalentwicklung im Raum Eisenstadt-Sopron in Form von Problemanalysen, Zielformulierungen und der Erstellung einer Vision und verschiedener Szenarien im Rahmen des Projektes Iron Curtain ergab die Schwerpunkte Natur, Kultur, Wein und Tourismus. Genau diesen Entwicklungsmöglichkeiten bieten sich gute Chancen für eine zukunftsträchtige im Rahmen der GAP mit der Stärkung der ländlichen Entwicklung. Ungarn wird hohe Fördersätze aus der Ziel 1 Förderung lukrieren und Burgenland wird in der nächsten Förderperiode sehr wahrscheinlich einen phasing out Status von Ziel 1 Förderungen bekommen, sodass Geldmittel zumindest bis 2013 in erhöhtem Asmaß für die Regionalentwicklung zur Verfügung stehen werden. Die finanziellen Voraussetzungen sind damit günstig. Auch die Maßnahmen zur Umstrukturierung der Weinbaugebiete (Österreich: 7 Millionen €, Ungarn: 10 Millionen € für 2005, *Europäische Kommission, 2004*) passen konsequent zu den herausgearbeiteten Entwicklungschancen für diese Region. Die Angabe von Stärken bzw. Defiziten in den Gemeinden der Referenzregion sollte einen Beitrag zur Entscheidungsunterstützung für die Anwendung der Fördermaßnahmen in grenzüberschreitender Sicht geben. Weitere Ergebnisse zum Projekt Iron Curtain sind auf der homepage http://www.ironcurtainproject.com einsehbar.

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ÖROK Atlas Online (Atlas Informationssystem Austria)

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ZUSAMMENFASSUNG

Bei diesem Projekt handelt es sich um eine Zusammenarbeit zwischen der Österreichischen Raumordnungskonferenz (ÖROK), dem Institut für Geographie und Regionalforschung – Kartographie und Geoinformation, der Universität Wien (IfGR), der ÖIR–Informationsdienste GmbH (ID) und dem Institut für Geoinformation und Kartographie der Technischen Universität Wien (IGK).

Das Ergebnis des Projektes ÖROK Atlas Online ist es einerseits, die kartographische Visualisierung unterschiedlicher Datensätze zu ermöglichen, andererseits die Abfrage und Analyse dieser zu erleichtern. Es wird ein System-Prototyp entwickelt, der sowohl geographische, als auch thematische Daten integriert und diese über ein interaktives Kommunikationsportal abrufbar macht und so eine Informationsschnittstelle für die Abfrage, Analyse und Darstellung von raumrelevanten Sachverhalten entstehen lässt.

Die einfache Zugänglichkeit und Bedienbarkeit des Systems, zusammen mit einem dualen Atlasprinzip (interaktives System und gedruckte Karte) sollen einen möglichst breiten Nutzerkreis ansprechen, der von politischen Entscheidungsträgern, Behörden der Planung und Verwaltung, Wissenschaft und Bildungseinrichtungen bis hin zur allgemeinen Öffentlichkeit reicht.

1 EINLEITUNG

Vor mehr als 20 Jahren wurde im Rahmen der ÖROK die Idee des ÖROK Atlas geboren. Ziel dieser Kartensammlung war und ist es, die räumliche Entwicklung Österreichs nach raumordnungsrelevanten aktuellen Schwerpunkten in kartographisch leicht verständlicher und anschaulicher Form darzustellen. Seit damals werden jährlich zu bestimmten (aktuellen) vom Ständigen Unterausschuss festgelegten Themenbereichen 10 bis 15 Kartenblätter mit Erläuterungstexten und Tabellen erstellt und an ca. 3.500 Interessierte aus Verwaltung, Politik und Schulbereich verteilt.

Die fortschreitende technische Entwicklung sowie der breite Einsatz neuer Medien ermöglicht es, an einer technischen, organisatorischen und inhaltlichen Weiterentwicklung des ÖROK Atlas bzw. eines regionalen Informationssystems zu arbeiten. Mit dem ÖROK Atlas Online kann ein wichtiger Schritt in diese Richtung gesetzt werden.

Das Projekt ÖROK Atlas Online stellt in mehrfacher Hinsicht eine Herausforderung dar. Zum einen sind bei der Konzeption wie bei der Realisierung sowohl inhaltliche, technische, aber auch administrativ-organisatorische Fragestellungen zu lösen und in Einklang zu bringen. Zum anderen bedarf es dabei auch der Berücksichtigung zukünftiger Entwicklungen nicht nur was die Möglichkeiten der Technologie, sondern auch was die Nachfragestruktur betrifft. Dies wurde auch bei der Zusammensetzung des anbietenden Konsortiums berücksichtigt. Die beiden Universitätsinstitute, das Institut für Geographie und Regionalforschung (IfGR) der Universität Wien sowie das Institut für Geoinformation und Kartographie (IGK) der TU Wien bringen nicht nur Erfahrung in der konkreten Umsetzung von webbasierten kartographischen Informationssystemen ein, sondern auch Forschungs- und Entwicklungs-kompetenz. Die ÖIR-Informationsdienste GmbH hingegen kann auf eine langjährige Erfahrung in der Bearbeitung des klassischen ÖROK Atlas zurückgreifen und zeichnet sich durch hohe fachliche Kompetenz aus.

Über Jahrhunderte stellte die gedruckte Karte die einzige Möglichkeit dar, Geoinformationen in kartographischer Form einem größeren Benutzerkreis zugänglich zu machen. Die zeitgemäße Kartographie entwickelt sich gegenwärtig hin zu einer modernen, interaktiven Kommunikationswissenschaft. Kartographische Abbildungen werden nicht mehr ausschließlich für reine Präsentationszwecke genutzt, sondern sollen auch zur Exploration von temporalen sowie nicht-temporalen Geodaten eingesetzt werden.

Während bei einer klassischen kartographischen Präsentation die räumlichen Strukturen und Phänomene bekannt sind und diese über qualitativ hochwertige Karten für die Öffentlichkeit bereitgestellt werden, ist bei der Exploration die Hypothesenfindung das Ziel. Interaktive mehrdimensionale Visualisierungs-werkzeuge helfen bei der Suche nach Mustern, Strukturen und Trends in Datenräumen. Daneben stellen moderne Visualisierungsumgebungen Funktionen zur Analyse und Synthese bereit.

Das Ergebnis des Projektes ÖROK Atlas Online ist es einerseits, die kartographische Visualisierung unterschiedlicher Datensätze zu ermöglichen, andererseits die Abfrage und Analyse dieser zu erleichtern. Es wird ein System-Prototyp entwickelt, der sowohl geographische, als auch thematische Daten integriert und diese über ein interaktives Kommunikationsportal abrufbar macht und so eine Informations-schnittstelle für die Abfrage, Analyse und Darstellung von raumrelevanten Sachverhalten entstehen lässt.

2 ZIELSETZUNGEN

Ziel des ÖROK Atlas Online ist es, unter Anwendung bestehender technischer Möglichkeiten und unter Berücksichtigung der laufenden Initiativen (Geodatenpolitik in Österreich, eGovernment usw.) regionalstatistische Informationen für Österreich in einer entsprechenden interaktiven, kartographischen Form anzubieten. Das Resultat wird ein System-Prototyp sein, der eine repräsentative Basisfunktionalität und Datenintegration umfasst. Das Ergebnis soll darüber hinaus auch als Grundlage für weitere Entscheidungen im Hinblick auf einer „großen Lösung“ dienen.

Auf Grund des inhaltlichen Umfangs sowie der Komplexität des Projekts sind drei Kernbereiche für eine Prototyperstellung zu berücksichtigen:

Inhaltliche Ausrichtung

Funktionelle Ausrichtung

System Architektur

2.1 Inhaltliche Ausrichtung

Aufbauend auf den bisherigen Erfahrungen des Einsatzes und der Verwendung des klassischen ÖROK Atlas sowie der Möglichkeiten, die sich durch die Anwendung neuer Medien ergibt, sollen im Wesentlichen folgende Zielgruppen angesprochen werden:

- Verwaltung
- Politik
- Schulen und Bildungseinrichtungen
- Fachöffentlichkeit
- interessierte allgemeine Öffentlichkeit

In der ersten Realisierungsphase sollen vor allem die Bedürfnisse der ÖROK-Partner (Verwaltung und Politikberatung, Wissenschaft/Planung) im Vordergrund stehen und abgedeckt werden.

Es geht in erster Linie darum,

- die räumliche Entwicklung Gesamtösterreichs sowie
- raumordungs- und regionalpolitisch relevanten Sachverhalte unter Berücksichtigung aktuell-politischer Schwerpunktsetzung darzustellen.

Die darzustellenden Themenbereiche orientieren sich an den von der ÖROK festgelegten und im traditionellen ÖROK Atlas behandelten Schwerpunkten.

Die Inhalte werden in Form von

- Karten
- Texten
- Grafiken
- Tabellen

für regionale administrative Einheiten, die als geometrische Daten vorliegen, zur Verfügung gestellt.

Diese geometrische Daten können flächenhaft-, linienhaft-, punkthaft- oder rasterbezogen sein. Dementsprechend unterschiedlich erfolgt ihre Aufbereitung und Behandlung. Sie bilden den Grundstock des Systems, sowohl als Träger der thematischen Informationen als auch zur Orientierung für den Nutzer. Da aus diesen Daten sowohl die digitale als auch die analoge Karte generiert wird, muss im Vorfeld auf die Gewährleistung einer hohen kartographischen Qualität geachtet werden. Demzufolge müssen mögliche Datengrundlagen in Bezug auf Eignung, Qualität, Verfügbarkeit, Kosten und rechtliche Situation evaluiert werden. Kartographische Richtlinien müssen festgelegt und die wichtigsten Informationsebenen in einem repräsentativen Maßstab erstellt werden. Im Rahmen des System-Prototyps wird nur ein Maßstabsbereich exemplarisch umgesetzt.

2.2 Funktionelle Ausrichtung

Der ÖROK Atlas Online kann nur in mehreren Entwicklungsschritten realisiert werden. Dabei ist die funktionelle Ausrichtung des Systems von großer Bedeutung. Die Funktionalität soll im Rahmen des Prototyps exemplarisch aufgezeigt werden. Im Hinblick auf einer „großen Lösung“ sollen folgende Bereiche thematisiert werden:

2.2.1 Informationsaufbereitung und -verbreitung

Dabei geht es in erster Linie um die Vermittlung von (Experten-) Erkenntnissen und Einschätzungen. Im Vordergrund steht

- die Visualisierung aktuell-politischer Inhalte entsprechend eines gegliederten Themenkatalogs
- durch Experten aufbereitete Inhalte und Darstellungen (auch in Form von Texten, Tabellen und Diagrammen)
- die Erweiterung des klassischen Mediums der Print-Karte durch Interaktivität und damit die Möglichkeit den Benutzer gezielt durch verwandte, sich sinnvoll ergänzende Themenbereiche zu führen.

Die Visualisierung besteht vor allem aus der Kartenerstellung. Hier muss besonders darauf geachtet werden, dass eine qualitativ hochwertige Karte bereitgestellt wird. Der Nutzer sollte die Möglichkeit bekommen Parameter, wie Anzahl der Klassen oder Farbgebung, selbst zu bestimmen. Diese Änderungen müssen aber in einem bestimmten Rahmen bleiben, die in Spezifikationen von Experten fixiert wurden.

Um mit der Karte interagieren zu können, braucht es noch zusätzliche Funktionen, die zur Navigation im kartographischen Kommunikationsportal nötig sind. Diese bestehen auf der einen Seite aus Tools zur räumlichen Navigation, wie Zoomfunktionen für Maßstabsänderungen im gewünschten Kartenausschnitt, oder Panfunktionen zum Verschieben des Ausschnitts. Auf der anderen Seite gibt es Funktionen zur thematischen Navigation, wie die Möglichkeit einzelne Ebenen einer Karte ein- und auszublenden.

Mithilfe der deskriptiven Statistik ist es möglich, unüberschaubare Datenmengen durch möglichst wenige, aber aussagekräftige Zahlen und Diagramme zu charakterisieren. Dazu müssen für jeden thematischen Datensatz Parameter und Koeffizienten angegeben werden. Ausgewählte Merkmale der deskriptiven (nicht-räumlichen) Statistik können durch Einbindung der räumlichen Dimension zu Kennzahlen der deskriptiven räumlichen Statistik erweitert werden.

2.2.2 ÖROK Atlas Online als Monitoringinstrument

Als Monitoringinstrument konzipiert und erweitert, ermöglicht der ÖROK Atlas Online den Benutzern innerhalb eines Rahmens eigenständige und laufende Beobachtung bestimmter festgelegter Themenbereiche.

Wichtig in diesem Zusammenhang ist es,

- die Kontinuität der Daten sicherzustellen sowie die beobachtbare Themen festzulegen
- Datenbeschreibungen anzubieten – Metadatenkatalog sofern keine Erläuterungen der Inhalte vorhanden.

2.2.3 ÖROK Atlas als Analyseinstrument

In einem fortgeschrittenen Entwicklungsstadium könnte der ÖROK Atlas Online auch um statistische und geographische Auswertungswerkzeuge erweitert werden. Diese Option sollte allerdings in der Grundkonzeption mit berücksichtigt werden, damit das System jederzeit ausbaufähig bleibt.

Geographische Informationssysteme (GIS) helfen raumrelevante Phänomene zu speichern, zu analysieren und zu visualisieren. Eine Stärke von geographischen Informationssystemen ist ihre Fähigkeit, mehrere Ebenen zusammen auszuwerten und daraus neue Informationen zu gewinnen. Damit lassen sich übergreifende Fragestellungen in vertretbarer Zeit beantworten und transparente Grundlagen für Entscheidungen schaffen. Wichtige GIS-Funktionalitäten, die unterschiedlichste räumliche Fragen beantworten und im Gesamtsystem zu berücksichtigen wären, sind:

Informationsabfrage

Messfunktion

Verschneidungsfunktion

Pufferfunktion

Interpolation

Modellierung

2.3 System-Architektur

Im Hinblick auf einer modularen, erweiterbaren sowie plattformunabhängigen Systemlösung ist eine nachhaltige System-Architektur erforderlich. Der Aufbau des Systems besteht daher aus unterschiedlichen Modulen, die für verschiedene Aufgaben verwendet werden. Jeder dieser Bausteine ist in sich konsistent und nach außen austauschbar. Dieses modulare Bausteinsystem ermöglicht ein völlig offenes System bezüglich Erweiterungsmöglichkeiten. Es ist schwer vorhersagbar, welche Funktionen und Möglichkeiten zukünftige Softwareprodukte bieten, deshalb ist der Weg der einfachen Austauschbarkeit und Erweiterbarkeit der Flexibelste. Neben den einzelnen Bausteinen sind auch die Schnittstellen zwischen den Modulen von Bedeutung. Diese sollten so einfach wie möglich gehalten werden, um bei einem Austausch eines Moduls weiter verwendbar zu sein. Idealerweise werden schon vordefinierte Schnittstellen, wie jene des OpenGIS Konsortiums verwendet.

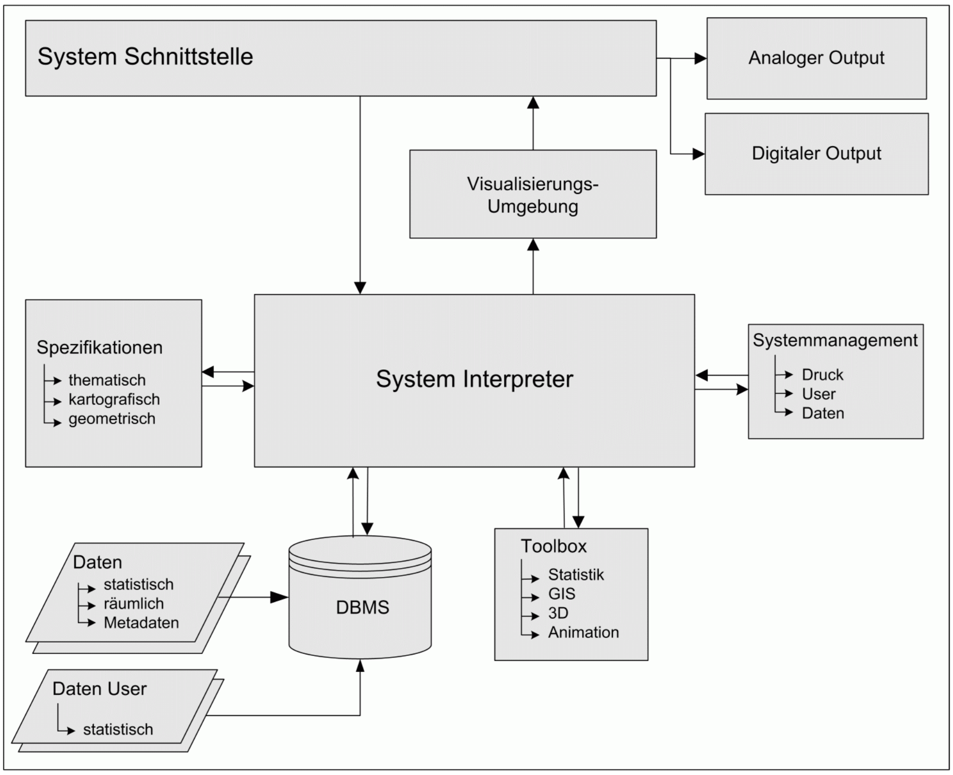

Abbildung 1: System-Architektur

System Interpreter

Das Kernstück einer modularen Systemarchitektur ist der System Interpreter, der das Zusammenspiel zwischen den einzelnen Modulen über vordefinierte Schnittstellen steuert.

DBMS

In einem Datenbank-Managementsystem werden die geometrischen und thematischen Daten sowie die Metadaten verwaltet. Zusätzlich können noch thematische Daten vom Nutzer hinzugefügt werden.

Toolbox

In diesem Modul werden alle Analyse- und Auswertungsfunktionen zusammengefasst. Diese können Statistikfunktionen (deskriptive Statistik, Clusteranalyse), GIS-Funktionalitäten (Puffer, Verschneidungen), Generierung von 3D Modellen oder Animationsfunktionen sein. Wie bei allen anderen Bausteinen ist die Toolbox so flexibel zu halten, dass zusätzliche Funktionen integriert werden können.

Systemmanagement

Dieses Modul hat mehrere Aufgaben zu verwalten. Die Nutzerverwaltung ermöglicht es, erstellte Karten zwischenzuspeichern. Registrierten Benutzern erlaubt das Datenmanagement thematische und geographische Daten auf den Client zu übertragen. Mithilfe des Druckmanagement können thematische Karten in ein drucktaugliches Format ausgegeben werden.

Spezifikationen

Die Spezifikationen definieren thematische, kartographische und geometrische Einschränkungen, die von allen Nutzern eingehalten werden müssen (Farbgebung, Linienstärke etc.). Für Anwender-Laien müssen vordefinierte Karten verwendet werden, um die Nutzung so einfach wie möglich zu gestalten. Experten wiederum sollten in der Lage sein, die Thematik oder die kartographische Gestaltung zu beeinflussen.

Visualisierungsumgebung

Hier wird die eigentliche kartographische Darstellung aus den vom System Interpreter übergebenen Parametern erzeugt. Es wird eine Grafik erstellt und an die System Schnittstelle übergeben.

System Schnittstelle

Die System Schnittstelle, auch User Interface (UI) genannt, ist die Verbindung vom System zum Nutzer. Das Interface ist jener Teil der Anwendung, den der Nutzer sieht und mit dem er arbeitet. Daher ergibt sich die Tatsache, dass viele Nutzer das Interface mit der eigentlichen Software assoziieren. Die graphische Benutzeroberfläche ist allerdings nur das sichtbare Werkzeug - das Bedienmodell - um mit einer Anwendung kommunizieren und interagieren zu können. Wichtig ist vor allem, eine einfache, übersichtliche Darstellung und intuitive Eingabe zu ermöglichen. Dabei sind alle Nutzergruppen und ihre unterschiedlichen Anforderungen an ein User Interface zu beachten.

3 ATLASKONZEPTION

Ein Atlas sollte niemals eine reine Ansammlung von Karten sein, sondern muss einem klar strukturiertem Konzept folgen.

Das kartographische Konzept eines internet-basierten Atlas weist einige wesentliche Überlegungen und Entscheidungen auf, die in der Startphase des laufenden Projekts festgelegt werden. Diese Entscheidungen bezüglich Inhaltsziele und Benutzerbedürfnisse beeinflussen in weiterer Folge den Fortlauf der Entwicklung, stellen sie doch das gedankliche „Grundgerüst“ des zu erstellenden Produktes dar.

Abbildung 2 zeigt die sequentielle Abfolge der Projektabschnitte von der Konzeption zur Realisierung des Prototyps. Das kartographische Konzept ist in der untersten Schicht anzusiedeln.

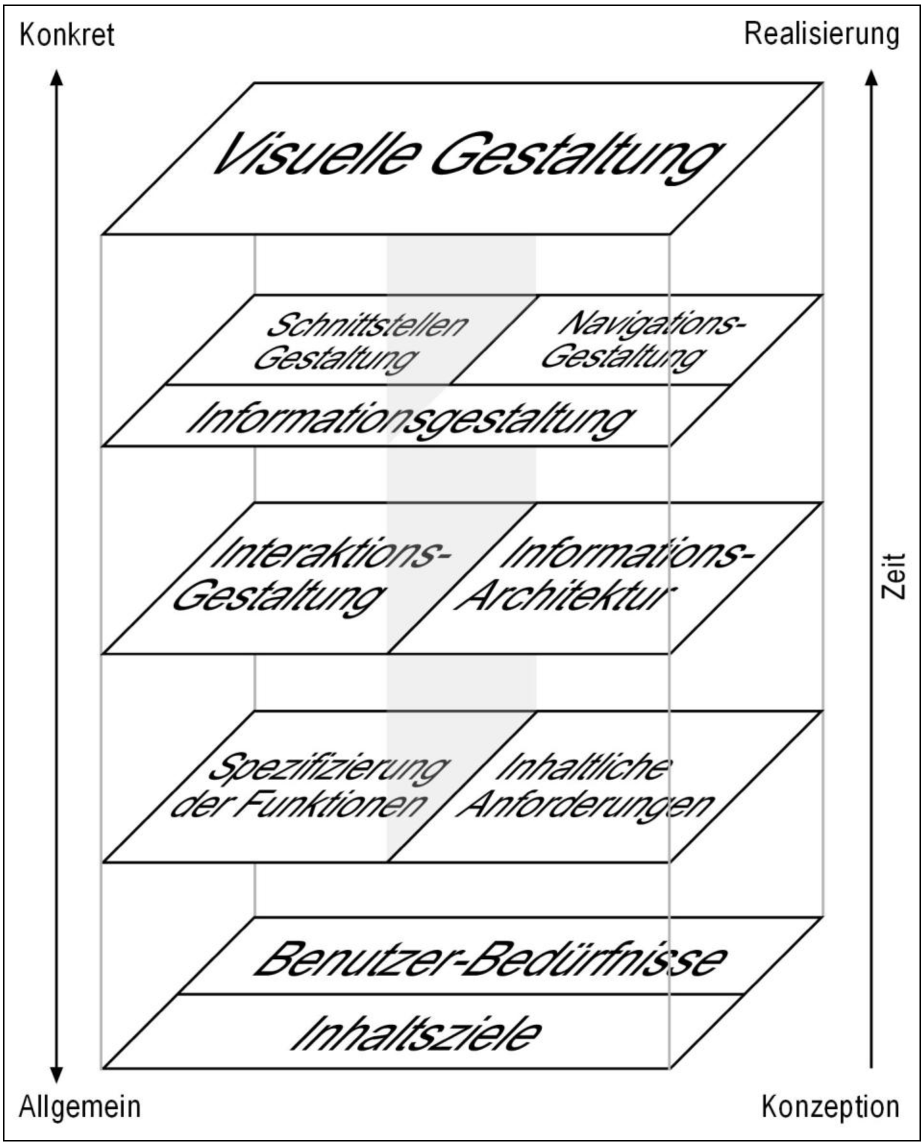

Abbildung 2: Sequentielle Abfolge der Projektabschnitte von der Konzeption zur Realisierung

Es ist von entscheidender Bedeutung, die wesentlichen Punkte des kartographischen Konzepts des ÖROK Atlas Online zu erläutern:

Themenbereich Daten

Themenbereich Funktionalitäten

Themenbereich Benutzerführung

Der ÖROK Atlas Online wird ein interaktives, multimediales Informationssystem unter Heranziehung österreichischer Geobasisdaten (Geometrie- und Sachdaten) und wird in Form eines thematischen kartographischen Atlasinformationssystems (AIS) realisiert.

Ziel der kartographischen Datenvisualisierung ist es, räumliche Zusammenhänge oder Disparitäten erkennbar und Sachinformationen, in eine topographische Bezugsgrundlage eingebettet, erkennbar zu machen.

Ausgangspunkte für die kartographische Realisierung sind:

Das Atlasinformationssystem wird Funktionen eines Geographischen Informationssystems (GIS) enthalten, basiert aber auf kartographisch aufbereiteten Geobasisdaten und bietet dem Nutzer maßgeschneiderte Eingriffsmöglichkeiten. Es handelt sich daher um ein kartographisches Informationssystem mit sinnvoller Benutzerführung.

Durch die bildschirmbedingte geringere Auflösung im Vergleich zu konventionellen Papierkarten bestehen deutliche Einschränkungen bezüglich des darstellbaren Informationsumfanges und der erreichbaren Informationstiefe. Es ist deshalb eine bildschirmgerechte kartographische Visualisierung erforderlich, die durch den Einsatz von Interaktivität erweitert wird, um so die Einschränkungen bestmöglich aufzuheben.

Um dem Nutzer sowohl Überblick als auch Detailinformationen bereitzustellen, müssen die Geobasisdaten für mehrere Maßstäbe unter Beibehaltung der Lesbarkeit aufbereitet werden.

Angepasst an die Anforderungen an webbasierte Informationssysteme werden ausschließlich Technologien verwendet, die eine plug-in-freie, browserunabhängige Darstellung gewährleisten.

Um die Konsistenz zum bestehenden ÖROK-Atlas zu bewahren, werden weiterhin Karten mittels einer Printfunktion zur analogen Ausgabe bereitgestellt.

Die Verbindung des ÖROK Atlas Online mit der integrierten Printfunktion resultiert in einem Dualprinzip, wobei darunter eine Ausgabe von kartographisch aufbereiteten Darstellungen auf unterschiedlichen Medien (Papier, Bildschirm) verstanden wird.

3.1.1 Themenbereich Daten

Die zentrale Überlegung eines kartographischen Konzepts bezüglich seiner Datenbasis ist die Tatsache, dass sämtliche Datensätze in „veredelter" Form Eingang in das System finden. Dies bedingt eine Aufbereitung bestehender Rohdaten zu topologisch korrekten und kartographisch hochwertigen Datensätzen.

Geodaten

Neben der kartographischen und geometrischen Qualität der Daten ist auf ihre Eignung in Hinblick auf die Verwendung in einem dualen System zu achten. Dies ist insbesondere in einem System von Bedeutung, das mehrere Detailgrade der Daten in Form unterschiedlicher Maßstabsebenen anbietet.

Unter dem Dualprinzip versteht man die kartographische Modellbildung (maßstabsabhängige Generalisierung sowie graphikdefinierte Visualisierung) für

die analoge Ausgabe (Medium Papier)

das Internet - Web Publishing (Medium Bildschirm).

Diese technisch ganz unterschiedlichen Ausgabemedien verlangen getrennte Modellierungsprozesse. Somit müssen Modelle erzeugt werden, die unterschiedlichen, vom Ausgabemedium abhängigen Modellauflösungen entsprechen. Eine entscheidende Rolle spielen dabei die Mindestdimensionen, die in direktem Zusammenhang mit der Feinheit der graphischen Darstellung stehen.

Diese Überlegungen führen zu folgenden, für das Bildschirmmedium vorbereitete, Inhaltsebenen:

Maßstab	**Region**	**Administrative Einheiten**	**Bildschirmausschnitt**
1 : 6.000.000	Österreich gesamt	Bundesländer, Bezirke	Bildschirm füllend
1 : 3.000.000	1-2 Bundesländer	Bundesländer, Bezirke, Gemeinden	Bildschirm füllend
1 : 1.000.000	Teil eines Bundesland	Gemeinden	Bildschirm füllend

Tabelle 1: Inhaltsebenen für Bildschirmmedium

Als Teil des Projektes werden Wege aufgezeigt, die zu geometrisch-visuell stimmigen topographischen Bezugsgrundlagen durch Eigenbearbeitung führen können. Eine exemplarische Vorgehensweise wird unter selektiver Verwendung bestehender Daten für oben genannte Maßstäbe erfolgen. Eine detaillierte Kosten/Aufwandabschätzung für die Erstellung topographischer Datensätze für die gängigsten Maßstäbe wird als Resultat entstehen. Des Weiteren werden kommerzielle Angebote geprüft, unter besonderer Berücksichtigung der österreichischen Geodatenpolitik.

Sachdaten

Für eine beispielhafte Umsetzung eines ÖROK Atlas Online in einem Prototyp wurden die Themengruppen Bevölkerung, Wirtschaft und Arbeitsmarkt, Verkehr und Infrastruktur, Naturraum und Umwelt gewählt. Dadurch werden einerseits jene Bereiche abgedeckt, die für ÖROK Abonnenten von Interesse sind, andererseits handelt es sich dabei auch um sehr unterschiedliche Daten im Hinblick auf die Erfassungsmethode und die Genauigkeit der Verortungsbasis (scharfe – unscharfe Grenzen). Einige der Daten sind auf Grenznetzwerke bezogen (Bevölkerung), andere auf Linienelemente (Verkehr) und bei wieder anderen wird die Bezugsgeometrie durch die Sachverhaltsabgrenzung ermittelt (Naturraum und Umwelt).

Hintergrund dieser Auswahl ist, schon im Rahmen der Entwicklung des Prototypen, eine optimale Simulation der gesamten Breite der Zugänglichkeit, des inhaltlichen Spektrums sowie der möglichen „Hindernisse" und auftretenden Probleme zu ermöglichen.

Wesentlichste Kriterien bei dieser Auswahl sind:

Unterschiedliche Quellen (BEV, Bund, Länder, Statistik Austria, Hauptverband der österreichischen Sozialversicherungsträger, Arbeitsmarktservice, Verkehrsträger usw.)

Unterschiedliche Kompetenzbereiche

Unterschiedliche regionale Verfügbarkeit (z.B. Bundesländer, Pol. Bezirke, AMS-Bezirke, Gemeinden, etc.)

Geografische Daten - Statistische Daten

Verfügbarkeit von konkreten Daten bzw. Planungs- bzw. Prognosedaten/informationen

Unterschiedliche/bestehende/nicht bestehende Metadatenkonzepte

Möglichkeit des Aufbaus von Verknüpfung im Zusammenhang mit Kontextthemen

(interne) Verfügbarkeit von Daten.

Ausgehend von diesen 4 Themenbereichen wurden in Anlehnung an die Methodik der Bearbeitung des traditionellen ÖROK Atlas (Print) mögliche Inhalte und Aussagen je Themenbereich vom Konsortium definiert. Um das Bestehen des ÖROK Atlas Online langfristig zu gewährleisten wurde in diesem Arbeitschritt gleichzeitig eine Diskussion über zukünftige Datenintegration und Nutzungsrechte (Stichwort Geodatenpolitik) im Rahmen dieses Mediums angeregt.

3.1.2 Themenbereich Funktionalitäten:

Der ÖROK Atlas Online stellt ein Rauminformationssystem dar, das sich durch seinen starken kartographischen Charakter von reinen Geoinformationssystemen unterscheidet. Dies zeigt sich insbesondere durch die Tatsache, dass es sich nicht um eine Ansammlung GIS-basierter Tools handelt, sondern um ein System, das sämtliche Funktionalitäten in eine konzeptionelle und strukturierte Ordnung gliedert.

Durch die eingeschränkte Größe und Auflösung des Mediums Bildschirm wirft vor allem die Visualisierung von komplexen Themen Probleme auf. Eine Darstellung, die einen Überblick verschafft und gleichzeitig komplexe Sachverhaltszusammenhänge bzw. Detailinformationen vermittelt, ist nicht realisierbar. Diesem Manko wird durch die Darstellung in mehreren Auflösungsebenen mit integrierter Interaktivität entgegengewirkt.

Es kann unterschieden werden zwischen:

Interaktivität, die Nachteile des Mediums Bildschirm gegenüber dem Medium Papier ausgleicht (z.B. Beschriftungen als Mouse-Over-Effekt) und

Interaktivität, die darüber hinaus Vorteile des Computers nützt und so analog nicht umsetzbare Möglichkeiten bietet (z.B. alternative Gruppenbildungen).

Durch interaktive Kartennutzung erhält der Nutzer die Möglichkeit, das Sekundärmodell (graphisches Erscheinungsbild) zu verändern, dessen Bildungsprozess zu beeinflussen sowie auf Primärdaten zuzugreifen. Vor allem durch den direkten Zugriff auf Primärdaten können die Restriktionen graphischer Darstellbarkeit (teilweise) aufgehoben werden.

Basierend auf der Evaluierung bestehender Atlanten sowie der Auswertung der ÖROK-Atlas Abonnenten-Befragung wird eine Liste potentieller Funktionalitäten erstellt, die in weiterer Folge die Informations-Architektur des Systems bestimmen werden.

Sämtliche potentielle Funktionalitäten lassen sich in eine der folgenden Komplexitätsstufen einordnen:

Betriebsfunktionalitäten

Graphische Interaktion

Zugriff auf Primärdaten

Erstellung neuer Datensätze

Veränderung von Primärdatensätzen

Die jeweilige Komplexität der Funktionalitäten lässt sich auf einer graphischen Achse darstellen, die, ausgehend von einer als Mainstream bezeichneten Hauptrichtung, bis zu als experimentell zu bezeichnenden Funktionen läuft.

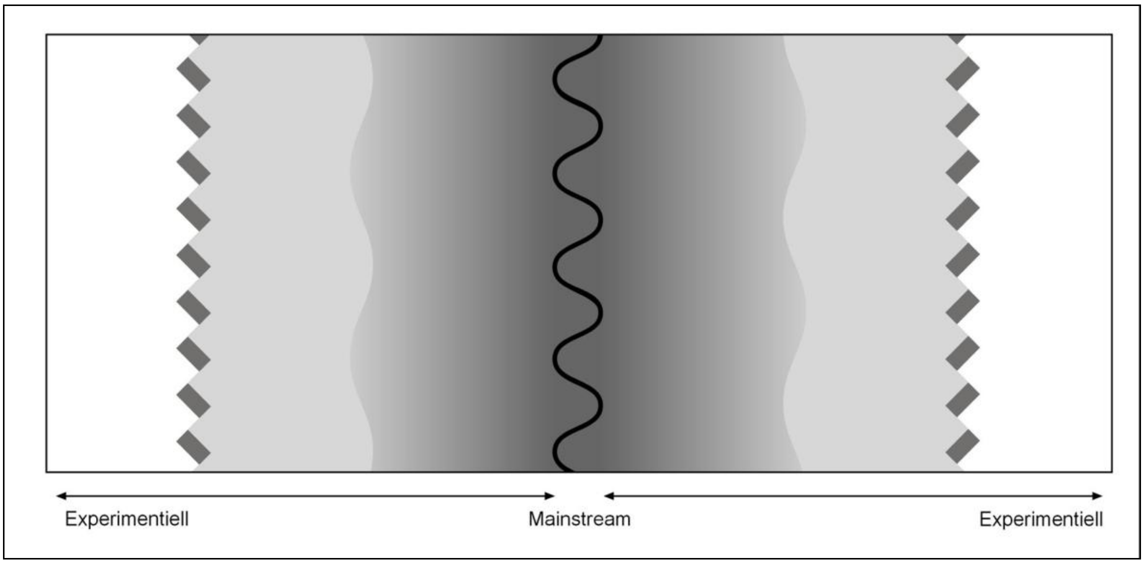

Abbildung 3: Komplexität der Funktionalitäten zwischen Mainstream und Experimentel

3.1.3 Themenbereich Benutzerführung

Die Benutzerführung des ÖROK Atlas Online soll einem restriktiv-flexiblen Ansatz folgen. Der Benutzer erhält in eingeschränktem Maße die Möglichkeit, Ebenen verschiedener Themen und Funktionalitäten zu kombinieren. Damit können sinnvolle Vergleiche ermöglicht und gefördert werden, während problematische und fälschliche Vergleiche unterbunden werden.

Das AIS-Konsortium ist sich der Tatsache bewusst, dass durch Kombination von mehreren Themen verschiedene Aussagen generiert werden können. Die „Aussageverantwortung“ aller beteiligten Institutionen muss gewahrt bleiben, um keinerlei Konflikte zu provozieren. Die Aussagen sollen stimmig und im Sinne der öffentlich-rechtlichen Verantwortung interpretierbar sein.

Diesem Anspruch muss das Konzept der Benutzerführung gerecht werden. Die Struktur der Applikation muss hierbei einer klaren Ordnung folgen. Auf Basis der Funktionalitäten, die der ÖROK Atlas Online bieten wird, ist in der Folge ein solches Strukturkonzept zu entwerfen. Der restriktiv-flexible Ansatz bietet hierzu diverse Möglichkeiten an, wobei sich eine nicht-lineare, netzwerkähnliche Struktur abzeichnet.

Der ÖROK Atlas Online wird ein sowohl für Laien als auch Experten nutzbares System darstellen, wobei die Trennung dieser beiden Nutzergruppen nicht restriktiv, sondern dynamisch über die Informationsarchitektur sowie die Gestaltung der Benutzerschnittstelle erfolgen wird.

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Bodensee - Geodatenpool

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1 PROJEKTPARTNER

EU-Projekt der Vermessungsverwaltungen der Bodensee-Anrainerländer.

Die Vermessungsverwaltungen der Bodensee-Anrainerländer Schweiz, Baden-Württemberg, Bayern, und Österreich sind auf ihrem jeweiligen Staatsgebiet für

die Landesvermessung (Grundlagenvermessung, topographische Landesaufnahme, Kartographie)

das Liegenschaftskataster (Führung und Fortführung) und für

die raumbezogenen Geobasisinformationen (Geodatenhaltung und -bereitstellung) zuständig.

Allesamt sind dies hoheitliche Aufgabenbereiche. Jedes Land hält *seine* aktuellen raumbezogenen Geobasisinformationen der Landesvermessung und des Liegenschaftskatasters flächendeckend für den Bürger, die Wirtschaft und Verwaltung auf der Basis einer modernen Geodateninfrastruktur bereit. Dies geschieht jedoch inhaltlich und als auch technisch in unterschiedlichen landesspezifischen Systemen. Diese Situation erschwert insbesondere in der Bodenseeregion die Nutzung länderübergreifender topografisch-kartografischer Geobasisdaten durch Dritte.

Hemmnisse ergeben sich insbesondere durch folgende Sachverhalte:

Derzeit müssen sich Fachanwender bei der Nutzung länderübergreifender Geobasisdaten in der Bodenseeregion ihre Geodaten „zusammenstückeln", indem mit allen 4 Vertriebsstellen der jeweiligen Vermessungsverwaltung „verhandelt" wird.

In der Bodenseeregion, die viele Grenz-Nahtstellen aufweist, ist der Geodatenaustausch bzw. das Zusammenführen von Geobasisdaten aufgrund der heterogenen Struktur (Referenzsysteme, Kartengrafik etc.) und der fehlenden einheitlichen Schnittstelle sehr aufwändig und zeitraubend und daher wenig kundenfreundlich.

Im Rahmen der Erfüllung ihrer gesetzlichen Aufgaben sind die Vermessungsverwaltungen der vier Bodensee-Anrainerländer jeweils „gezwungen", ihre Bearbeitungsgebiete über die Grenzen hinaus auszudehnen, was derzeit eine redundante Datenbearbeitung und Datenhaltung mit hohem Aufwand zur Folge hat

2 PROJEKTZIEL

2.1 Allgemeine Projektziele

- Zusammenwachsen der Länder in der Bodenseeregion.
- Verbesserung der Informationsinfrastruktur durch Schaffung eines Datenverbunds und Bildung bzw. Intensivierung von partnerschaftlichen Netzwerken in der Region.
- Bewusstseinsbildung bei politischen Entscheidungsträgern über die Produkte und Dienstleistungen der Vermessungsverwaltungen der Bodensee-Anrainerländer.

2.2 Spezielle Projektziele

- Ein einheitlicher, standardisierter (harmonisierter) Geobasisdatenbestand mit einer einheitlichen Datenschnittstelle wird geschaffen. Durch die Zusammenführung von vier Datenbeständen zu einem einzigen Datenbestand soll garantiert werden, dass ein ländergrenzüberschreitender raumbezogener Geobasisdatenbestand für die Bodenseeregion aktuell bereitgehalten wird.
- Den Kunden werden landesgrenzüberschreitende Geobasisdaten in der Bodenseeregion aus einem Guss angeboten. Dabei kann der Kunde seinen Ansprechpartner bzw. seine Vertriebsstelle selbst wählen. In jedem Fall hat er nur noch 1 Anlauf-/Servicestelle von der er beraten wird und von der er seine Daten erhält.
- Eine Datenbank mit einem einheitlichen hochaktuellen landesgrenzübergreifenden Geodatenbestand, auf den die Bürger und Fachanwender in der Bodenseeregion jederzeit - auch online - zugreifen können, trägt erheblich dazu bei, dass Hemmnisse im Umgang und bei der Nutzung mit raumbezogenen topographisch-kartographischen Geobasisdaten in der Bodenseeregion beseitigt werden. Dadurch wird die Nutzung von Geobasisdaten gefördert und letztendlich ein grenzüberschreitender Mehrwert erzielt.
- Im Rahmen der grenzüberschreitenden Zusammenarbeit der Vermessungsverwaltungen der Bodensee-Anrainerländer wird in dem exklusiven und einmaligen Projekt „Bodensee-Geodatenpool" gemeinsam geplant, organisiert, gemanagt, finanziert und umgesetzt.

2.3 Zielgruppen

- Die Fachanwender aus dem Bereich der Raumplanung, insbesondere die Zielgruppe, die sich innerhalb der Internationalen Bodenseekonferenz mit der Bodenseeregion als attraktivem Lebens-, Natur-, Kultur- und Wirtschaftsraum beschäftigt.
- Die Bürger insgesamt, die in ihrer Freizeit die Bodenseeregion zu Lande, zu Wasser und aus der Luft erleben möchten.

3 PROJEKTINHALT

Inhalt des Projektes ist der Aufbau einer länderübergreifende Geobasisdatenbank. Dies soll in der ersten Stufe mit den Rasterdaten im Maßstab 1:50 000 realisiert werden (Grundversion). Der gemeinsame Datenbestand der Bodensee-Anrainerländer wird für das in Abb.1 abgegrenzte Gebiet (Bodensee in zentraler Lage) mit einer Fläche von ca. 18 000 km² aufgebaut, gepflegt und bereitgestellt.

Hierzu zählt:

- Erstmaliges Zusammenfügen der „Länder-Datensätze“
- Fortführung bzw. Nachführung des gemeinsamen Datenbestandes entsprechend den Änderungszyklen der Länder (Fortführungsturnus, Spitzenaktualitäten, insb. bei größeren Veränderungen)
- gemeinsame Datenhaltung/-verwaltung
- Online-Bereitstellung oder Bereitstellung über die Vertriebsstellen/Kundenzentren bei den Vermessungsverwaltungen der Bodensee-Anrainerländer (Wahl einer Anlaufstelle)

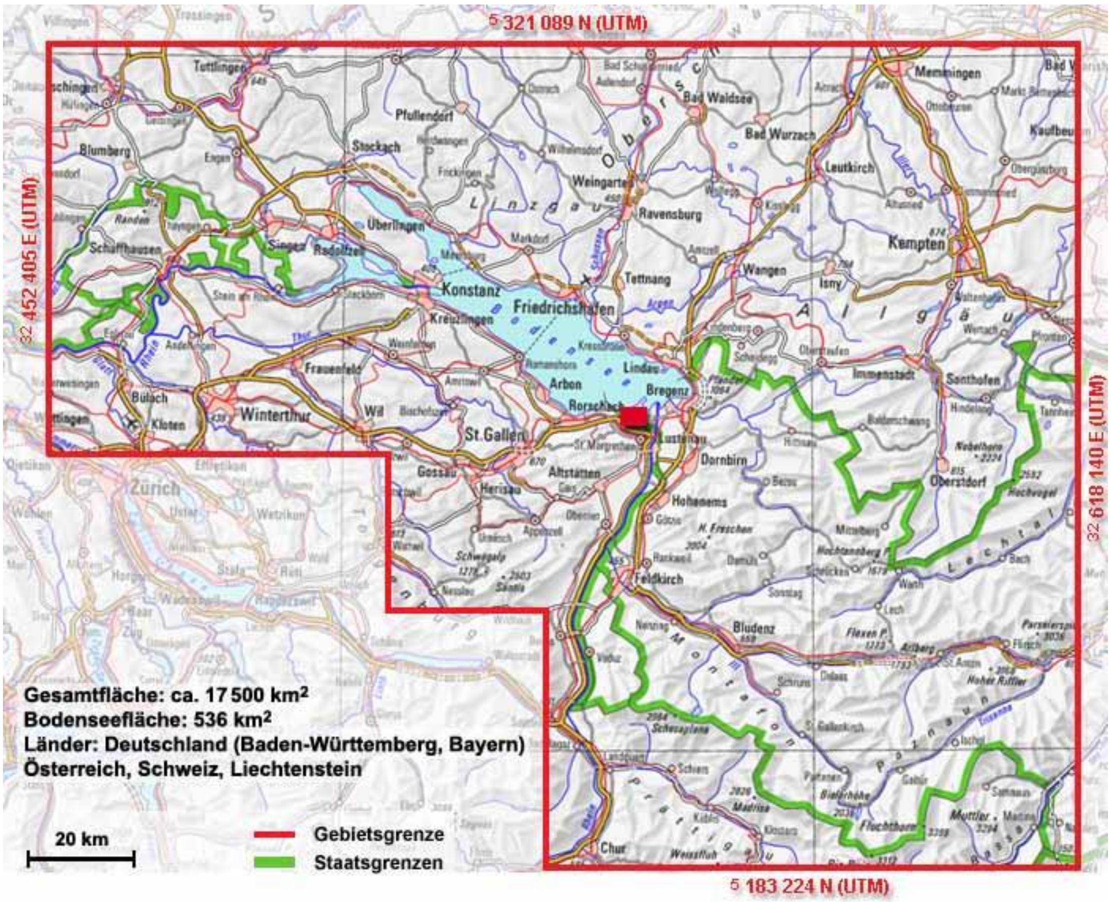

Abb.1: Gebiet des Bodensee-Geodatenpools

3.1 Der Datenbestand (Grundversion) ist gekennzeichnet durch folgende Inhalte:

- Rasterdaten der Topographischen Karte 1:50 000 im Zeichenschlüssel des jeweiligen Landes in einem einheitlichen Referenzsystem (WGS 84/UTM, 9 Grad)
- Karten-Layer: Situation (Grundriß+Schrift), Gewässerlinien, Höhenlinien, Waldkanten, Waldton, Seeton, Straßen rot, Straßen gelb, Fels (Ergänzung für Österreich)
- Vektor-Overlay „Grenzen, Verwaltungsgrenzen“
- Bodenseetiefenmodell (Animation der Bodenseetiefendaten)

3.1.1 Rasterdaten 1:50 000

- länderübergreifende Abgabe der Geobasisdaten nach Maßgabe der Nutzungsrechtsvorschriften
- mit einem kostenlosen Projekt-Werbeartikel „Bodensee-Geodatenpool“ in Form einer gedruckten Gebietskarte im Kleinformat (43x 33 cm) soll zur Steigerung des Bekanntheitsgrads der gemeinsamen Produkte/Dienstleistungen der Vermessungsverwaltungen der Bodensee-Anrainerländer beigetragen werden.

3.1.2 Bodensee-Geodatenpool online

Das Projekt „Bodensee Geodatenpool“ mit seinem Geobasisdatenbestand (Rasterdaten 1:50 000) soll über ein Internetportal einer breiten Öffentlichkeit und den Fachanwendern aus Wirtschaft, Verwaltung und Wissenschaft mit folgendem Angebot zur Verfügung gestellt werden:

- als Werbe- und Präsentationsplattform in Form eines kostenlosen Services für jedermann (Internet-Geodatenportal - vgl. www.austrianmap.at)

Ergänzt wird der Inhalt des Internetportals durch Metadaten zum Produkt- und Dienstleistungsangebot der Vermessungsverwaltungen der Bodensee-Anrainerländer, insbesondere zu den Produkten Digitale Orthophotos und Digitales Geländemodell.

Als Weiterentwicklung des Internetportals ist die Integration weiterer Fachdaten (z.B. Wind- und Wetterinformationen, ÖPNV-Informationen, Informationen zur Bodenseeflotte und den Bodenseeschifffahrtslinien) denkbar.

4 INTERREG IIIA - FÖRDERUNG FÜR EIN GRENZÜBERSCHREITENDES PROJEKT

Das Projekt wurde im Oktober 2003 im INTERREG IIIA - Lenkungsausschuss beraten. Es wurde vom Lenkungsausschuss positiv

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Alpenrhein·Bodensee·Hochrhein

bewertet und eine Förderzusage im Rahmen des INTERREG III A-Programms „Alpenrhein-Bodensee-Hochrhein“ erteilt.

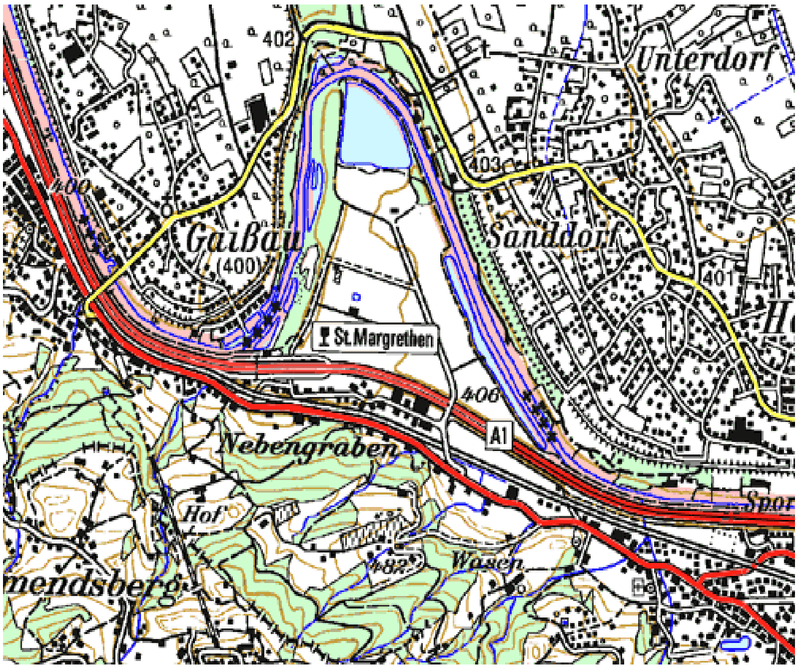

Abb2: Ausschnitt aus dem Rasterdatenbestand 1:50 000

5 ZEITPLAN

- Projektbeginn: November 2003
- Meilenstein 1: Mai 2005 - Aufbau der Geobasisdatenbank (TK50)
- Meilenstein 2: September 2005 - Realisierung des Geodatenportals (Internetauftritt)
- Meilenstein 3: Dezember 2005 - Werbeartikel „Minikarte“

6 SCHLUSSBETRACHTUNG

Die Stärken der Vermessungsverwaltungen liegen u.a. in der Bereitstellung von raumbezogenen, flächendeckenden und aktuellen Geobasisinformationen. Mit dem Projekt, welches sich auf die Realisierung eines gemeinsamen Bodensee-Rasterdatenbestands 1:50.000 konzentriert, wird angestrebt, eine nachhaltige internationale Geodaten-Infrastruktur in der Bodenseeregion aufzubauen. Dem Projekt kommt eine infrastrukturelle Basisfunktion zu. In erster Linie ist das Projekt dem Förderbereich "Raumordnung" zuzuordnen. Eine Verbindung mit anderen Förderbereichen wie „Standortmanagement“, „Dienstleistung und Tourismus“, „Technische Infrastruktur“ und „Vernetzung und Bewusstseinbildung“ wird ebenfalls gesehen.

Die Erfahrungen die aus dem Projekt gewonnen werden, fließen direkt in die Verfahren und Prozesse der mitbeteiligten Vermessungsverwaltungen ein, sodass über das Projekt hinaus Synergieeffekte zu erwarten sind.

Aufbau und effektive Nutzung der Geodateninfrastruktur in kommunalen Verwaltungen

Hartmut MÜLLER

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1 ZUSAMMENFASSUNG

Der Beitrag zeigt am Beispiel des deutschen Bundeslandes Rheinland-Pfalz die vorhandene Ist-Situation sowie Anforderungen und konkrete Lösungswege zur Nutzung der bereits vorhandenen öffentlichen Geodateninfrastruktur auf. Zwischen dem zuständigen Landesministerium und der kommunalen Verwaltungsebene wurde ein Vertrag über die Übermittlung und umfassende Nutzung amtlicher Geobasisinformationen gegen ein jährlich für das gesamte Bundesland pauschal zu entrichtendes Entgelt geschlossen. Damit verfügt die kommunale Ebene in Rheinland-Pfalz über eine finanziell langfristig gesicherte Datenbasis, um eigene fachliche Informationssysteme mit Raumbezug entwickeln und damit zum weiteren Ausbau der Geodateninfrastruktur beitragen zu können.

Der für die mittlere kommunale Ebene der Landkreise zuständige Spitzenverband lässt im Rahmen einer Projektinitiative ein Musterkonzept erarbeiten, in dem die Geschäftsprozesse einer Kreisverwaltung an Hand einer ausgewählten Piloteinheit dargestellt und der Nutzen und die Anwendungspotentiale der raumbezogenen Datenverarbeitung in den einzelnen Prozessen verdeutlicht werden.

Eine Projektgruppe fungiert im Sinne eines Lenkungsausschusses als zentrales Entscheidungsgremium innerhalb des Projekts. Die Beauftragten ausgewählter Verwaltungen wirken hier entscheidend mit, um ein zwischen den verschiedenen Verwaltungseinheiten möglichst abgestimmtes Vorgehen zu erreichen. Die Projektgruppe fällt bei ihren regelmäßigen Sitzungen die Entscheidungen zum weiteren Vorgehen, ist aktiv in die operationelle Projektarbeit eingebunden und erarbeitet abgestimmte Empfehlungen, um die notwendigen Voraussetzungen für die GIS-Einführung zunächst vor allem in den Landkreisen des Bundeslandes Rheinland-Pfalz zu schaffen.

Für eine Piloteinheit wird exemplarisch das vollständige Phasenmodell einer IT-Einführung mit den Projektphasen Systemanalyse – Systemauswahl – Systemeinführung durchlaufen. Der Beitrag stellt den konzeptionellen Projektaufbau, die Projektorganisation, die Ergebnisse der Ist-Erhebung und der Anforderungsanalyse sowie das fachliche Konzept der GIS-Einführung auf der Basis der vorhandenen öffentlichen Geodateninfrastruktur dar. Weiterhin wird das Vorgehen und die Ergebnisse einer Nutzwertanalyse erläutert, welche die Basis für die Priorisierung der GIS-Einführung auf der Grundlage eines modularen Systemkonzepts liefert.

2 AUSGANGSSITUATION

2.1 Hintergrund

Der föderale Aufbau der Bundesrepublik Deutschland geht einher mit einer breit gefächerten Vielfalt öffentlicher Verwaltungsstrukturen auf allen Verwaltungsebenen. Diese unterschiedlichen Verwaltungsstrukturen führen auch zu entsprechend unterschiedlichen Anforderungen an alle einzuführenden GIS-Lösungen. In vielen Bereichen, und zwar insbesondere auf den unteren Verwaltungsebenen, sind bis jetzt nur wenige GIS-Lösungen im Einsatz. Diese wenigen Lösungen sind in vielen Fällen kaum oder überhaupt nicht vernetzt und und leisten deshalb eher einem weiteren Wildwuchs unkoordinierter Insellösungen Vorschub.

Auf Landkreisebene existiert ein sehr breites Spektrum sinnvoll nutzbarer GIS-Anwendungen (siehe z.B. auch Bayerisches Staatsministerium der Finanzen, 2003). Beispielhaft seien die Themen Liegenschaftsverwaltung und Topographie, Planung und Raumordnung, Natur- und Umweltschutz, Ökologie, Katastrophenmanagement, Öffentlicher Personennahverkehr, Wirtschaftsförderung/Gewerbeinformation, Infrastrukturplanung und -dokumentation, Denkmalpflege, Abfallwirtschaft genannt.

Um eine hohe Wertschöpfung des GIS zu erzielen, ist eine sachgebietsübergreifende GIS-Lösung unbedingt erforderlich. Erst mittels Kombination und Mehrfachnutzung eigener Daten der Kreisverwaltung und amtlicher Geobasisdaten sowie mit Fachinformationen weiterer öffentlicher und privater Stellen lässt sich das volle Wertschöpfungspotenzial der GIS-Nutzung und der vorhandenen und neu zu erhebenden Geodaten für möglichst viele Anwendungsfelder erschließen. Die Verbindung dieser Daten mit den Geodaten der kreisangehörigen Gemeinden, z. B. über Kooperationsmodelle sowie mit den kommunalen und regionalen Ver- und Entsorgungsbetrieben kann darüber hinaus langfristig eine effiziente kommunale Geodateninfrastruktur schaffen.

2.2 Situation auf Landkreisebene

Die hier vorgestellte Studie befasst sich speziell mit den Anforderungen der Verwaltungen rheinland-pfälzischer Landkreise, um deren Bedürfnisse möglicht detailliert zu erheben und darzustellen. Die aktuelle Situation auf der Landkreisebene im Bundesland Rheinland-Pfalz ist gekennzeichnet durch folgende Gegebenheiten:

Die Verwaltungen der 24 Landkreise (Kreisverwaltungen) haben in weiten Teilen übereinstimmende, meist gesetzlich geregelte Aufgaben, sind jedoch organisatorisch unterschiedlich aufgebaut.

Der aktuelle Stand der GIS-Einführung reicht von weit gehender Fehlanzeige bis zu einer fast vollständigen Ausstattung der entsprechenden Sacharbeitsplätze zumindest mit GIS- Auskunftsfunktionen.

Die Landkreise haben seit dem Jahr 2002 das langfristig vertraglich geregelte Recht, sämtliche bei der Vermessungs- und Katasterverwaltung verfügbaren Geobasisinformationen gegen ein jährlich für das gesamte Bundesland pauschal zu zahlendes Entgelt zu beziehen und für ihre eigenen Zwecke zu nutzen.

Die Kreisverwaltungen nutzen mehr und mehr digital vorhandene Informationen weiterer öffentlicher und privater Institutionen, z.B. in Form von Online-GIS. Der Aufbau digitaler räumlicher Datenbestände wird sich entsprechend fortsetzen, so dass sich weitere Nutzenpotenziale erschließen lassen.

3 PROJEKTORGANISATION

3.1 Projektpartner

Der Landkreistag Rheinland-Pfalz unterstützt in seiner Funktion als kommunaler Spitzenverband die Kreisverwaltungen in Rheinland-Pfalz bei der Einführung und dem Ausbau der raumbezogenen Informationsverarbeitung mithilfe von Geo-Informationssystemen (GIS). Zu diesem Zweck hat der Landkreistag Rheinland-Pfalz das Projekt ‚Implementierung eines GIS bei den Kreisverwaltungen in Rheinland-Pfalz' initiiert, das durch das Institut für Raumbezogene Informations- und Messtechnik – i3mainz der Fachhochschule Mainz mit einer Projektstudie fachlich begleitet wird. Die Studie hat das Ziel, die konzeptionelle Grundlage für die in ihren einzelnen Komponenten aufeinander abgestimmte landesweite GIS-Einführung auf der mittleren Verwaltungsebene aller Landkreise des Bundeslandes Rheinland-Pfalz an Hand der als Piloteinheit ausgewählten Kreisverwaltung Bernkastel-Wittlich zu erarbeiten.

Der Landkreis Bernkastel-Wittlich, in seiner heutigen Struktur entstanden um 1970 im Rahmen der Verwaltungsreform (siehe Abb. 1), ist mit einer Fläche von ca. 1.200 qkm bei ca. 120.000 Einwohnern der zweitgrößte Landkreis in Rheinland-Pfalz; er setzt sich aus 7 Verbandsgemeinden mit insgesamt 106 Ortsgemeinden und zwei verbandsfreien Gemeinden zusammen und zählt mit einer Bevölkerungsdichte von ca. 100 Einwohnern pro qkm zum eher ländlich geprägten Raum. Die Kreisverwaltung Bernkastel-Wittlich wurde als Piloteinheit ausgewählt, um ein Handlungskonzept für die GIS-Einführung auf Landkreisebene exemplarisch zu entwickeln und praktisch zu erproben. Wesentliche Kriterien für die Auswahl der Piloteinheit waren

der eindeutig erklärte Wille der politischen Führung zur Unterstützung des Projekts, der zu den entscheidenden Erfolgsfaktoren jedes Projekts und insbesondere von IT-Projekten zählt,

das bei den Beteiligten vorhandene Bewusstsein für das GIS-Nutzenpotenzial, verbunden mit einer generell innovativen Einstellung, die für die praktische Projektarbeit sehr hilfreich ist,

das zu Projektbeginn weitgehende Fehlen einer GIS-Infrastruktur, weshalb sich das Konzept rein anwendungs- und aufgabenorientiert ohne Rücksicht auf bereits vorhandene Teilllösungen in Zusammenarbeit mit den weiteren Projektpartnern entwickeln lässt. Damit entsteht eine weitgehend universale Grundlage für die GIS-Einführung in weiteren rheinland-pfälzischen Landkreisen, dem erklärten Projektziel des für die Projektinitiative verantwortlichen Spitzenverbands.

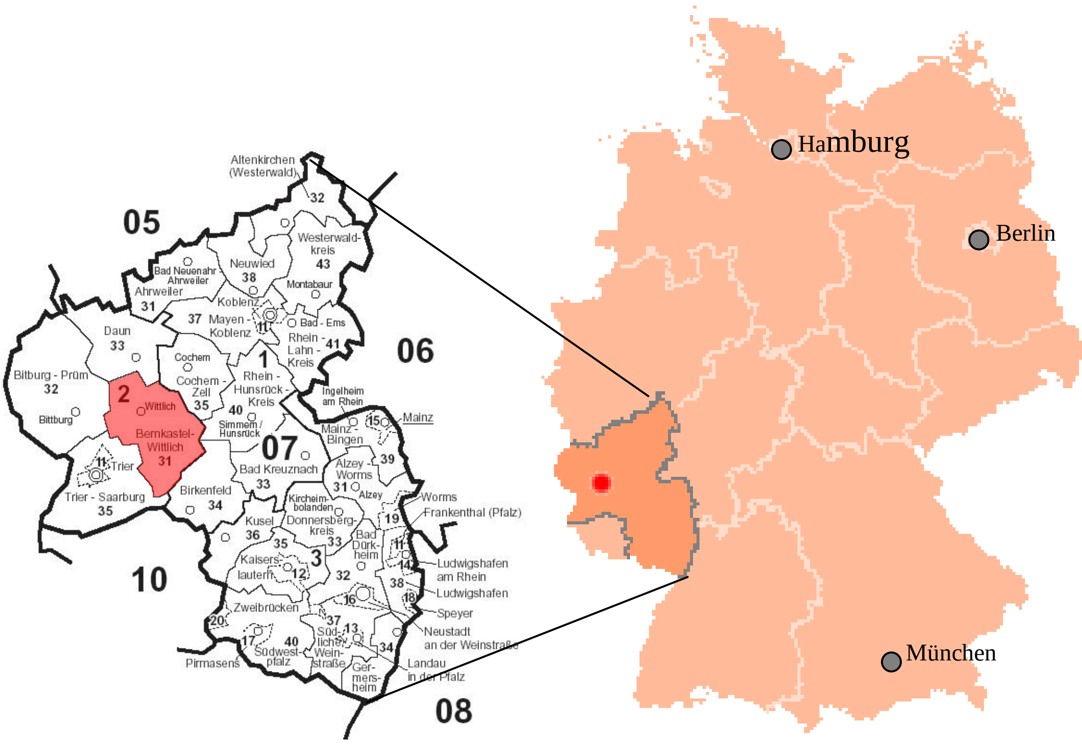

Abb.1: Projektgebiet mit Piloteinheit (Verwaltungsgrenzen: Statistisches Bundesamt 98 –6 - 0531)

3.2 Projektgruppe

Der Landkreistag Rheinland-Pfalz hat eine Projektgruppe (PG GIS) ins Leben gerufen (siehe Abb. 2), die im Sinne eines Lenkungsausschusses als zentrales Entscheidungsgremium innerhalb des Projekts fungiert. Die Projektgruppe besteht aus Vertretern des kommunalen Spitzenverbandes, aus den Beauftragten ausgewählter Kreisverwaltungen, insbesondere auch aus der als Piloteinheit fungierenden Verwaltung Bernkastel-Wittlich, aus Vertretern der öffentlichen Vermessungsverwaltung, aus den Projektbeteiligten des begleitenden Instituts i3mainz sowie aus Vertretern weiterer öffentlicher Institutionen. Die Projektgruppe tagt zu festgelegten Berichtszeitpunkten, bespricht den aktuellen Projektstand, fällt die Entscheidungen zum weiteren Vorgehen und ist aktiv in die operationelle Projektarbeit eingebunden. Neben den fachlichen Entscheidungen erarbeitet die Projektgruppe auch Empfehlungen, um die notwendigen Voraussetzungen für die GIS-Einführung in allen Landkreisen zu schaffen.

3.3 Plenum

Der Projektfortschritt wird regelmäßig in Plenarveranstaltungen dargestellt, an denen die GIS-Beauftragten aller rheinland-pfälzischen Landkreise teilnehmen (GIS Plenum, s. Abb. 2). Diese Veranstaltungen dienen dem Ziel, die Möglichkeiten der GIS-Nutzung auf Landkreisebene bekannt zu machen und entsprechende Aktivitäten zu stimulieren. Allen Projektbeteiligten steht ein webbasiertes GIS-Austausch- und Informationsforum zur Verfügung, in dem die bei der Projektarbeit erzeugten Dokumente abgelegt sind und allen autorisierten Personen zur Verfügung stehen.

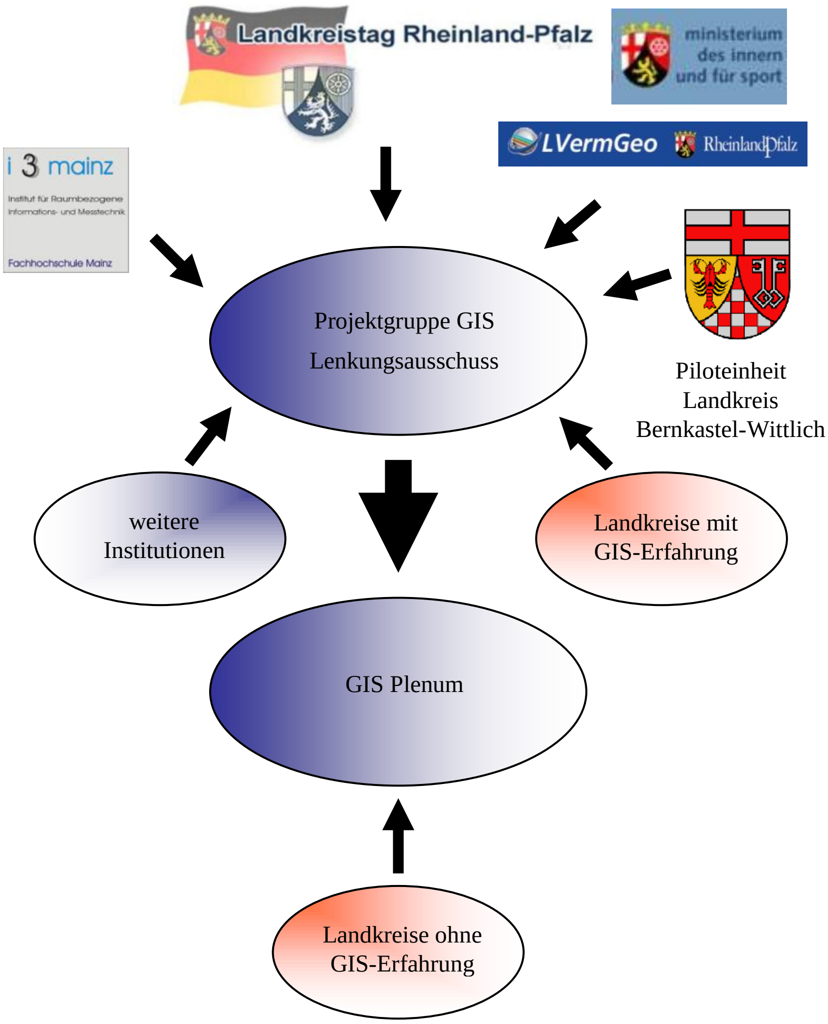

Abb.2: Projektbeteiligte

3.4 Phasenmodell

Die Durchführung des Projekts orientiert sich an den Projektphasen Systemanalyse – Systemauswahl – Systemeinführung (siehe Behr, 2000). Das erste Teilprojekt, das mit einer Dauer von 18 Monaten für den Zeitraum zwischen Juli 2003 bis Dezember 2004 terminiert ist, befasst sich mit der Ist-Erhebung und Analyse, mit der konzeptionellen Modellierung, mit der Erstellung des fachlichen und des IT-technischen Konzeptes sowie mit Kosten-Nutzen-Aspekten.

4 PROJEKTERGEBNISSE

4.1 Ist-Zustand und Anforderungsanalyse

Der zur Zeit vorhandene Ist-Zustand und die GIS-Anforderungen aus Nutzersicht wurden in der als Piloteinheit ausgewählten Kreisverwaltung dokumentiert. Zu diesem Zweck wurden mehr als 50 Mitarbeiterinnen und Mitarbeiter aus 20 Fachbereichen an Hand eines zuvor zwischen den Projektverantwortlichen abgestimmten zweistufigen Fragebogens einzeln befragt. Ziel dieser Befragung war es, das GIS-Potenzial detailliert für alle 170 in der Kreisverwaltung erzeugten Dienstleistungsprodukte bzw. Leistungen zu erfassen.

Der Landkreis Bernkastel-Wittlich stellt einen Produktorientierten Haushalt auf, der sich an den Strukturen des Neuen Steuerungsmodells orientiert (KGST, 1993) und der speziell an die Gegebenheiten vor Ort angepasst ist. Das zugehörige Dokument steht auf der Website des Landkreises unter http://www.bernkastel-wittlich.de/ öffentlich zum Download bereit Die Untersuchung wurde auf die Einheit ‚Produkt' bzw. ‚Leistung' bezogen, da diese Objekte die Ergebnisse der Tätigkeit der als Piloteinheit fungierenden Kreisverwaltung umfassend beschreiben, den Mitarbeitern vertraut sind und eine zuverlässige Einschätzung des Wertschöpfungspotenzials von GIS erlauben.

Als erstes Ergebnis der Untersuchung konnte festgestellt werden, dass von insgesamt 170 definierten Produkten 147, also etwa 86 Prozent, grundsätzlich auf einer raumbezogenen Datengrundlage erzeugt werden. Auch wenn diese Angabe sich lediglich auf die Menge der Produkte und nicht auf die Menge der raumbezogenen Daten bezieht, so kann sie immerhin als eine gewisse Bestätigung für die gängige Annahme angesehen werden, nach der etwa 80 Prozent aller kommunalen Daten über einen Raumbezug verfügen.

Produkt Nr.: **10-04**	Produktbezeichnung: **Straßengütekarte (Straßenzustandsbericht)**
Anz. gesamt (analog/digital/Datenformat)	1, digital, pdf
Datenart (graphisch/alphanumerisch)	graphisch
Datenlieferant (selbst / intern / extern)	Landesbetrieb Straßen und Verkehr
Dokumentation v. **Stand/Erstellungsdatum**?	Legende
Regelmäßige **Aktualisierung**? / Wie oft?	ja, jährlich
Zugriff auf welche **Zeiträume**?	nur aktuell gültige Datenbestände
Werden **Metadaten** erfasst?	nein
Wie werden **Daten vorverarbeitet**?	Daten ins Netzwerk stellen
Mögliche **Synergieeffekte**?	Direkter Zugriff auf Daten des Landesbetriebs Straßen und Verkehr
Datenverfügbarkeit/Datenschutz	gut/nein
Anforderungen an **Zugriff**	nur lesen evtl. zu erneuernde Straßen markieren und mit Maßnahmen oder mit Priorität verknüpfen
Benötigte **GIS-Funktionen**	Straßen zur besseren Übersicht verschieden einfärben, je nach Zustand Straßen, die nicht von Interesse sind ausblenden (z.B. Autobahn) Klick auf Straße für weitere Informationen (letzter Ausbau...) Anzeige der Verkehrsdichte auf der jeweiligen Straße

Tab. 1: Auszug aus dem Fragebogen für ein ausgewähltes Produkt

Tab. 1 enthält für das ausgewählte Produkt „Straßengütekarte (Straßenzustandsbericht)" einen Auszug aus den produktbezogen erfassten Informationen. Die ausgewerteten Ergebnisse der Befragung bilden die Bezugsbasis für die konzeptionelle Aufarbeitung in den nachfolgenden Projektschritten. Gleichzeitig können die Befragungsergebnisse auch als Muster für die Aktivitäten zur GIS-Einführung in den übrigen Landkreisen durch die Mitglieder der Projektgruppe und des GIS Forums (s. Abschnitte 3.2 und 3.3) genutzt werden.

4.2 Nutzwertanalyse

Da die GIS-Einführung aus organisatorischen und finanziellen Gründen schrittweise erfolgen muss, wurde in einem nächsten Schritt das Wertschöpfungspotenzial der GIS-Nutzung ebenfalls produktbezogen erfasst. Die Klassifizierung der Nutzenkategorien richtet sich nach Behr (2000). Da insbesondere auf der Kostenseite, vor allem im Hinblick auf die personellen Aufwendungen, keine genauen monetären Angaben möglich waren, wurde auch die Bewertung der Nutzenseite auf die Festlegung von Prioritäten beschränkt, um so zu einem zeitlichen Ablaufplan für die GIS-Einführung zu kommen. Als Instrument für die Priorisierung diente eine Nutzwertanalyse nach dem in BMF (2001) angegebenen Verfahren.

Die Nutzwertanalyse wurde in drei Schritten durchgeführt:

1. Schritt: Festlegung der Bewertungskriterien. Die Bewertung wird in den vier Nutzenkategorien *Nutzen durch erhöhte Produktivität / Operationeller Nutzen / Strategischer Nutzen / Externer Nutzen* (siehe Tab. 2) durchgeführt. Da die Beurteilung sich insgesamt ausschließlich auf qualitative Angaben stützt, wurde auf eine unterschiedliche Gewichtung verzichtet: alle vier Nutzenkategorien werden als gleich bedeutend behandelt.

2. Schritt: Bewertung der Auswirkung einer GIS-Einführung. Für jedes Produkt wird beurteilt, ob ein Kriterium zutrifft, teilweise zutrifft oder nicht zutrifft. Dabei wurde die Unterscheidung eingeführt*: 0 kein erkennbarer Nutzen / 1 geringer erkennbarer Nutzen / 2 mittlerer erkennbarer Nutzen / 3 hoher erkennbarer Nutzen* (siehe Tab. 2).

3. Schritt: Berechnung des Ergebnisses. Der Teilnutzen für ein Produkt hinsichtlich eines Kriteriums ergibt sich aus dem in der Bewertung zugewiesenen Wert. Der gesamte Nutzwert der GIS-Einführung für ein Produkt errechnet sich aus der Addition aller zugehörigen Teilnutzen und dient als Vergleichsmaßstab zur Bewertung der GIS-Einführungsalternativen untereinander. Das in Tab. 2 beispielhaft dargestellte Produkt erhält danach die insgesamt höchst mögliche Zahl von 3+3+3+3 = 12 Bewertungspunkten.

Produkt Nr.: **20-10** Produktbezeichung: **Gefahrenabwehr**	Bewer-tung
Nutzen durch erhöhte Produktivität	
Fortführung analoger Daten entfällt Vereinigung von Datenbeständen (Kreisverwaltung und Wasserdaten) Schnellere Entscheidungsmöglichkeiten Digitale Bereitstellung der Informationen	**3**
Operationeller Nutzen	
Verknüpfung von Informationen (Flurstück und Einwohner / Giftstoffe) Erstellung thematischer Karten Flexible Ausschnitts- und Maßstabswahl Beschleunigung bei der Auskunftserteilung	**3**
Strategischer Nutzen	
Realisierung technologisch bedingter Änderungen Verbesserung der Reaktionsfähigkeit gegenüber äußeren Einflüssen GIS-Daten für nachvollziehbare Investitionsentscheidungen (Hochwasserschutz...) Größere Entscheidungssicherheit, da verbesserte Basisinformationen	**3**
Externer Nutzen	
Bürger: können die Sachlage besser einschätzen Feuerwehr u.a. Hilfsdienste: können sich besser auf Situation vorbereiten Firmen: Giftstoffe evakuieren	**3**
Bewertung des erkennbaren Nutzens: **0** nicht vorhanden, **1** gering, **2** mittel, **3** hoch	

Tab. 2: Ergebnis der Nutzwertanalyse für ein ausgewähltes Produkt

In Abb. 3 ist das Gesamtergebnis der Nutzenpriorisierung für die untersuchten 147 Dienstleistungsprodukte der untersuchten Verwaltungseinheit grafisch dargestellt. Wie daraus hervor geht, lässt die Unterstützung der Verwaltungstätigkeit durch eine

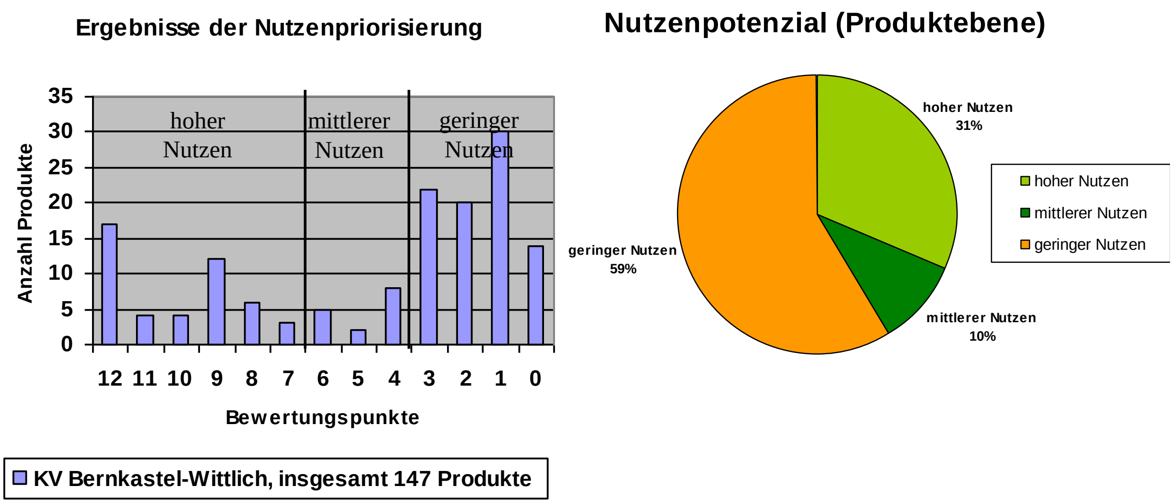

Abb.3: Gesamtergebnis der Nutzenpriorisierung

adäquate GIS-Funktionalität bei etwa 30 % der untersuchten Produkte einen hohen Nutzen erwarten.

In der folgenden Tab. 3 sind sämtliche Produkte aufgeführt, für die in der Untersuchung ein sehr hohes GIS-Nutzenpotenzial (Anzahl der Bewertungspunkte 10 bis 12) bzw. ein hohes GIS-Nutzenpotenzial (Anzahl der Bewertungspunkte 7 bis 9) identifiziert wurde. Das größte Potenzial liegt erwartungsgemäß hauptsächlich in den planerischen Bereichen (Bauleitplanung mit Landschaftsplanung, Raumordnung, etc.) sowie in der Abwehr von Gefahren (Artenschutz, Gefahrenabwehr, Infektionsschutz, Tierseuchenbekämpfung, Zivile Verteidigung, etc.), für die in sämtlichen Nutzenkategorien – Nutzen durch erhöhte Produktivität, operationeller Nutzen, strategischer Nutzen, externer Nutzen - bei der Bewertung jeweils die maximale Punktzahl vergeben wurde, für die also in jeder einzelnen Kategorie ein hoher Nutzen zu erwarten ist.

Bei der Einzelinterpretation ist die konkrete Definition der jeweiligen Produkte zu beachten. Im Rahmen der Projektarbeit hat es sich gezeigt, dass die Definition der einzelnen Produkte sich von Landkreis zu Landkreis zum Teil unterscheidet. Die hier wiedergegebene Liste bezieht sich auf die im Produktorientierten Haushalt des Pilotkreises nieder gelegten Produktdefinitionen; sie muss bei der Übertragung auf weitere Verwaltungseinheiten überprüft und gegebenenfalls modifiziert werden.

Produktbezeichnung	**Bewertung**		**Produktbezeichnung**	**Bewertung**
Allgemein: Bedarfsplanung FB 12	12		Öffentlicher Personennahverkehr ÖPNV	10
Allgemein: Bedarfsplanung FB 30	12		Verkehrsregelung und –Lenkung:	10
Anzeige und Genehmigungsverfahren	12		Aufsicht über Gewässer	9
Artenschutz	12		Bauaufsichtliche Entscheidungen	9
Beratung in der Bauleitplanung	12		Beratung und Information in der Bauverwaltung	9
Beratung und Information	12		Fremdenverkehr	9
Finanzen	12		Objektbezogene Stellungnahmen	9
Gefahrenabwehr	12		Prüfung bautechnischer Nachweise	9
Infektionsschutz	12		Schutz vor Immissionen	9
Landesplanerische Stellungnahmen	12		Überprüfungen	9
Landschaftsplanung i d Bauleitplanung	12		Verkehrsrechtliche Entsch.	9
Planung, Koordination von Hilfen (Bedarfsplanung)	12		Verwaltungsführung	9
Raumordnungsverfahren	12		Vollzug Wasserverbandsgesetz	9
Regelungen der Landschaftsnutzung	12		Widerspruchsverfahren	9
Stellungnahmen zu anderen Verfahren	12		Geschäftsstelle Kreisrechtsausschuss	8
Tierseuchenbekämpfung	12		Gremien	8
Zivile Verteidigung	12		Rechtsberatung Kreisrechtsausschuss	8
Agrarförderungsmaßnahmen:	11		Regelungen zur Abfallentsorgung	8
Führung der Einrichtung Abfallwirtschaft	11		Straßenbau	8
Umwelthygiene: Trinkwasserüberwachung	11		Wahlen	8
Wirtschaftsförderung	11		Beratung, Begleitung in der Dorferneuerung	7
Beförderung zu Kindergärten / Schulen	10		Bewirtschaftung Einnahmen/Ausgaben	7
Kreisentwicklung	10		Jagd / Fischerei	7

Tab. 3: Produkte mit hohem GIS-Nutzenpotenzial

4.3 Darstellung der Nutzeranforderungen als Use Cases

Die Datenmodellierungssprache Unified Modeling Language (UML), deren Semantik und Notation im UML Notation Guide beschrieben sind (s. z.B. Boochs et al., 1999), stellt verschiedene Werkzeuge zur Beschreibung von Anwendungsschemata bereit. Eine Vielzahl unterschiedlicher Diagrammarten ist verfügbar, um die verschiedenen Stadien einer Systementwicklung in einer eindeutig definierten Notation zu beschreiben. Die Diagrammform ‘Use Case Diagramme’ eignet sich besonders, um Anforderungsdefinitionen aus Nutzersicht in einer einheitlichen Form darzustellen. Um auch in diesem fortgeschrittenen Stadium der Definition möglichst weit gehend die fachliche Sicht der im Lenkungsausschuss vertretenen Fachleute wiederzugeben, wurde – zunächst für diejenigen Produkte, bei denen ein hohes bzw. mittleres Nutzenpotenzial für die GIS-Einführung identifziert worden war (siehe Abb. 3) – jeweils ein eigenes Use Case Diagramm definiert und in der Projektgruppe mit allen Beteiligten abgestimmt. Die damit verbundene Redundanz in der grafischen Darstellung der einzelnen Geodatenbestände wurde dabei zu Gunsten der Lesbarkeit für die Fachanwender bewusst in Kauf genommen.

Abb. 4 zeigt beispielhaft, dass das Dienstleistungsprodukt ‘41-02 Beratung und Information in der Bauverwaltung’ Informationen aus insgesamt 8 von unten im Uhrzeigersinn zu lesenden Datenquellen Bebauungsplan, Flächennutzungsplan, Lärmschutz, Windkraftanlagen, Überschwemmungsgebiete, Schutzgebiete, Landschaftsplan, Geobasisdaten benötigt. Weiterhin geht aus dem Diagramm hervor, welche GIS-Funktionalität in Verbindung mit jeder Datenquelle konkret bereit zu stellen ist, um die Anforderungen, die dieses Produkt an die GIS-Nutzung stellt, zu erfüllen.

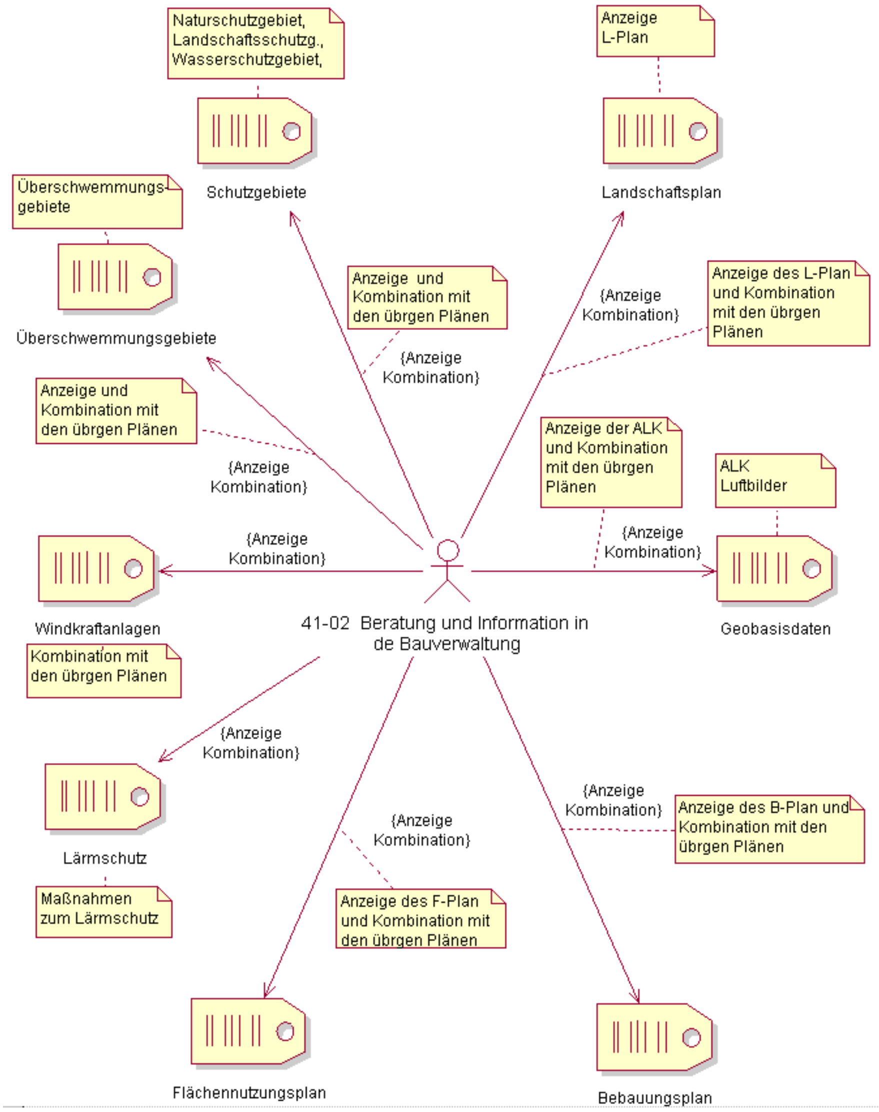

Abb.4: Use Case Diagramm in Unified Modeling Language (UML) Notation

Die Use Cases in der dargestellten Form sind wesentlicher Bestandteil eines aus Anwendersicht und damit systemunabhängig formulierten Pflichtenhefts, das die Anforderungen an die raumbezogene Datenverarbeitung aus Sicht der rheinland-pfälzischen Landkreisverwaltungen beschreibt. In diesem Pflichtenheft sind die genutzten externen und internen Datenbestände einschließlich des Datenformats, in denen sie vorliegen, spezifiert. Auf der Grundlage der Datenbestände sind die jeweiligen funktionalen Anforderungen der Nutzer definiert.

Um den absehbaren weiteren Entwicklungen, die einen verstärkten Datenaustausch bzw. verwaltungsübergreifende Online-Nutzung von Datenbeständen erwarten lassen, Rechnung zu tragen, sollen die zu implementierenden Systemlösungen alle inzwischen vorliegenden GIS-Standards einhalten. Eine besondere Rolle spielen in diesem Zusammenhang die Spezifikationen des OGC Open Geospatial Consortium (http://www.opengeospatial.org) sowie der ISO International Organization for Standardization (http://www.iso.org), hier vor allem die vom Technical Committee ISO/TC 211 Geographic Information/Geomatics (http://www.isotc211.org/) erarbeiteten Standards der Gruppe 19xxx., die sich speziell mit der Standardisierung auf dem Gebiet der raumbezogenen Datenverarbeitung beschäftigen.

In Deutschland zu beachten sind auch die von den Vermessungsverwaltungen gesetzten Standards zur IT-Verarbeitung der amtlichen Geobasisdaten: die amtlichen Informationssysteme werden zur Zeit in eine neue Struktur, nämlich das sog. AAA Modell überführt (ADV, 2004). Auf die Nutzer der Geobasisdaten wirkt sich dies vor allem in Form geänderter Formate für die zu beziehenden Daten aus. Während die Daten zur Zeit noch in eigens zum Zweck der amtlichen Geobasisdatenverwaltung entwickelten Formaten bereit gestellt werden, wird die Datenabgabe gleichzeitig mit der Datenhaltung im neuen AAA Datenmodell auf das vom World Wide Web Consortium W3C spezifizierten Extensible Markup Language (XML) Format umgestellt.

5 FAZIT UND AUSBLICK

Neben den objektiv quantifizierbaren Größen, auch "harte Faktoren" genannt, wie buchhalterisch erfassbare Größen, Qualitätshandbücher, Pflichtenhefte, etc. sind für den Erfolg eines Projekts in gleicher Weise auch die sogenannten "weichen Faktoren", also nicht objektiv quantifizierbare Größen, wie beispielsweise die Unterstützung durch die Führungsebene oder die richtige Zusammensetzung und die Kommunikation innerhalb des Projektteams, sowohl fachlich als auch persönlich, entscheidend. Die Begriffe “harte Faktoren” und “weiche Faktoren” gehen zurück auf die Mc Kinsey-Berater Tom Peters und Robert H. Waterman jr., die in den siebziger Jahren des letzten Jahrhunderts das "7-S-Modell" entwickelt haben, um die Erfolgsfaktoren von Unternehmen herauszufinden (Peters, Waterman, 1995).

Im hier beschriebenen Projekt kommt den weichen Faktoren eine besondere Bedeutung zu, da die Projektbeteiligten aus unterschiedlichen organisatorisch voneinander unabhängigen Institutionen stammen, die jeweils selbstständige Entscheidungsbefugnisse haben. Formale Weisungsbefugnis ist nur vereinzelt gegeben, der wesentliche Teil der Projektarbeit und damit auch des Projekterfolgs ist eng verknüpft mit Faktoren wie Kommunikation, Kooperation, Partizipation, Engagement, Verantwortungsbereitschaft, Interesse, etc. aller Projektbeteiligten. Neben der rein fachlichen Projektarbeit ist deshalb in den einzelnen Projektschritten besonders darauf zu achten, dass die Beteiligten aus den einzelnen Verwaltungen durch entsprechende Information und Berücksichtigung von Rückmeldungen bzw. fehlenden Rückmeldungen stets aktiv am Projektfortschritt partizipieren und ihn aktiv mitgestalten können.

Nach dem Abschluss der Systemanalyse zum Jahresende 2004 ist für das Jahr 2005 die Auswahl und Einführung des GIS insbesondere bei der Piloteinheit vorgesehen. Neben der Entscheidung für eine konkrete Systemlösung ist auf der Seite der Verwaltung als zukünftigem Systemnutzer für die Bereitstellung der Fachdaten in entsprechend verarbeitbarer digitaler Form zu sorgen. In diesem Zusammenhang muss insbesondere ein Konzept entwickelt und umgesetzt werden, nach dem die bereits vorhandenen Karten und Pläne mit vertretbarem Aufwand in eine adäquate Form überführt sowie neue grafische Unterlagen möglichst effektiv integriert werden können. Ein weiterer wesentlicher zu bearbeitender Themenkomplex wird die Art des Zugriffs auf extern erhobene und gepflegte Daten, z.B. amtliche Geobasisdaten, sein.

Der Landkreistag Rheinland-Pfalz als der für die Projektinitiative verantwortliche kommunale Spitzenverband verfolgt das Ziel, die Kreise bei der Implementierung einer möglichst homogen aufgebauten Geodateninfrastruktur zu unterstützen, um die gemeinsame Nutzung von Ressourcen zu ermöglichen und weiter zu vereinfachen. Es ist deshalb wünschenswert, auch bei der Systemeinführung ein abgestimmtes Vorgehen möglichst vieler Verwaltungen zu realisieren.

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Datenmanagementsystem für die Stadtplanung

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ABSTRACT

We present the data management system DaMaViS tailor-made to support town planning. Our system is multifunctional and serves a wide range of applications, like virtual walkthroughs, GIS-Reports and decision supports. The system is based on a client-server architecture and platform independent.

1 EINFÜHRUNG

In der heutigen Zeit produziert fast jede Anwendungsdomäne sehr große, heterogene Datenmengen. Für den Bereich der Stadtplanung eröffnet sich daraus ein immer breiteres Themenfeld, in dem zukünftig rechnerunterstützte Entscheidungshilfen Anwendung finden. Als Beispiel hierfür kann ein virtueller Rundgang genannt werden, der eingesetzt werden kann, Entscheidungen in der Stadtentwicklungspolitik zu einem Ziel zu führen, da die visuelle Aufbereitung der Plandaten die Vorstellungskraft der Entscheidungsträger stärkt. Viele Auswertungen in der Stadtplanung werden noch von Hand erledigt, da für Rechneranwendungen keine geeigneten Module auf dem Markt angeboten werden. Die auf dem Markt befindlichen Module sind vielfach Insellösungen, die in getrennten Arbeitsschritten, nacheinander ausgeführt, zu einer Problemlösung führen.

Mit Hilfe von Datenmanagementsystemen wird in den einzelnen Fachdisziplinen der Komplexität der Daten begegnet. Meistens sind die existierenden Systeme jedoch auf ausgewählte Anwendungsbereiche spezialisiert und relativ statisch konzipiert. Im Anwendungsfeld Raum- und Umweltplanung existieren diverse spezialisierte Informationssysteme wie beispielsweise Landinformationssysteme, Rauminformationssysteme, Umweltinformationssysteme. Diese Systeme bieten spezifische Auswertungen einzelner Anwendungsbereiche an.

Das von uns entwickelte Datenmanagementsystem **DaMaViS** (**Da**ten**Ma**nagement**Vi**sualisierungs**S**ystem) vereinigt verschiedene Insellösungen in einem System für die Anwendung in der Stadtplanung. **DaMaViS** benutzt generische Datenstrukturen, wodurch es in der Lage ist, Daten aus den unterschiedlichsten Anwendungsdomänen zu verarbeiten. Beispielsweise kann es eingesetzt werden, um die Daten eines Geographischen Informationssystems (**GIS**) zu verwalten und zu visualisieren. Ein weiteres Anwendungsfeld ist die Erstellung eines virtuellen **Walkthrough** durch eine Stadt oder kleinere Teilräume. Das System verknüpft eine große Zahl heterogener Datenbanken miteinander und ermöglicht eine gezielte Auswertung der gesammelten Daten im Bereich der nachhaltigen **Stadtteilentwicklung** (z.B. Bahnhofsumgebung Kaiserslautern) und der **Konversion** im weiteren Sinne. Die Basis bilden verschiedenste Datenbanken mit Statistiken, Texten und Bildern sowie Graphiken. Insgesamt erfolgt eine Visualisierung der Ergebnisse mittels geeigneter Techniken aus dem Bereich der Informationsvisualisierung. Neben den vorab genannten spezifischen Anwendungsmöglichkeiten bietet das System grundlegende Möglichkeiten Texte zu bearbeiten und einzelne Textpassagen in einen Report zu integrieren.

Das Datenmanagementsystem **DaMaViS** ist ein komponentenbasiertes Client-Server System. Des Weiteren zeichnet sich das System neben seiner generischen Datenstruktur durch die Verwendbarkeit für andere Anwendungen und die Kompatibilität zu anderen Systemen bei schneller bedarfsgerechter Anpassungsfähigkeit aus. Für die Kommunikation zwischen Client und Server wird **CORBA** (Common Object Request Broker Architecture) eingesetzt. Das Datenmanagementsystem basiert auf „open source“ Bausteinen, was flexible Einsatzmöglichkeiten zulässt und einen weiteren bedarfsgerechten Ausbau in der Zukunft ermöglicht.

2 GRUNDLAGEN

Aufgrund der stark wachsenden Datenmengen bei der computergestützten Verarbeitung von Daten erfahren Datenmanagementsysteme eine immer stärkere Verbreitung im beruflichen sowie im privaten Umfeld. Es existieren diverse Systeme zur Bewältigung dieser Datenflut. Diese Systeme sind aber meistens auf einen bestimmten Anwendungsbereich spezialisiert. Im Bereich der Geoinformationssysteme findet sich keine umfassende Lösung für komplexe Fragestellungen, obwohl auch hier immer größere Datenmengen anfallen.

Der Begriff des Geoinformationssystems wird in der Literatur in vielfältiger Weise definiert. Allgemein wird hiermit die Verarbeitung und Verwaltung raumbezogener Daten (Geo-Daten) mithilfe der elektronischen Datenverarbeitung bezeichnet. Als raumbezogen werden solche Informationen bezeichnet, die sich eindeutig mithilfe von Koordinaten in einem Untersuchungsgebiet verorten lassen. Basierend auf diesen Rahmenbedingungen wurde für das Datenmanagementsystem **DaMaViS** ein Plugin entwickelt, welches es ermöglicht, GIS-Daten in Datenbanken zu verwalten sowie diese Daten zu visualisieren. Die Berücksichtigung der OpenGIS Standards bei der Organisation und Verwaltung der GIS-Daten in den Datenbanken stand dabei im Vordergrund.

Das Ziel des Projektes **DaMaViS** ist die Erstellung eines verwaltungsspezifischen Datenmanagement- und Visualisierungssystems. Ein Schwerpunkt im Datenmanagement liegt auf der Koordination der verteilt vorliegenden, heterogenen, sehr großen Datenmengen. Die Komplexität und Heterogenität der vorhandenen Datenbanken, die sowohl verteilt über mehrere Standorte, als auch sehr umfangreich sind, erfordert einen erhöhten Aufwand für die Datenkoordination und -haltung. Ein weiterer Hauptaugenmerk liegt im

Bereich Visualisierungssysteme, da hier, basierend auf dem Datenmanagementsystem, eine Auswertung und optisch ansprechende Präsentation der Daten vorgenommen wird.

Im Folgenden wird die Architektur des entwickelten Datenmanagementsystems beschrieben und anschließend die bisher implementierten Anwendungsbereiche dargestellt. Zum Abschluss werden in einem kurzen Ausblick die Potentiale des Systems aufgezeigt.

3 ARCHITEKTUR DAMAVIS

3.1 Client-Server-Architektur

Das für das Projekt **DaMaViS** entwickelte Konzept basiert auf einem Client-Server-System, wobei die Hauptaufgaben auf dem Server ausgeführt werden, so dass nur die Ergebnisse auf den Arbeitsplatzrechner transferiert werden. Abbildung 1 beschreibt die Systemstruktur sowie den Aufbau des Servers und des Clients. Das System ist flexibel gestaltet, was die einfache und effiziente Einbindung weiterer externer Programme ermöglicht (z.B. das externe Programm JUMP-Viewer).

Zur Gewährleistung der Plattformunabhängigkeit wird für die Kommunikation zwischen den einzelnen Komponenten die weit verbreitete Middleware **CORBA** (**C**ommon **O**bject **R**equest **B**roker **A**rchitecture) der **OMG** (**O**bject **M**anagement **G**roup) eingesetzt. Aus Sicherheitsgründen erfolgt der Zugriff vom Client auf den Server mittels Passwortschutz und gesicherter CORBA-Verbindung.

Aufgrund der Nutzung der **JDBC**-Technologie (**J**ava **D**ata **B**ase **C**onnectivity) unterstützt **DaMaViS** eine Vielzahl verschiedener Datenbanken und erreicht somit eine weitgehende Datenbankunabhängigkeit. Einzige Reglementierung bei der Einbindung der Datenbanken ist die Existenz eines JDBC-Treibers für die gewählte Datenbank.

An den verschiedenen Standorten existieren Datenbanken mit sehr heterogenen Daten, wie zum Beispiel numerische Daten, Vektor- und Rasterdaten. Numerische Daten sind beispielsweise Gemeinde-, Förder-, Finanzdaten und statistische Daten. Vektor- und Rasterdaten liegen in Form kartografischer Daten vor. Des Weiteren existieren Textdateien, Bilder und multimediale Elemente (Videos,...).

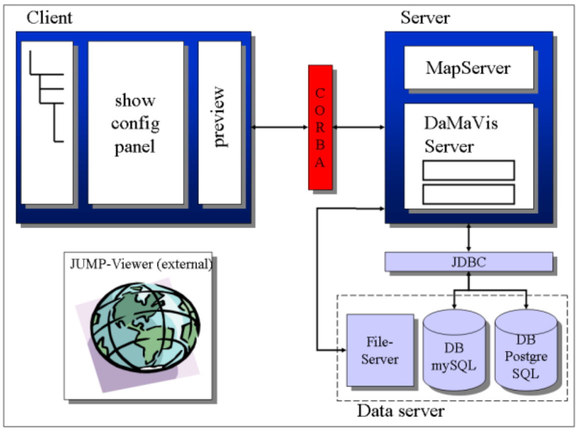

Abb.1: Systemstruktur von DaMaViS

Zum Laden und Speichern von Projekten wird die Metasprache **XML** (Extensible Markup Language) verwendet. Mit XML und einem geeigneten Style Sheet ist es möglich, Projektdaten in einem Format zu exportieren, welches unter anderem von Microsoft Office 2003-Produkten gelesen werden kann.

3.2 Client

Die Clientapplikation **CliVViS** (**Cli**ent-**V**iewer-**Vi**sualisierungstool-**S**trukturbaum) umfasst das auf dem Arbeitsrechner laufende Programm. Der Client dient zum Erzeugen neuer Projekte und zum Zugriff der auf dem Server abgelegten Projekte.

Der Client unterstützt das Erstellen von Dokumenten durch die Verwendung von Projektvorlagen. Soll ein neues Projekt gestartet werden, ist es möglich, eine Vorlage auszuwählen oder ein neues Projekt ohne Vorlage anzufertigen. Danach wird der Anwender durch die einzelnen Objekte (Tabellen, Bilder, Texte, Datenbankabfragen) geführt, um diese basierend auf den hinterlegten Daten mit Inhalt zu füllen. Der Client besteht aus einer Bedienoberfläche, mit dem die Funktionen auf dem Server koordiniert werden, einem Fenster, in dem die Basisbausteine angezeigt werden und einem Vorschaufenster (Preview) der einzelnen Objekte.

Eine große Stärke des Systems ist die Benutzerfreundlichkeit. Diese wurde mit Hilfe einer intuitiven Menüführung und der Definition verschiedener Sichtweisen verwirklicht. Diese Sichtweisen entsprechen einem pyramidenförmigen Aufbau und reduzieren die Informationsvielfalt auf die benutzerspezifischen Bedürfnisse. Der ausgebildete Spezialist erhält die Möglichkeit, auf dem Server gespeicherte Daten und Abfragemodi zu verändern und hat somit einen umfassenden Zugriff auf das Gesamtsystem. Personen, die keine vertieften Kenntnisse des Systems besitzen, haben lediglich die Möglichkeit, Standardberichte aus bereits gespeicherten Vorlagen zu generieren.

Mittels der graphischen Oberfläche des Clients wird dem Benutzer eine effiziente Interaktion mit dem System ermöglicht. Der Client gliedert sich in drei Bereiche: Den Strukturbaum, das Konfigurationspanel und den Preview-Bereich. In Abbildung 2 ist der prinzipielle Aufbau des Clients dargestellt.

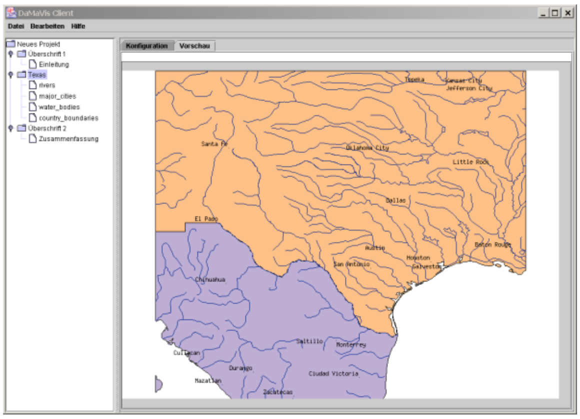

Abb.2: DaMaViS Client

Auf der linken Seite wird der strukturelle Aufbau des aktuellen Projektes in Form eines Baumes visualisiert. Jedes Objekt des Projektes wird als ein Knoten bzw. ein Blatt dargestellt. Ein Knoten untergliedert sich in weitere Unterobjekte, ein Blatt stellt die tiefste Ebene der jeweiligen Hierachie dar. Innerhalb des Strukturbaumes ist es möglich, Objekte zu löschen oder zu generieren. Beispielsweise kann ein GIS-Report erzeugt werden, in dem unterschiedliche Textbausteine mit Tabellen und einer mit dem System erzeugten Karte kombiniert werden.

Die rechte Seite des Clients gliedert sich in zwei Karteikarten (tabbed pane). Die erste Karteikarte besteht aus einem Konfigurationspanel, für das aktuell selektierte Objekt des Strukturbaumes. Jedem Objekt des Strukturbaumes ist ein solches Panel zugeordnet. Die zweite Karteikarte beinhaltet einen Preview-Bereich, in dem eine Vorschau der aktuell ausgewählten Komponente des Strukturbaumes dargestellt wird. Auch hier ist jeder Komponente des Strukturbaumes ein eigener Preview zugeordnet. Wird beispielsweise eine GIS-Komponente in dem Strukturbaum selektiert, wird in dem Preview-Bereich die entsprechend generierte Karte eingeblendet. In Abbildung 2 ist beispielsweise ein Kartenausschnitt von Texas zu sehen.

3.3 Server

Der Server ist die zentrale Komponente des **DaMaViS**-Systems. Er koordiniert die Anfragen der Clients und steuert den Zugriff auf die Datenbanken.

Die Implementierung des Servers erfolgt mittels **JAVA**, was zur Flexibilität (Einsatz unter verschiedenen Betriebssystemen) des Systems beiträgt. Für die Kommunikation zwischen dem Server und den Datenbanken werden **JDBC**-Treiber eingesetzt. Einerseits wird hierdurch die Integration unterschiedlicher Datenbanksysteme ermöglicht und andererseits wird die Flexibilität und Widerverwendbarkeit des Systems erhöht.

Aus der Vielzahl von Datenbankystemen wurde für den **DaMaViS**-Server die Datenbanksoftware PostgreSQL ausgewählt. Ausschlaggebend für die Wahl dieser Datenbank-Software ist die Erweiterbarkeit von PostgreSQL durch das Paket PostGIS welches es ermöglicht, GIS-Objekte zu verwalten. PostGIS stellt eine Erweiterung für die relationale Datenbank PostgreSQL dar. Zusätzlich zu alphanumerischen Daten und Attributen können so auch geometrische Daten in der Datenbank verwaltet werden. Die Organisation der geometrischen Daten in der Datenbank orientiert sich an den Richtlinien des **OGC** (**O**pen**G**IS **C**onsortium). Die Standards des OGC sind weltweit verbreitet und sichern somit die Interoperabilität des Systems. Des Weiteren beherrscht PostgreSQL den Umgang mit Transaktionen bei der Verwaltung der Daten. Diese Eigenschaft ist besonders für den Mehrbenutzerbetrieb der Datenbank wichtig. Ein weiterer Punkt für die Wahl von PostgreSQL ist die freie Verfügbarkeit der Software im Netz (Open-Source). Die Verwendung von Open-Source-Produkten sichert die Unabhängigkeit von kommerziellen Anbietern.

Das externe Programm **MapServer** ist in den Server integriert und bietet die Möglichkeit, basierend auf GIS-Daten Karten zu generieren, d.h. aus den Metadaten der Layer einer GIS Komponente werden Bilder erzeugt. Die Konfiguration der zu erzeugenden Bilder erfolgt über so genannte Mapfiles. Dieser Mechanismus stellt die Basiskonfiguration des MapServers dar. Das Mapfile enthält die Informationen über das Aussehen des Bildes sowie die Orte an denen die benötigten Daten zu finden sind. Es beinhaltet keine GIS Daten. Das Endprodukt ist ein normales Bild, z.B. im jpeg-Format und kann an den Client zur weiteren Bearbeitung im aktuellen Projekt übertragen werden.

Im Folgenden wird die Datenstruktur des Servers näher betrachtet.

Die Schnittstelle „DaMaVisBaseObject“ wurde entwickelt, um die Konformität der verschiedenen Objekte im Strukturbaum des CliVViS zu gewährleisten. Diese Schnittstelle gibt neben Operationen zur Wartung des Strukturbaumes auch XML-Operationen zur Speicherung der Daten vor. Des Weiteren wird eine Methode definiert, die zu jedem Objekt das zugehörige Konfigurationspanel liefert. Alle Objekte, die in den Strukturbaum aufgenommen werden sollen, müssen diese Schnittstelle implementieren. Ein Ausschnitt des Vererbungsdiagramms ist in Abbildung 3 dargestellt.

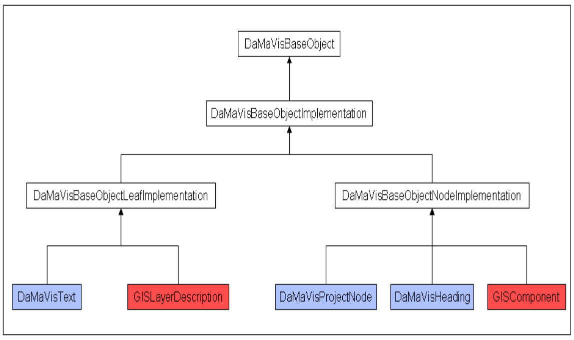

Abb.3: Objekthierarchie

Durch die enorme Variationsbreite der Objekte, die in die DaMaViS-Objekthierachie integriert werden können, wird die Flexibilität des Systems weiter gesteigert.

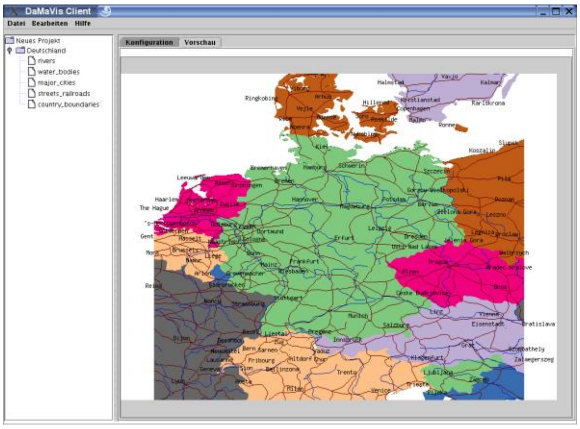

Abb.4: GIS Komponente mit 5 Layerreferenzen

Die in Abbildung 3 rot gekennzeichnete GISComponent wurde zur Speicherung der Referenzen der verschiedenen Layer entwickelt. Da sie von der DaMaVisBaseObjectNodeImplementation abgeleitet wurde, implementiert sie die Schnittstelle DaMaVisBaseObject. Dies bildet die Grundlage für das Einfügen von Instanzen der GIS-Komponente in den Strukturbaum des Clients. Die einzelnen Layer werden als Söhne an den Knoten GIS-Komponente angehängt. Abbildung 4 zeigt eine solche GIS-Komponente. Sie enthält in diesem Fall 5 Layerreferenzen, die im linken Bereich des Fensters im Strukturbaum angezeigt werden.

4 POTENTIAL FÜR DIE STADTPLANUNG

In der Stadtplanung öffnet sich ein immer breiteres Themenfeld in dem rechnerunterstützte Entscheidungshilfen zukünftig eingesetzt werden können. In der heutigen Zeit werden noch viele Auswertungen in diesem Anwendungsbereich von Hand erledigt, da für Rechneranwendungen keine geeigneten Module auf dem Markt angeboten werden. Es existieren vielfach Insellösungen, die in getrennten Arbeitsschritten, nacheinander ausgeführt, zu einer Problemlösung führen. Die Flexibilität des Datenmanagementsystems **DaMaViS** erlaubt es bei Bedarf neue Funktionalitäten in das System einzubinden und somit eine einzige Basis für eine Vielzahl von Entscheidungen zu erhalten. Im Folgenden werden anhand von drei Beispielen die bereits implementierten Anwendungsfelder näher beschrieben.

4.1 2D: GIS Bericht

Basierend auf den in den Datenbanken gespeicherten Metadaten können verschiedenste Berichte erstellt werden. Im GIS Bericht werden, wie in einem herkömmlichen Geoinformationssystem, raumbezogene Daten mit Sachinformationen gekoppelt und diese Daten in Form einer Karte in 2D ausgegeben.

Zum Erstellen eines GIS Bericht muss der **DaMaViS** Client gestartet werden. Anschließend wird eine neue GIS Komponente angelegt. Innerhalb dieser Komponente werden alle benötigten Daten referenziert und innerhalb der Karte dargestellt. In dieser Karte können flexibel und bedarfsgerecht die Information geladen und bearbeitet werden, die im Einzelfall benötigt werden. Der GIS Bericht enthält dann Informationen, wie sie auch ein herkömmliches GIS-System erstellen kann.

Nach Erstellen des GIS Berichtes werden die zusammengestellten Daten an den Server übergeben. Auf dem Server können verschiedene Ausgabeformate für diesen GIS Bericht erstellt werden. Mittels des MapServers wird beispielsweise ein Rasterbild erstellt, welches sich in einem weiteren Schritt problemlos in einen zu erstellenden Bericht oder ein neu zu erstellendes Dokument einfügen lässt. Abbildung 5 zeigt ein Beispiel eines solchen GIS Berichts für den Bereich Kaiserslautern und Umgebung. Im Preview-Fenster wird als Basis eine Karte des Großraumes angezeigt, in die Zusatzinformationen wie Städtenamen oder Flüsse eingezeichnet werden. Ein weiterer Layer gibt eine farbkodierte Übersicht über die verschiedenen Länder. Mit diesem Bild wird aufgezeigt, wie die geometrischen Daten wie Position und Lage mit den Metadaten wie Text und Farbe verknüpft werden.

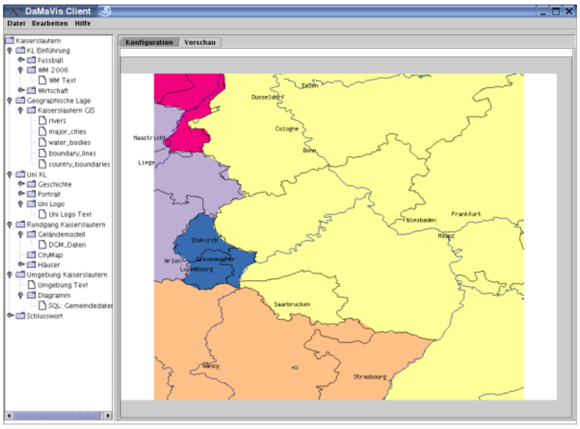

Abb.5: GIS Report über Kaiserslautern und Umgebung

4.2 3D: Virtueller Rundgang

Ein weiteres Anwendungsfeld im Bereich der Stadtplanung ist die Erstellung virtueller Rundgänge. Basierend auf einem digitalen Geländemodell kann ein virtueller Rundgang durch ein für den Anwender interessantes Stadtgebiet erstellt werden. Dadurch ist es möglich, einen Eindruck des Stadtbildes zu vermitteln. Darüber hinaus können Veränderungen in der Bausubstanz visuell dargestellt werden und so zur Entscheidungsfindung ob ein Bauvorhaben verwirklicht wird, beitragen.

Im Folgenden wird die Erstellung eines virtuellen Stadtrundgangs unter Verwendung des Datenmanagementsystems beschrieben. Der **DaMaVis** Client wird gestartet und eine neue Komponente „walkthrough" hinzugefügt. Automatisch werden die erforderlichen Knoten für den virtuellen Rundgang im Strukturbaum angelegt.

Hierbei enthält der erste Knoten das digitale Geländemodell, wobei das relevante digitale Geländemodell durch den Nutzer ausgewählt werden muss. Alle für die Modellierung des Geländes benötigten Höhendaten im digitalen Geländemodell sind in Gauss-Krüger-Koordinaten angegeben. Innerhalb dieses Knotens erfolgt die Modellierung des Geländes und der Gebäudehöhen.

Der zweite Knoten enthält einen Stadtplan mit den genauen Grundrissinformationen aller Gebäude. Die Datenquelle für den Stadtplan können XML oder ESRI-Daten sein. Innerhalb des Stadtplans erfolgt die Selektion der Gebäude, die Teil des virtuellen Rundgangs werden sollen. Abbildung 6 zeigt einen Stadtplan von Kaiserslautern im Preview-Bereich.

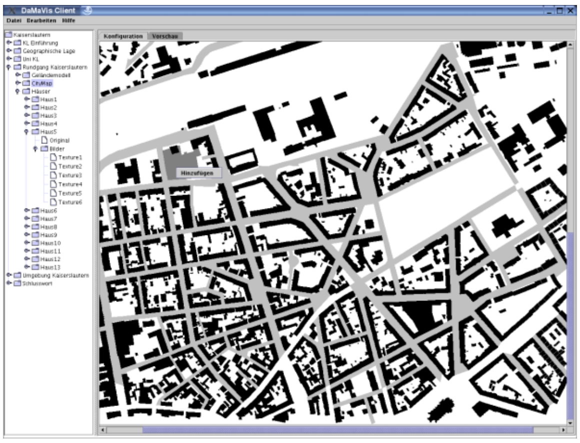

Abb.6: Stadtplan von Kaiserslautern

Der dritte Knoten enthält die weitergehenden Informationen der selektierten Gebäude. In diesem Knoten sind die Unterknoten angelegt, die die Informationen der einzelnen Gebäude repräsentieren. Hierbei handelt es sich z.B. um die Lage, Adresse, die Höhe des Gebäudes und ähnliches.

Zum Erreichen einer photorealistischen Darstellung der Gebäude werden zusätzlich Texturen für die Gebäude benötigt. Diese werden aus hochauflösenden Bildern extrahiert. Zum einpassen der Texturen an der richtigen Stelle auf dem Gebäude werden die Geometrieinformationen im Grundriss des Bauwerks um eine Nummerierung der Kanten ergänzt, was in Abbildung 7 exemplarisch für ein Gebäude gezeigt wird. Jeder Kantennummer wird eine Textur zugeordnet und diese damit verknüpft.

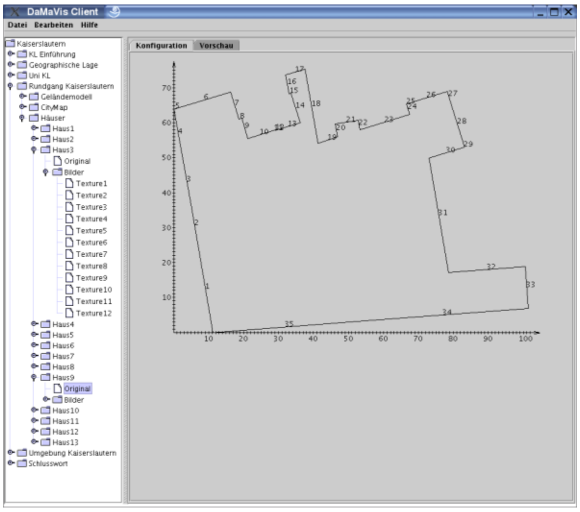

Abb.7: Gebäudegrundriss mit nummerierten Kanten

Für das Stadtbild interessante Gebäude wie zum Beispiel der Bahnhof oder die Post, können als „point of interest“ gekennzeichnet werden. Durch diese Kennzeichnung ergibt sich beim später generierten Rundgang ein Pfeil der auf dieses Gebäude hinweist, eine Orientierung ermöglicht und alle Zusatzinformationen zu diesem point of interest liefert. Abbildung 8 zeigt eine solche Situation am Beispiel des Bahnhofsumfelds in Kaiserslautern, wobei die im Vordergrund befindlichen Gebäude zur besseren Sicht auf das Gerichtsgebäude bereits reduziert wurden. In Abhängigkeit von der vorliegenden Anwendung kann der Level of Detail erhöht oder reduziert werden.

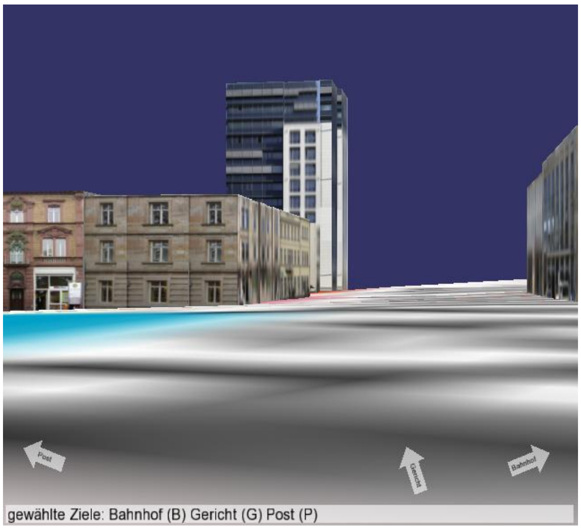

Abb.8: Walkthrough mit POI

Im Anschluss an die Selektion der relevanten Gebäude wird das 3D-Modell generiert. Alle Daten für das 3D-Modell werden als Open Scene Graph files abgelegt.

Zur Visualisierung des virtuellen Rundgangs enthält **DaMaViS** einen externen Viewer, der auf dem OSG (**O**pen**S**cene**G**raph) graphics toolkit basiert. Hierfür wurde der Original OSG-Viewer zusätzlich mit der Fähigkeit ausgestattet, alle „points of interest“ anzuzeigen. Hierbei weist ein Pfeil am unteren Bildrand auf einen möglichen interessanten Punkt in einer bestimmten Richtung hin, was eine einfache Navigation innerhalb des Rundgangs hin zu möglichen Zielen zulässt.

4.3 Entscheidungshilfe für die Umnutzung von Konversionsflächen

Ein weiteres Anwendungsfeld in der Stadtplanung ist die Entscheidungshilfe für die Umnutzung von Konversionsflächen. Diese Entscheidungshilfe verläuft rechnergestützt mit Hilfe des Programms **DaMaViS** und bereitet die Ergebnisse visuell, für die Entscheidungsträger verständlich auf.

Die Konversion freiwerdender militärischer Flächen wird in den nächsten Jahren in Europa weiterhin eine wichtige Rolle im Rahmen der Stadt-, Raum- und Umweltplanung einnehmen. Diese Situation ist bedingt durch zahlreiche Umstrukturierungen der in Europa stationierten Streitkräfte zur Anpassung an die veränderten Sicherheitsbedürfnisse europa- und weltweit. In Deutschland stellt die Konversion seit Beginn des Truppenabzugs Anfang der Neunziger Jahre ein großes Problem dar. Der Abzug der französischen und sowjetischen Truppen sowie der Teilabzug der amerikanischen Streitkräfte bedingte ein Freiwerden zum Teil großer Flächen sowohl in guter Innenstadtlage als auch in Randlagen. Im Bereich der „zivilen Konversion“ werden durch die Aufgabe von Bahnflächen und Poststandorten zurzeit ebenfalls Flächen unterschiedlichster Kategorien frei, die einer sinnvollen Umnutzung zugeführt werden müssen.

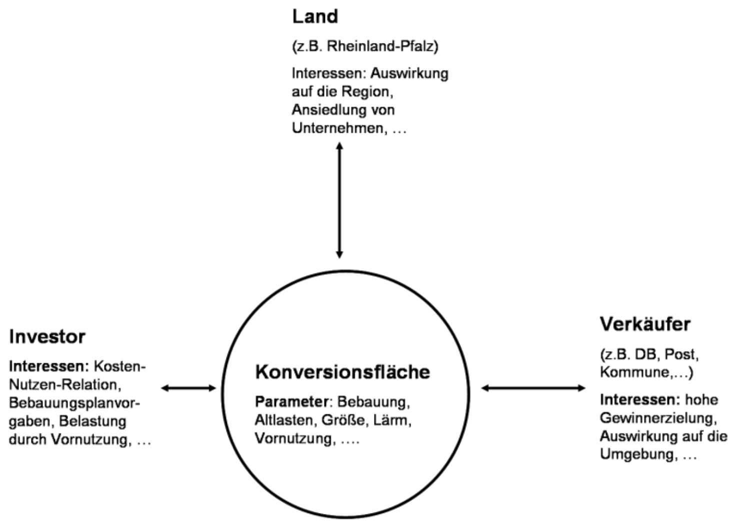

Abbildung 9: Zusammenhang der einzelnen Akteure

In diesen beiden Bereichen wird es vermehrt notwendig sein, freiwerdende Liegenschaften zu überplanen und in die städtebaulichen und raumplanerischen Rahmenbedingungen einzupassen.

Den verschiedenen Interessengruppen bieten sich unterschiedliche Sichtweisen auf die einzelnen Konversionsflächen. Abbildung 9 zeigt die hauptsächlich an einer Umnutzung beteiligten Akteure mit einer Auswahl der Parameter, die ihre Entscheidungen bezüglich einer solchen Fläche steuern. Anhand dieser Parameter muss eine Auswertung vorgenommen werden. Als Grundlage für die Entscheidungsfindung wird eine Bestandsaufnahme der relevanten Flächen durchgeführt. Diese Bestandsaufnahme enthält alle Parameter, die eine Fläche charakterisieren, wie zum Beispiel Größe, Lage,... Die Bewertung der Parameter erfolgt nicht auf monetärer Basis, sondern anhand der verschiedenen Sichtweisen der Akteure. Hierbei wird der Akteursbezug mittels der drei Sichtweisen des Verkäufers, des Landes und des Investors hergestellt. Die Kombination der Parameter erfolgt für die einzelnen Sichtweisen getrennt und führt so zu einem Ergebnis für den jeweiligen Akteur, welche Fläche für ihn die optimale Wahl bedeutet. In einem weiteren Schritt werden die verschiedenen Sichtweisen mittels einer geeigneten Visualisierungstechnik aus dem Bereich der Informationsvisualisierung für die Entscheidungsträger leicht verständlich dargestellt und führen so zu einem Gesamtergebnis, das die für alle Beteiligten optimierte Fläche herausstellt.

5 ZUKÜNFTIGE ARBEITEN

Aufgrund der Flexibilität und Erweiterungsmöglichkeit des DaMaViS-Systems sind diverse Ausbaustufen denkbar, die im Folgenden beschrieben werden.

Multimediale Daten, wie Videos und Sound können mit der GIS-Komponente oder dem Walkthrough kombiniert werden. Es könnte ein multimediales Informationssystem entstehen, das auf Basis der Geometriedaten alle Zusatzinformationen für die Sinne Ohr und Auge begreifbar macht.

Eine weitere Ausbaumöglichkeit besteht im Erstellen von Texturen für Gebäude, beispielsweise für den Walkthrough. Hierbei soll es möglich werden, die Texturen von perspektivisch aufgenommenen Gebäudeaufnahmen interaktiv anzupassen und somit die Bearbeitung von Hand zu vermeiden. Die Erfassung der Texturen, die zurzeit mit Digitalkameras durchgeführt wird soll den neuesten Technologien angepasst werden und beispielsweise mittels 3D Laser Scanner erfolgen.

Darüber hinaus ist eine automatische Textdokumentenerkennung geplant, die neue Dokumente mit Hilfe von Schlüsselwörtern klassifizieren soll. Anhand dieser Klassifizierungen werden die erforderlichen Fakten aus dem Dokument extrahiert und in den Datenbanken gespeichert.

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Publizieren von Kartenserien im Web-gestützten Fachinformationssystem des Magistrats Wien

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1 FIS – ENTWICKLUNG UND HINTERGRUND

Bereits seit Anfang 2000 arbeiten der Fachbereich Stadt- und Regionalforschung (TU Wien) und die Umweltschutzabteilung im Magistrat der Stadt Wien (MA22) am Aufbau und der Weiterentwicklung des sog. Fachinformationssystem (FIS), einem integrierten, web-basierten Informationssystem, das nunmehr gemeinsam mit der MA18 – Stadtentwicklung und Stadtplanung (Elektronischer Planungsatlas / EPA) betrieben wird und den Mitarbeiterinnen und Mitarbeitern der Fachabteilungen den reibungslosen Zugang zu raumbezogenen Informationen im Intranet ermöglichen soll. (vgl. RIEDL, KALASEK 2001; RIEDL et al., 2002).

Für die Benutzer präsentiert sich das System in Form einer Web-Anwendung deren zentrales Steuerfenster (neben anderen Informationen) die hierarchisch organisierte Struktur verfügbarer Informationen über die unter Windows allgegenwärtige Baum-Metapher visualisiert. Dieser sog. „FIS-Inhaltsbaum" leitet den Benutzer – unterstützt durch die ebenfalls bewährten Funktionalität des Ein- und Ausblendens von Teilen der Inhaltshierarchie – zu den im FIS enthaltenen Dokumenten: in erster Linie dynamisch generierte interaktive Karten aber auch anderen Web-Dokumenten (wie PDF, Grafiken, Word- und Excel-Dokumente). Durch die vorgegebene, tiefengestaffelte Inhaltsaufbereitung bietet diese Form der Benutzerführung hohe Orientierungsqualität. Neben der Navigation dient der Baum auch als Steuer- und Informationskonsole: Die Dokumente (also die eigentlichen Träger der Information) werden im Baum als Link implementiert. Ein Mausklick auf den Eintrag öffnet ein Browserfenster mit dem gewählten Inhalt. Im Fall der FIS-Karten erfolgen Navigation, Abfrage von Tabelleninformation und Veränderung von Darstellungsoptionen in diesem sog. Karten-Fenster.

Neben den Modulen für die Informationssuche, -abfrage und -darstellung (Benutzerebene), besteht das FIS aus Werkzeugen für den Auf- und Ausbau des Informationsraums (Inhaltsebene) sowie für die Systemsverwaltung (Design- und Administrationsebene).

Durch die Nutzung von ArcView als Entwurfswerkzeug für kartographische FIS-Inhalte ist gewährleistet, dass Kartenautorinnen und Kartenautoren beim Entwurf auf ihr bereits vorhandenes Know-How zurückgreifen können. Auch die Veröffentlichung von Inhalten im FIS folgt dem Leitmotiv, möglichst einfache, bewährte und vor allem schulungsextensive Verfahren anzuwenden. Berechtigte Autorinnen und Autoren legen dazu lediglich Dateien an den entsprechenden Stellen in der Ordnerstruktur des FIS-Servers ab. Administrationsaufgaben werden in einer eigenständigen, ausschließlich den Administratoren zugänglichen Web-Applikation durchgeführt.

In den vergangenen beiden Jahren wurde das System inhaltlich kontinuierlich erweitert. Parallel dazu erfolgte auch eine Ausweitung des Benutzerkreises – ein Umstand, dem durch die Implementierung eines Rollenkonzeptes (i.e. in etwa Benutzergruppen) mit entsprechenden Zugangsbeschränkungen und Sicherheitsmechanismen Rechnung getragen wurde. ArcView hat sich als Plattform für die kartographischen Entwurfswerkzeuge bewährt. Im letzten Ausbauschritt wurde deren Funktionalität auf Wunsch der Anwenderinnen und Anwender ergänzt, z.B. um Säulen- und Balkendiagramme innerhalb von Attributtabellen. Die Rückmeldungen der Kartenautoren zeigten jedoch auch die eine oder andere konzeptive Schwäche auf.

Wie bei den meisten vergleichbaren Systemen, die im Grunde auf statischen Kartenbeschreibungen (i.d.R. in XML-Syntax, z.B. ArcIMS) beruhen, ist die Erstellung bzw. Veränderung von Karten trotz der eingesetzten Werkzeuge ein arbeitsintensiver Prozess. Insbesondere, wenn es sich um Kleinserien mit starken Ähnlichkeiten, beispielsweise gleichen Hintergrundlayern, Legendentypen oder Autoreninformationen, handelt, sind beim Entwurf wiederholt Arbeitsschritte notwendig, die zum einen unproduktiv Bearbeitungszeit kosten und zum anderen (nicht zuletzt eben dadurch) fehleranfällig sind. Ebenfalls unverhältnismäßig aufwändig sind nachträgliche Veränderungen an derartigen Karten. In jeder einzelnen (!) Kartenbeschreibungsdatei müssen alle von der Veränderung betroffenen Elemente und Attribute aufgefunden und entsprechend modifiziert werden. Die Erfahrung zeigt, dass gerade solche, besondere Konzentration und Akribie erfordernden Änderungen häufiger unterbleiben !

Vor diesem Hintergrund wurde von Seiten der FIS-Betreiber der Wunsch nach Werkzeugen artikuliert, mit deren Hilfe Karten gleichsam in „Serie" produziert und modifiziert werden können – sog. „**FIS-Kartenserien**".

2 FIS-KARTENSERIEN

Bereits in der aktuellen Version des Fachinformationssystems ist es prinzipiell möglich mehrerer Karten mit ähnlich strukturierten und aufzubereitenden Inhalten zu publizieren.

Als Beispiele mögen folgende Karten dienen:

Verbreitungsgebiete verschiedener Pflanzen mit jeweils einer Karte je Pflanzenart,

Schadstoffemissionen nach Verursachergruppen mit einer Karte je Schadstoffart und Verursachergruppe,

Einkäufe und Besorgungen nach dem verwendeten Verkehrsmittel (absolut und relativ).

Diese Karten unterscheiden sich bezüglich wesentlicher Darstellungselemente meist nicht bzw. nur geringfügig. Der Großteil der dargestellten oder darstellbaren Kartenschichten ist ebenso ident, wie etwa die Legendenklassifizierung und -symbolisierung. Häufig variiert also lediglich der Inhalt des eigentlichen Kartenthemas. Meist erfolgt sogar dessen Visualisierung anhand standardisierbarer Vorgaben, etwa bezüglich der Klassenanzahl, der Klassengrenzen oder auch der Farbpalette. Für jede derartige Karte ist (ohne die hier behandelten Werkzeuge für Kartenserien) im FIS-MapDesigner eine eigene Kartenspezifikationsdatei zu erzeugen. Dabei können selbstverständlich sämtliche Möglichkeiten die ArcView zum Vervielfältigen von Karten (Views) und Themen, zur Mehrfachverwendung von Legenden und dgl. aber auch zum Automatisieren von Arbeitsschritten bietet, genutzt werden. Letztlich stünde für größere Auflagen ähnlicher Karten sogar die Möglichkeit offen, mit Avenue (ArcView's Programmiersprache bis Versionen 3.x) entsprechend Applikationen maßgeschneidert zu programmieren.

Sowohl der Ansatz der manuellen Vervielfältigung und Adaptierung von ArcView-Views und -Themen als auch jener der Programmierung in Avenue widersprechen dem zu Beginn des Projektes formulierten Anspruch: Kartenautoren sollen mit den ihnen im Alltag zur Verfügung stehenden Werkzeugen UND mit ihrem vorhandenen GIS-Know-how Karten im Fachinformationssystem veröffentlichen können. Die genannten Rahmenbedingungen und Argumente sprachen also für ein Konzept, das die Herstellung von „Kartenserien" mit ebenso einfachen Mitteln erlaubt, wie sie bislang für die übrigen Aufgaben zur Verfügung standen.

2.1 Definition und Konzept

Kartenserien werden hier als das dynamische Generieren von mehreren Einzelkarten ausgehend von einer definierten Vorlage in systematischer Kombination mit Kartenschichten variablen Inhalts verstanden.

Diese inhaltliche Variabilität stellt sich im Detail wie folgt dar:

verschiedene inhaltliche Kategorien,

verschiedene inhaltliche Auflösungen (Subkategorien),

verschiedene räumliche Auflösungen,

und ggf. Kombinationen davon.

Das grundsätzliche Schema der Funktionalität von Kartenserien ist Abb. 1 zu entnehmen. Der abgebildete Knoten „Kombination" besteht im Wesentlichen aus einer Seriendefinitionsdatei, welche Regeln enthält, wie variable und statische Inhalte zusammen geführt werden.

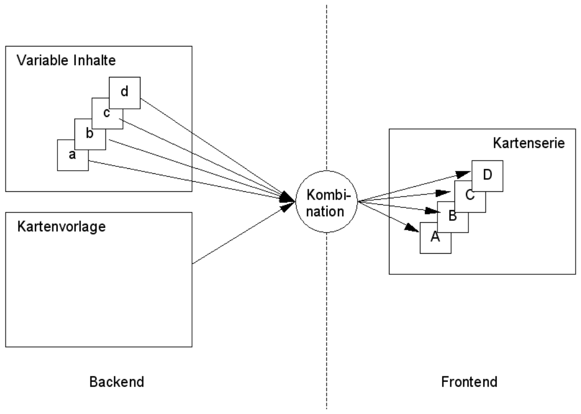


Abb. 1: Schematische Darstellung einer Kartenserie mit einem inhaltlichen Gliederungskriterium (a,...,d)

2.2 Ziele und Umsetzung

Im aktuellen Ausbauschritt des FIS wurden die notwendigen Werkzeuge für das dynamische Generieren von Kartenserien sowie alle Module zu deren Administration geschaffen. Dieses Set gibt den Autoren nicht nur Möglichkeit, die erforderlichen Kartenvorlagen, wie bisher, im entsprechend erweiterten ArcView MapDesigner zu generieren, sondern auch die notwendigen Verknüpfungsvorschriften über eine selbständige Browser-Anwendung (den „Serien Editor") bei der Erstellung der Serie zu setzen und in der Folge zu verwalten.

Kartenserien in der nun im FIS implementierten Form bestehen aus folgenden Elementen/Objekten:

HTML-Dokumenten und andere WWW-taugliche Dokumenttypen, wie Pdf, GIF, etc.

Karten – die eigentlichen Produkte der „Serienproduktion" kartographischer Information

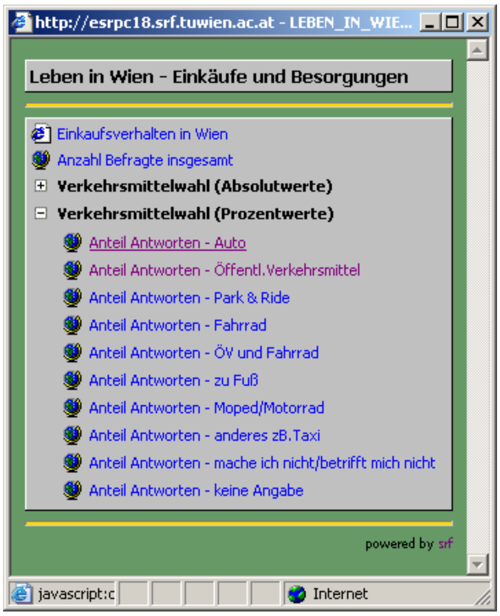
Karten(unter)serien – Subserien, die wiederum HTML-Dokumente, Karten und/oder Kartenserien enthalten können

Mit Hilfe der Verschachtelung von Kartenserien geht das hier vorgestellte Konzept über die ursprünglich fokussierte „Massenproduktion" des Informationsträgers Karte hinaus. Die Position der einzelnen Karte in der Hierarchie aus KartenSubSerien vermittelt eine zusätzliche Informationsdimension – nämlich jene der Gliederung und Zugehörigkeit.

Auf Grund technischer und organisatorischer Rahmenbedingungen wurden bisher im FIS tabellarische Informationen jeweils ausschließlich als Attributtabellen verarbeitet. Sämtliche innerhalb einer Karte *(sowohl für die Symbolisierung als auch die Tabellendarstellung)* vorgesehenen Informationen müssen dabei Teil der Attributtabelle des Geodatenbestands selbst sein. Das führt bei den im konkreten Projekt absehbar komplexen Sachverhalten zum einen zu sehr umfangreichen Tabellen und zum anderen irgendwann zwangsweise zur Mehrfachhaltung von Geodaten und damit letztlich zur Gefahr von Dateninkonsistenz. Die Implementierung von Tabellenverknüpfungen über Schlüsselfelder (vergleichbar mit table-joins bei relationalen Datenbanken) erwies sich daher als notwendige Voraussetzung für eine sinnvolle Umsetzung des entworfenen Konzepts. Auf die bei der Realisierung der sog. „table-relates" aufgetretenen Probleme mit Datenaustauschformaten, länderspezifischen Einstellungen und partiell auftretenden Performanceproblemen im Zusammenspiel von MapObjects, Internet Information Server und ODBC-Datenquellen sei hier nur am Rande hingewiesen.

Die eigentlichen Geodaten können durch die Möglichkeit der Verknüpfung mit eigenständigen Datentabellen „schlank" gehalten werden. Werden für eine Karte Sachdaten aus Datentabellen benötigt, erfolgt die dynamische Anbindung entsprechend der in der Kartenseriendefinition festgelegten Verknüpfungsvorschriften.

2.3 Hierarchische Serien



Der FIS Benutzer findet im FIS-Inhaltsbaum entsprechend gekennzeichnete Links für Kartenserien, die beim Klick auf den Link ein eigenes Serienfenster je Serie öffnen (siehe nebenstehende Abb. 3).

In diesem Fenster wird der Inhalt der Serie, ähnlich wie im FIS-Inhaltsbaum, in Form eines hierarchisch strukturierten Inhaltsverzeichnisses dargestellt. Jede auf die Serie bezogene Benutzerinteraktion erfolgt über dieses Browserfenster. Voraussetzung dafür ist eine Datei im FIS-Inhaltsbaum, die im FIS-Startfenster (wie die übrigen Dateien) als spezieller Link dargestellt wird und in der, mittels entsprechender XML-Einträge, auf die eigentliche Position der Kartenserie am FIS-Server verwiesen wird. Am Ziel dieses Verweises befindet sich ein System von Ordnern und Dateien, die im Einzelnen zu beschreiben, den Rahmen sprengen würde. Den Kern bildet eine (oder auch mehrere) Seriendefinitionsdatei(-en). Sie enthalten in XML-Syntax die Beschreibung der Serie, bestehend aus

Tabellen + Tabellenfeldern,

Formatierungsvorschriften – Renderer, Legenden,

Kartenannotationen wie Autor, Copyright, etc.

Abb. 3: FIS-Kartenserien – Frontend

Wie bereits erwähnt, können Kartenserien auch zu hierarchischen Strukturen zusammengefügt werden. Ähnlich wie ein Ordner das Gefäß für weitere Ordner und/oder Dateien ist, so enthält die Kartenserie HTML-Dokumente und Karten sowie weitere Kartenserien. In der Abbildung weiter oben enthält die Kartenserie „Leben in Wien – Einkäufe und Besorgungen“ beispielsweise auf der ersten Ebene ein HTML-Dokument „Einkaufsverhalten in Wien“, eine Karte die die Anzahl der Befragten insgesamt wiedergibt und zwei weitere Kartenserien, nämlich „Verkehrsmittelswahl (Absolutwerte)“ – „zugeklappt“ dargestellt – sowie „Verkehrsmittelwahl (Prozentwerte)“ – mit der Auflistung aller darin enthaltenen Karten dargestellt.

3 BEISPIEL

Ein wesentlicher Bestandteil der FIS-Administrationswerkzeuge ist der Editor für Kartenserien. Mit Hilfe dieser Web-basierten Applikation bauen Kartenautoren neue Kartenserien auf bzw. verändern bereits bestehende Serien.

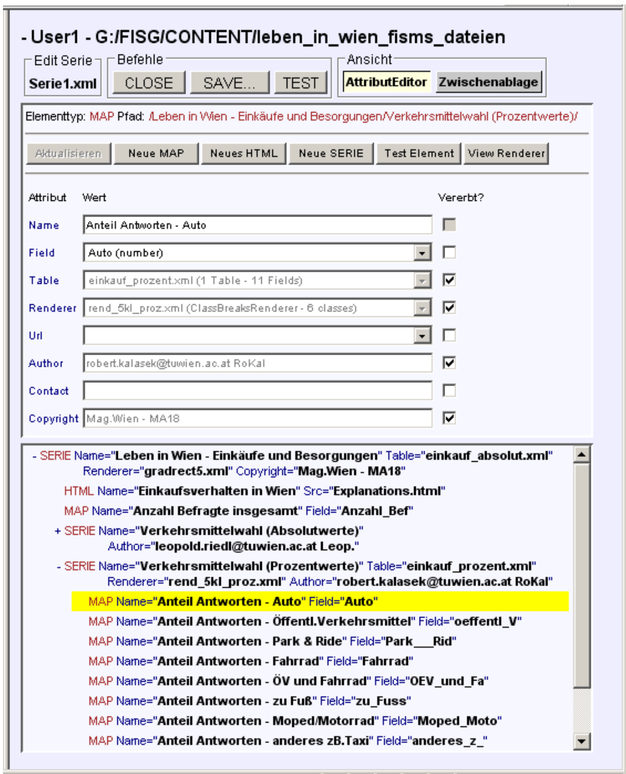


Abb. 4: FIS-Serieneditor - Backend

Abb. 4 zeigt den Editor für das o.g. Beispiel „Leben in Wien – Einkäufe und Besorgungen“

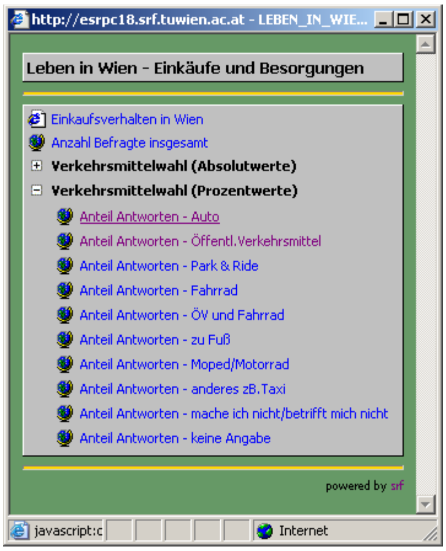
Exemplarisch seien hier folgende Merkmale hervorgehoben: Für die einzige Karte auf Ebene 1 „Anzahl Befragte insgesamt“ werden folgende Eigenschaften auf Ebene der Serie „Leben in Wien – Einkäufe und Besorgungen“ gesetzt:

- die Datentabelle: `Table="einkauf_absolut.xml"`,
- die Legendensymbolisierung: `Renderer="gradrect5.xml"`,
- die Copyright-Information: `Copyright="Mag.Wien – MA18"`

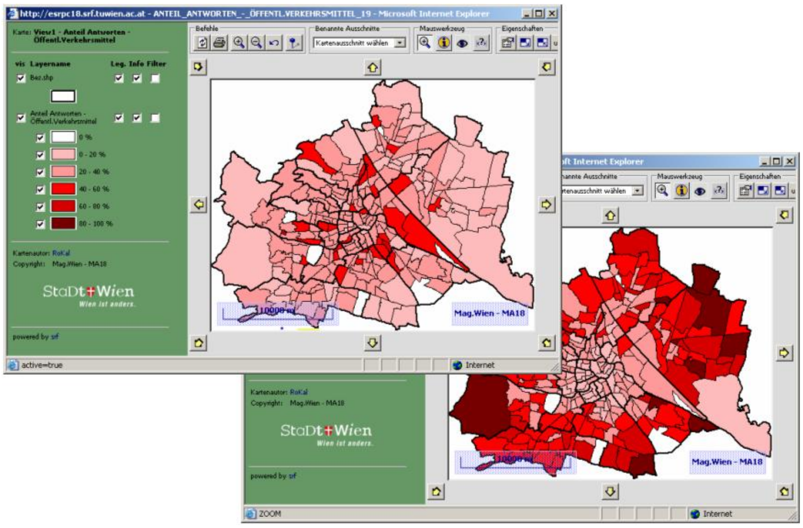
Alle Karten der Unterserie „Verkehrsmittelwahl (Absolutwerte)“ auf Ebene 2 erben genau diese Eigenschaften vom übergeordneten Serien-Element. Zusätzlich ist auf dieser untergeordneten Ebene ein Autor angegeben (`Autor="leopold.riedl@tuwien.ac.at Leop."`).

Im Unterschied dazu ist für die Karten der Ebene 2 / „Verkehrsmittelwahl (Prozentwerte)“ im entsprechenden Serien-Element ein eigenes Table-Attribut gesetzt, d.h. die Attributdaten werden aus der Tabelle „einkauf_prozent.xml“ aufgebaut. Auch die Legendensymbolisierung (Renderer) wird nicht vom übergeordneten Serien-Element übernommen, sondern über den Eintrag `Renderer="rend_5kl_proz.xml"` explizit für diese Ebene gesetzt.

Für die einzelnen Karten ist also in diesem Beispiel die explizite Angabe eines Tables auf Grund der beschriebenen Vererbung nicht mehr notwendig. Der Inhalt der Karte bezieht sich auf ein Feld der Datentabelle und wird mit dem Attribut `Field` festgelegt.



(a)


(b)

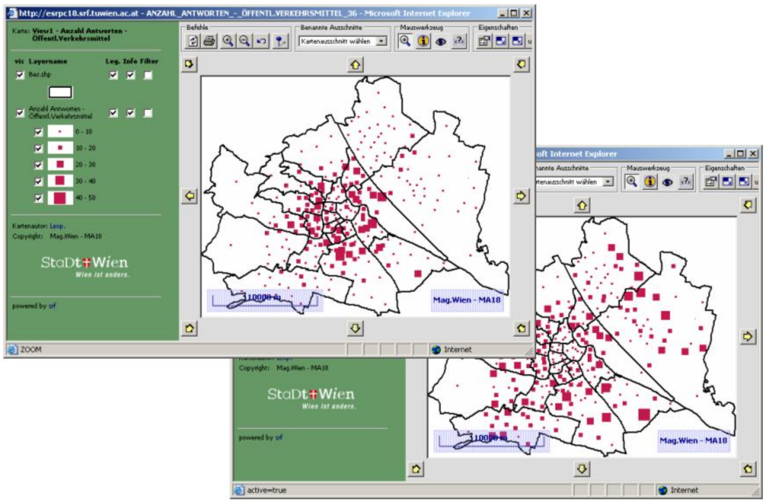

(c)

Abb. 4 (a): FIS-Kartenserien – Fronten; Datenquelle: Magistrat der Stadt Wien, MA 18 / Rohdaten der Befragung „Leben in Wien"

Abb. 4 (b): Verkehrsmittelwahl – Anteil Antworten ÖV (im Vordergrund) / Auto (im Hintergrund)

Abb. 4 (c):Verkehrsmittelwahl – Anzahl Antworten ÖV (im Vordergrund) / Auto (im Hintergrund)

Datenquelle Abb. 4 (b) und 4 (c): Magistrat der Stadt Wien, MA 18 / Rohdaten der Befragung „Leben in Wien" (2003) (dankenswerter weise zu Testzwecken überlassen)

Für die Benutzer sind Kartenserien über entsprechende Einträge im FIS-Inhaltsbaum zugänglich. Die Navigation innerhalb der Kartenserie erfolgt analog zum Inhaltsbaum selbst. Unterserien – wie im Beispiel oben (Abb. 4 a) – werden mit dem +/- Symbol ein und ausgeblendet:

Verkehrsmittelwahl (Absolutwerte): Die Karten der Subserie sind ausgeblendet,

Verkehrsmittelwahl (Prozentwerte): Die Kartentitel sind sichtbar; mittels Mausklick auf einen Eintrag wird die entsprechende Karte im eigenständigen FIS-Kartenfenster geöffnet, das sich nicht von anderen Kartenfenstern im FIS unterscheidet.

In allen vier dargestellten Karten dienen die Bezirksgrenzen (Gemeindebezirke Wien) als Orientierungshilfe und sind Teil einer einzelnen für die gesamte Serie definierten Kartenvorlage. Für ein- und dieselbe Serie können mehrere derartige Kartenvorlagen innerhalb des FIS bestehen.

Die Veränderung einer solchen Vorlage zieht automatisch die Änderung aller darauf beruhenden Karten der Serie nach sich. Auf diesem Weg könnten z.B. die abgebildeten Bezirksgrenzen in einem einzigen Arbeitsschritt für alle (!) Karten der Serie „Leben in Wien – Einkäufe und Besorgungen" durch ein Satellitenbild ersetzt bzw. ergänzt werden.

4 LITERATUR

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Multimediale Beschreibung geo-referenzierter touristischer Objects of Interest

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ABSTRACT

Das typische touristische Informationsangebot, das ein Tourist auf einer Reise in Anspruch nimmt, ist in verschiedensten Datenformaten strukturiert und stammt im Allgemeinen aus unterschiedlichen Quellen. Die vorhandenen Informationen werden je nach Anbieter in proprietären Formaten gespeichert und verwaltet. Dadurch ist der Austausch und die Wiederverwendung bereits erhobener Daten mit einem unerwünschten Transformationsaufwand verbunden.

Bisher existieren nur unzureichende Ansätze, multimediale und geo-referenzierte Daten für touristische Objects of Interest (OOI) einheitlich zu strukturieren. Das am weitesten entwickelte Standardformat für diesen Zweck ist die Tourism Markup Language (TourML), die für den Tourismus relevante Objekte beschreibt. Allerdings können multimediale Daten nur eingeschränkt über Referenzen in TourML eingebunden und nicht detailliert beschrieben werden. Weiters können derzeit nur Punktinformationen als Ortsbezug eines Objektes angegeben werden.

In dieser Arbeit beschreiben wir, wie diese Einschränkungen durch eine Erweiterung von TourML überwunden werden können. Für die multimediale Beschreibung von Objekten kommt die Synchronized Multimedia Integration Language (SMIL) zum Einsatz. Zur Beschreibung der geografischen Ausdehnung touristischer Objekte werden Punkt- und Flächenfeatures eingesetzt, die in der Notation der Geography Markup Language (GML) in TourML eingebunden werden.

Das vorgeschlagene Datenformat vereinfacht die Verarbeitung der Daten touristischer Objekte und erleichtert deren Einsatz in verschiedenen Applikationen. Durch die Erweiterung der Konzepte von TourML mit den Standards SMIL und GML und die Einführung einer Kategorisierung von touristischen Objekten wird die thematische und geografische Suche von OOI ermöglicht. Aus der Beschreibung der geografischen Ausdehnung können nicht nur distanzbezogene Beziehungen zwischen verschiedenen Objekten, sondern auch Teile-Ganzes-Beziehungen abgeleitet werden.

1 EINLEITUNG UND RELATED WORK

Ausgangspunkt für die Entwicklung eines Standardformats für touristische Objects of Interest (OOI) sind die Anforderungen, die sich für die Entwicklung eines mobilen Wanderführers in einer ländlichen Region ergeben. Die dafür vorgesehene Region ist vor allem für landschaftlich und kulturell interessierte Radfahrer und Wanderer attraktiv, die sich gerne in hügeligem Gelände bewegen. Insbesondere bemüht sich die Region seit kurzer Zeit, ihr Angebot durch Pilgerwege und dazu passende Infrastruktur zu erweitern. Neben den typisch touristisch relevanten Objekten wie Unterkünften und Restaurants befinden sich deshalb in diesem Zielgebiet auch sehr viele Einrichtungen, die nur für kleinere Zielgruppen interessant sind. Beispiele hierfür sind Kapellen und Marterl, aber auch Naturdenkmäler oder besondere Tierarten.

Um die Gesamtheit aller touristischen Objekte in der Zielregion adäquat zu erfassen, sind bisher bekannte Standardformate für touristische OOI bzw. Points of Interest (POI) in mehrfacher Hinsicht unzulänglich. In bisherigen Arbeiten und Anwendungen wurden verschiedene Konzepte zur Beschreibung von POI entwickelt, wie z.B. Cyberguide (Long et al., 1996), CRUMPET (Schmidt-Belz et al., 2002), DEEP MAP (Malaka und Zipf, 2000) und Lol@ (Uhlriz und Lechthaler, 2002). Diese Konzepte sind in ihrer Art jedoch meist proprietär und immer wieder von neuem umgesetzt (Krösche und Boll, 2004).

POI sind als geo-referenzierte Punkt-Objekte definiert, die zur Darstellung ortsabhängiger Informationen verwendet werden. Im Allgemeinen sind sie in bestimmte Gruppen wie etwa Museen, Unterkünfte, etc. eingeteilt. Im touristischen Anwendungsfeld sind in vielen Fällen flächenhafte Objekte auch als POI realisiert. Diese Objekte können eine sehr unterschiedliche räumliche Ausdehnung besitzen, die in vielen Fällen nicht mehr durch einen POI allein beschrieben werden können. Für eine bessere Beschreibung solcher Objekte wird das Konzept der POI durch das Konzept der OOI ersetzt. Damit wird es erleichtert, auch größere Regionen und deren touristische Informationen mit einem Objekt zu beschreiben.

2 RELEVANTE STANDARDS

2.1 Tourism Markup Language (TourML)

TourML (Open Tourism Consortium, 2004) steht für Tourism Markup Language und ist eine XML basierte Auszeichnungssprache, die eine formale Beschreibung von touristischen Objekten und Events ermöglicht. TourML wurde vom Open Tourism Consortium entwickelt, das sich aus Unternehmen, Regierungsbehörden, Universitäten sowie Einzelpersonen zusammensetzt. Ihre Aufgabe ist die Unterstützung von Tourismusorganisationen bei der Entwicklung offener Standards und Open Source Software. TourML besteht aus einer Reihe unterschiedlicher XML-Schemata, die für die Öffentlichkeit zugänglich sind (Open Source). Abbildung 1 stellt den Zusammenhang zwischen den einzelnen XML-Schemata in TourML dar.

TourML besteht aus einer Hierarchie von Schemata. *TourML.xsd* stellt das Root-Element dar. Es kann die Schemata *Object of Interest.xsd*, *TransportationSystem.xsd* und *Geography.xsd* inkludieren. Das Schema *Objects of Interest.xsd* kann wiederum all jene Schemata inkludieren, die eine Pfeilverbindung zu *Objects of Interest.xsd* aufweisen. In diesem Fall sind dies die Schemata *Category.xsd*, *Organization.xsd*, *TransportationSystem.xsd*, *DataTypes.xsd* und *LoopupTypes.xsd*. Das gleiche Prinzip gilt bei den Schemata *TransportationSystem.xsd* und *Geography.xsd*.

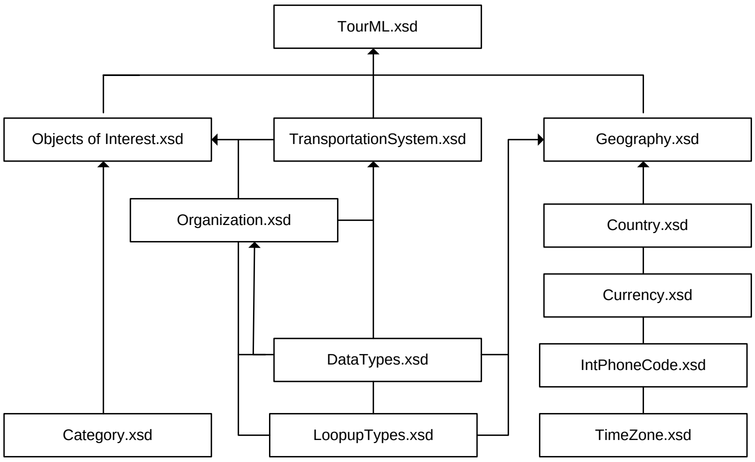

Abbildung 1: TourML Schema-Familie (Seibold, 2004)

Auf Basis dieser XML-Schemata kann eine formale Beschreibung der touristischen Objekte und Events erfolgen. Neben Elementen wie Name, Angebot, Adresse, Parkmöglichkeiten, Öffnungszeiten, etc. können auch geografische Koordinaten miteingebunden werden, um das OOI lokalisieren zu können.

2.2 Synchronized Multimedia Integration Language (SMIL)

Im August 2001 veröffentlichte das World Wide Web Consortium (W3C) SMIL 2.0, den Nachfolger von SMIL 1.0. SMIL ist ein nicht proprietäres, text-basiertes Format, mit dem es möglich ist, multimediale Präsentationen formal auf Basis von XML zu beschreiben. Es ist das einzige Format zur Beschreibung multimedialer Präsentationen, das vom W3C bereitgestellt und unterstützt wird. MP3, WAV oder andere Formate stellen im Gegensatz zu SMIL bestimmte Datenformate dar. SMIL jedoch ist keine Animationssprache oder Datenformat, sondern eine Auszeichnungssprache, mit der es möglich ist, multimediale Präsentationen plattformunabhängig zu beschreiben. Präsentationen, die mit SMIL erstellt worden sind, können mit sogenannten SMIL-Playern abgespielt werden. Beispiele für SMIL-Player sind AmbulantPlayer (http://www.ambulantplayer.org), RealPlayer (http://www.real.com) und GRiNS Player (http://www.oratrix.com) (Bulterman und Rutledge 2004).

SMIL Profile

SMIL stellt verschiedene Profile für unterschiedliche Clients, auf denen SMIL ausgeführt wird, zur Verfügung. Jedes Profil stellt eine fixe Sammlung von Elementen und Attributen bereit. Folgende Profile existieren (Bulterman und Rutledge 2004):

SMIL 2.0 Language: Das SMIL 2.0 Language Profil stellt das gesamte Set von Elementen und Attributen, die in der SMIL 2.0 Spezifikation definiert sind, zur Verfügung. Dieses Profil ist für Desktops und Serversysteme gedacht, die eine breite Palette an Medienpräsentationen unterstützen müssen.

SMIL 2.0 Basic: SMIL 2.0 Basic stellt eine begrenzte Sammlung von Elementen und Attributen der SMIL 2.0 Spezifikation bereit. Dieses Profil ist für low-power Geräte wie PDAs gedacht.

3GPP Mobile SMIL: Das 3GPP (Third Generation Partnership Project Consortium), ein Zusammenschluss verschiedener Organisationen, die Telekommunikationsstandards entwickeln (z.B. ETSI, TTA), wählte SMIL als Basis für multimediale Präsentationen auf Mobiltelefonen. Das Profil beinhaltet ein Subset von SMIL 2.0, das die meisten Features unterstützt.

XHTML+SMIL: XHTML+SMIL stellt eine Teilmenge von SMIL 2.0 dar. Mit XHTML+SMIL ist es möglich, SMIL Elemente mit Hilfe von HTML Konstrukten in XHTML-Dateien einzubinden.

Übersicht der Hauptfunktionalitäten von SMIL

Die Auszeichnungssprache SMIL bietet eine Vielzahl von Möglichkeiten, um multimediale Präsentationen zu beschreiben (Bulterman und Rutledge 2004):

Einbinden von Medienobjekten: In SMIL können Medienobjekte wie Texte, Bilder, Videos und Animationen direkt eingebunden werden. Diese können als lokales File, als externe Datei oder (im Falle eines Textes) direkt als Text in die SMIL-Präsentation eingefügt werden.

Festlegen des Layouts: Das Layout legt fest, wo die einzelnen Komponenten der SMIL-Präsentation am Bildschirm angezeigt werden. SMIL unterscheidet zwischen dem BasicLayout, AudioLayout, MultiWindowLayout und HierachicalLayout.

Zeitliche Koordinierung in SMIL-Präsentationen: Die Timing-Funktion in SMIL-Präsentationen legt fest, wann welche Elemente in der Präsentation angezeigt werden und wie lange diese angezeigt werden.

Inhaltliche Auswahl: SMIL bietet die Möglichkeit, Inhalte einer Präsentation an verschiedene Bedürfnisse anzupassen, z.B. die Wahl zwischen verschiedenen Medienobjekten abhängig von der bevorzugten Sprache des Benutzers oder Inhalte mit hohem/niedrigem Bandbreitenbedarf.

Übergangseffekte bei Medienobjekten: Die Definition von Übergangseffekten zwischen verschiedenen Medienobjekten stellt eine weitere Grundfunktionalität von SMIL dar (z.B. das Verschwinden von Bild 1, während Bild 2 langsam erscheint).

Neben den angeführten Features stellt SMIL noch weitere, technisch ausgefeiltere Möglichkeiten bereit, um multimediale Präsentationen zu gestalten.

Geography Markup Language (GML)

Die Geography Markup Language (GML) ist eine Auszeichnungssprache, die für die Beschreibung von geografischer Information verwendet wird. GML basiert auf XML und wird vom Open GIS Consortium ständig weiterentwickelt und soll in der Version 4.0 in einen ISO-Standard übergeführt werden. GML wird für die Beschreibung, Speicherung und Referenzierung von geografischen Elementen verwendet, die räumliche oder nicht-räumliche Eigenschaften besitzen können. Weiters wird mit GML eine Verbesserung des Austausches und der Weitergabe von geografischer Information und deren Metadaten über das Internet erreicht. In der aktuellen Version (GML 3.0) sind komplexe Geometrien, räumliche und temporale Referenzsysteme, Topologie, Maßeinheiten, Metadaten und Rasterdaten eingebunden (Cox et al., 2003).

Für die multimediale Beschreibung touristischer POI und OOI werden aus GML verschiedene Schemata herangezogen. Punkt-Schemata werden für POI, wie z.B. Informationstafeln, Flächen-Schemata für OOI eingesetzt. Zusätzlich werden z.B. für Wanderwege Linien-Schemata eingesetzt. Neben der Beschreibung der Lage, der Gestalt und der Ausdehnung der geografischen Elemente sind aus GML noch weitere Schemata für die Georeferenzierung und der Beschreibung von Metadaten der Objekte in das im Punkt 3 beschriebene Datenmodell eingeflossen.

Point of Interest Exchange Language (POIX)

Die Point of Interest Exchange Language (POIX) ist eine XML basierte Auszeichnungssprache für Punkte und Routen. Sie wurde von einem japanischen Konsortium, das Interessen im Bereich der Autonavigation verfolgt, entwickelt. POIX wurde für den Austausch von ortsbezogenen Informationen zwischen mobilen Endgeräten und zentralen Datenspeichern angefertigt. Mit ihr können auch die geografische Verortung und dessen zusätzliche nicht-räumliche Informationen von Objekten beschrieben werden. Weiters kann mit POIX auf unterschiedliche geografische Koordinatensysteme zugegriffen werden (Kanemitsu und Kamada, 1999).

3 KATEGORISIERUNG TOURISTISCHER „OBJECTS OF INTEREST“

Der Tourismus ist von einer Vielzahl an touristischen Objekten geprägt, die durch sehr viele und unterschiedliche Eigenschaften gekennzeichnet sind (z.B. Bild im Museum, Löwe im Tierpark, Restaurant im Hotel). Eine Kategorisierung der verschiedenen touristischen Objekte stellt eine Möglichkeit dar, diese in eine geordnete Struktur zu bringen und so eine maschinelle Weiterarbeitung dieser zu ermöglichen.

Ein wichtiger Punkt bei der Klassifizierung von touristischen OOI ist, dass ein möglichst generisches Modell entwickelt wird, in dem jedes Objekt seinen Platz in einer Kategorie findet.

Folgendes konzeptuelle Modell (Abbildung 2) beschreibt, wie die Zuordnung von touristischen OOI zu unterschiedlichen Kategorien erfolgen kann.

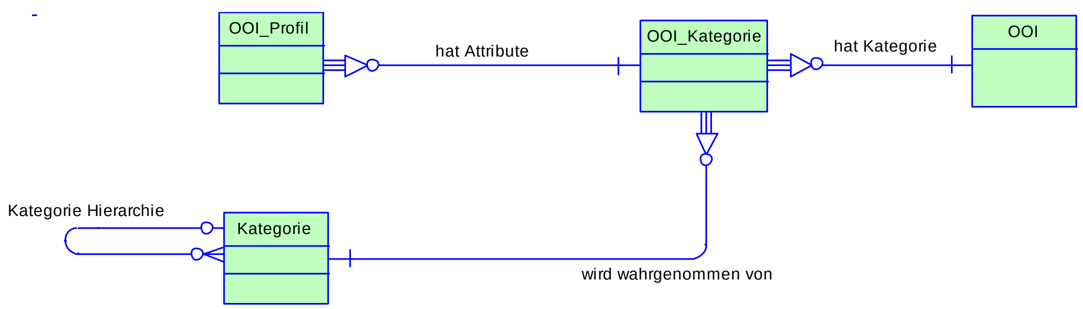

Abbildung 2: ER-Modell (Zuordnung OOI zu Kategorie)

Beschreibung des Datenmodells

Relation „Kategorie“

Wie aus dem ER-Modell (Abbildung 2) ersichtlich, besitzt die Relation *Kategorie* eine Parent-Child-Beziehung. Unter einer Parent-Child-Beziehung versteht man die Referenzierung auf ein in der Relation bereits existierendes Objekt. Aufgrund dieser Beziehung ist es möglich, eine Hierarchie von Kategorien zu modellieren und jeder Kategorie beliebig viele Unterkategorien zuzuordnen.

Beispiel einer Parent-Child-Beziehung:

Bezeichnung	Primärschlüssel	Fremdschlüssel
Übernachtung	1	
Hotel	2	1
Gasthof	3	1

Tabelle 1: Beispiel einer Parent-Child-Beziehung

Die Relation *Kategorie* beinhaltet sechs verschiedene Hauptkategorien. Jede dieser sechs Hauptkategorien beinhaltet wiederum eine Vielzahl von Unterkategorien. Als Beispiel werden in Abbildung 3 die Unterkategorien der Kategorie Übernachtung vollständig angeführt, die restlichen Unterkategorien werden beispielhaft dargestellt.

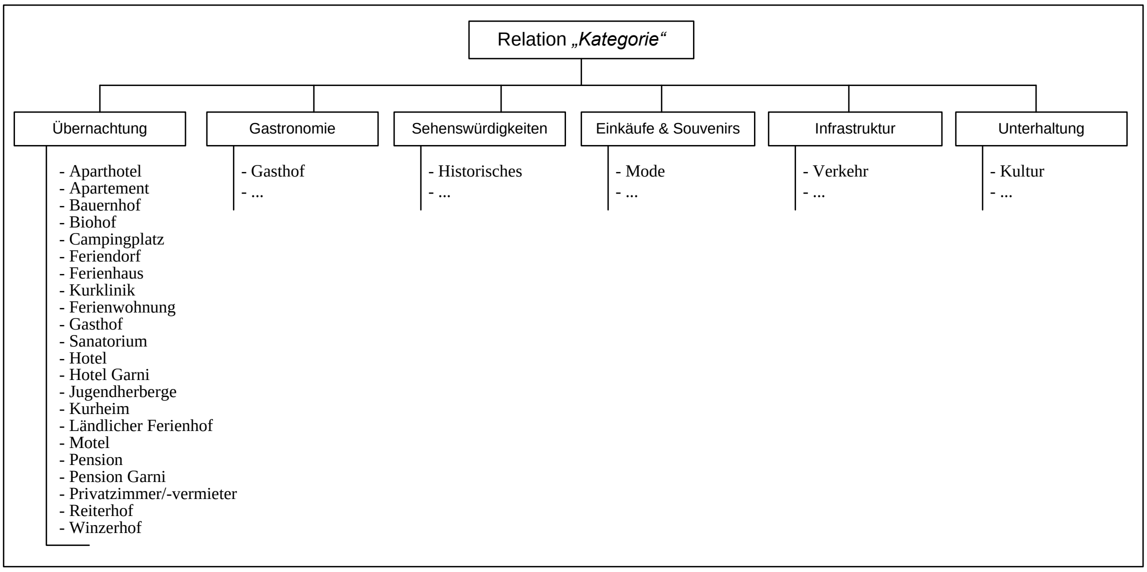

Abbildung 3: Kategorien-Hierarchie

Um möglichst alle Arten von Beherbergungsbetrieben in Europa in der Kategorie Übernachtung zu beinhalten, wurde die Touristische Informationsnorm - TIN (Deutscher Tourismusverband, 2001) als Leitfaden herangezogen. Die Norm wurde vom Deutschen Tourismusverband entwickelt und beinhaltet eine Klassifizierung von Beherbergungsbetrieben. Neben dieser Norm existiert unter anderem die DIN EN ISO 18513 2003-12, die die Terminologie von Hotels und anderen touristischen Unterkünften zum Inhalt hat (DIN, 2004).

Relation „OOI“

Die Relation *OOI* beinhaltet allgemeine Eigenschaften eines OOI, die sich unabhängig von der Zuordnung des OOI zu einer Kategorie nicht verändern, wie z.B. der Name des OOI (z.B. Mozart Geburtshaus) oder Geoinformation.

Relation „OOI_Kategorie“

Mit Hilfe der Relation *OOI_Kategorie* kann einem OOI eine Kategorie oder mehrere Kategorien zugewiesen werden. Das heißt, ein OOI kann in mehreren Kategorien existieren. Das „Mozart Geburtshaus“ wird zum Beispiel einerseits der Kategorie „Sehenswürdigkeiten“ zugewiesen, da es eine Sehenswürdigkeit der Stadt Salzburg darstellt. Andererseits wird es der Kategorie „Einkäufe & Souvenirs“ zugeteilt, da der Tourist die Möglichkeit hat, dort Souvenirs zu kaufen.

Die Relation *OOI_Kategorie* steht in einer „dependent“-Beziehung zu der Relation *OOI* und der Relation *Kategorie*. Unter einer „dependent“-Beziehung versteht man, dass die Relation, von der die „dependent“-Beziehung ausgeht, nicht ohne der Relation, wo die „dependent“-Beziehung endet, existieren kann. Dies bedeutet, dass die Relation *OOI_Kategorie* ohne die Relation *OOI* und die Relation *Kategorie* nicht existieren kann. Als Inhalt weist die Relation *OOI_Kategorie* die eindeutige ID eines OOI sowie die eindeutige ID einer Kategorie auf. Anhand dieses Tupels ist die Zuweisung eines OOI zu einer Kategorie eindeutig.

Beispiel:

OOI	Kategorie
1 (z.B. ID von OOI Mozart Geburtshaus)	1 (z.B. ID für Kategorie Sehenswürdigkeiten)
1	2 (z.B. ID für Kategorie Einkäufe & Souvenirs)

Tabelle 2: Tupel in der Relation *OOI_Kategorie*

Relation „OOI_Profil“

Die Relation *OOI_Profil* steht in einer „dependent“-Beziehung zu der Relation *OOI_Kategorie*, wodurch die Relation *OOI_Profil* nicht ohne die Relation *OOI_Kategorie* existieren kann. Sie speichert die vollständige Information eines OOI. Dies beinhaltet

- den Inhalt der Relation *OOI_Kategorie* (d.h. die eindeutige ID des OOI sowie die eindeutige ID der Kategorie, die dem OOI zugwiesen ist)
- sowie die Beschreibung des OOI bezogen auf die Kategorie (Attribute wie z.B. Kurzbeschreibung, Langbeschreibung, Angebotsbeschreibung, Adresse, etc.).

ID_OOI	ID_Kategorie	Kurzbeschreibung	Langbeschreibung	Angebot	Adresse
1	1	Ausstellung Mozart	Das Museum in Mozarts Geburtshaus zeigt …	Eintrittspreis: € 10 Museumsführer: € 10 etc.	Getreidegasse 9 5020 Salzburg
1	2	Souvenirgeschäft in Mozarts Geburtshaus	Das Souvenirgeschäft befindet sich im Erdgeschoss und freut sich auf Ihren Besuch!	Ansichtskarten Musik-CD's etc.	Getreidegasse 9 5020 Salzburg

Tabelle 3: Tupel in der Relation *OOI_Profil*

Vorteile des Datenmodells

Mit bisher entwickelten Datenmodellen, die die Beschreibung touristischer OOI ermöglichen, kann einem OOI genau eine Kategorie zugewiesen werden (z.B. Das Hotel gehört zu der Kategorie Übernachtung.). Es wurde jedoch nicht berücksichtigt, dass ein OOI in mehreren Kategorien enthalten sein kann (z.B. Das Hotel gehört auch zu der Kategorie Gastronomie, denn es besitzt ein Restaurant).

Unser Datenmodellvorschlag hat eine Sichtweise auf touristische OOI aus mehreren Blickwinkeln, nämlich aus den Blickwinkeln der sechs verschiedenen Hauptkategorien. Dies bedeutet, dass ein OOI nicht nur einer bestimmten Kategorie zugewiesen werden kann, sondern in mehreren Kategorien existieren kann. Diese Zuweisung des OOI zu ein oder mehreren Hauptkategorien bzw. in weiterer Folge Unterkategorien wird mit Hilfe der Relation *OOI_Kategorie* im Datenmodell ermöglicht.

Neben der Zuordnung eines OOI zu einer Kategorie oder zu mehreren Kategorien ist die individuelle Beschreibung des OOI je nach Kategorie ein wichtiger Punkt (z.B. Beschreibung der Zimmer des Hotels bei Zuordnung des Hotels zur Kategorie Übernachtung, Beschreibung der Küche des Hotels bei Zuordnung des Hotels zur Kategorie Restaurant). Diese Beschreibung, abhängig von der Kategorienwahl, wird in unserem Datenmodell mit Hilfe der Relation *OOI_Profil* berücksichtigt.

Zusammenfassend ist der Vorteil des von uns entworfenen Datenmodells, die Zuweisung von touristischen OOI zu einer Kategorie, aber bei Bedarf auch zu mehreren Kategorien. Weiterer Vorteil ist die Beschreibung des OOI aus Sichtweise der gewählten Kategorie, was zu einem höheren Informationsgehalt der Beschreibung des OOI führt.

Zur Veranschaulichung folgt abschließend ein Beispiel, in dem das Hotel Edelweiß einerseits als Beherbergungsbetrieb, andererseits als Gastronomiebetrieb beschrieben wird. Es ist also sowohl der Kategorie Übernachtung->Hotel zugeordnet als auch der Kategorie Gastronomie->Restaurant.

```
<OOI>
 <nameOOI>Hotel Edelweiss</nameOOI>
 <gml>geografische Daten</gml>

 <main_category>
  <name>Übernachtung</name>
  <subcategory>
   <name>Hotel</name>
   <short_info>Das Hotel Edelweiss bietet seinen Gästen...</short_info>
   <description>Mitten im Zentrum von Salzburg befindet sich...</description>
   <services>250 Betten, modern eingerichtet,...</services>
   <smil>multimediale Daten</smil>
   <contact>Frau Theresia Winkler</contact>
   <street>Franz-Josef-Str. 3</street>
   <postcode>5020</postcode>
   <city>Salzburg</city>
   <country>Österreich</country>
   <telephone>0662-456 789</telephone>
   <fax>0662-456 789-22</fax>
   <email>theresia.winkler@hotel-edelweiss.at</email>
  </subcategory>
 </main_category>

 <main_category>
  <name>Gastronomie</name>
  <subcategory>
   <name>Restaurant</name>
   <short_info>Das Restaurant Edelweiss bietet den Gästen...</short_info>
   <description>Das edel eingerichtete Restaurant...</description>
```

<services>50 Sitzplätze, traditionelle Kost,...</services>
<smil>multimediale Daten</smil>
<contact>Herr Hubert Ebner</contact>
<street>Franz-Josef-Str. 3a</street>
<postcode>5020</postcode>
<city>Salzburg</city>
<country>Österreich</country>
<telephone>0662-456 678</telephone>
<fax>0662-456 678-22</fax>
<email>hubert.ebner@restaurant-edelweiss.at</email>
</subcategory>
</main_category>
</OOI>

4 LÖSUNGSANSATZ FÜR EIN OBJECT OF INTEREST-STANDARDFORMAT

Ausgangspunkt für die Entwicklung eines Standardformats für touristische OOI sind die Anforderungen, die sich für die Entwicklung eines mobilen Wanderführers in einer ländlichen Region ergeben. Die dafür vorgesehene Region ist vor allem für landschaftlich und kulturell interessierte Radfahrer und Wanderer von Bedeutung, die sich gerne in hügeligem Gelände bewegen. Insbesondere bemüht sich die Region seit kurzer Zeit, ihr Angebot durch Pilgerwege und die dazu passende Infrastruktur zu erweitern. Neben den typisch touristisch relevanten Objekten wie Unterkünfte und Restaurants befinden sich deshalb in diesem Zielgebiet auch sehr viele Einrichtungen, die nur für kleinere Zielgruppen interessant sind. Beispiele hierfür sind Kapellen und Marterl aber auch Naturdenkmäler oder besondere Tierarten.

4.1 Zielsetzung

Unter Berücksichtigung der konkreten Zielregion verfolgen wir bei der Entwicklung eines Standardformats für touristische OOI eine Reihe von Zielen mit unterschiedlicher Gewichtung. Oberste Priorität hat dabei die möglichst umfangreiche Erfassung der verschiedenen touristischen Objekte in einer Region. Das Datenformat soll so allgemein wie möglich gehalten sein und sich auch für vorher nicht explizit berücksichtigte Arten von touristischen Objekten eignen.

Informationen zu touristischen Objekten können für viele Zwecke verwendet werden. Der Aufwand zur Erfassung dieser Daten fällt idealerweise für jedes Objekt nur ein einziges Mal an, während sie für möglichst viele Anwendungen wiederverwendet werden können. Ein Ziel eines allgemeinen Datenformats ist es, die Wiederverwendbarkeit der Informationen zu gewährleisten, indem die entwickelte Datenstruktur soweit wie möglich auf bereits existierende Standards aufbaut und eine semantische Interpretation ermöglicht.

Soweit dies sinnvoll erschien, wurde bei der Entwicklung des Datenformats versucht, einen hohen Grad an Kompatibilität mit existierenden Standards aus dem Anwendungsbereich zu erreichen. Dazu wurden viele Ideen und Konzepte sowie Komponenten von anderen Initiativen übernommen.

Die Beschreibung von touristischen Objekten allein durch Textinformation erscheint in vielerlei Hinsicht nicht ausreichend. Für viele Objekte sind zumindest Bilder, für einige auch Audio- und Video-Informationen sinnvoll oder auch notwendig. Ein Datenformat zur Beschreibung von OOI muss diesen Anforderungen Rechnung tragen und diese Arten von Medien unterstützen.

Eine zentrale Anforderung bei der Entwicklung eines mobilen Wanderführers ist die Berücksichtigung von geografischen Eigenschaften der darin beschriebenen Objekte. Viele der untersuchten Formate speichern dazu Punktkoordinaten ab. Dies ist in vielen Fällen ungünstig oder falsch. Im Zielgebiet sind eine Reihe von Objekttypen anzutreffen, die nur unzureichend mit Punktkoordinaten erfasst werden können. Beispiele dafür sind Wanderwege oder Seen, die vorzugsweise als Polylinien bzw. Flächen beschrieben werden. Es ist somit notwendig, zum einen die räumliche Ausdehnung, zum anderen die Koordinaten der Objekte zu erfassen und zu verwalten. Wenn diese Daten einmal vorhanden sind, können darauf aufbauend alle Spielarten von ortsbasierten Diensten realisiert sowie weitergehende Informationen aus der Georeferenz abgeleitet werden.

4.2 Bausteine

Um die Gesamtheit aller touristischen Objekte in der Zielregion adäquat zu erfassen, sind bisher bekannte Standardformate für touristische OOI in mehrfacher Hinsicht unzulänglich. Das Standardformat POIX ist mit dem Ziel, ein Austauschformat für POI zur Verfügung zu stellen, entwickelt worden. Damit kann die Georeferenz eines Punktes oder mehrerer Punkte und weitere Informationen, wie z.B. die Erreichbarkeit oder Kontaktangaben beschrieben werden. Für die individuelle Beschreibung eines Punktes ist ein Fließtext beliebiger Länge vorgesehen. POIX könnte prinzipiell als Ausgangsbasis für ein Datenformat für OOI dienen. Da dieses Format primär für die Speicherung geografischer Information zu einem Punkt gedacht ist, könnte es auch als Komponente für ein allgemeineres Format eingesetzt werden.

Das Standardformat TourML (Seibold, 2004) erfasst touristische Objekte unter der Bezeichnung „physical object", wobei jedes Objekt einer bestimmten Kategorie zugeordnet wird. In TourML ist jedes Objekt die Instantiierung einer der vordefinierten Klassen, wie z.B. Restaurant, Bar, Hotel, etc. Es sind jedoch auch weniger häufige Typen wie Strand, Wasserfall oder Tankstelle vorgesehen. TourML umfasst zwar eine große Anzahl an Objekttypen, es sind jedoch nicht alle benötigten Typen für die Zielregion vorhanden und die Möglichkeiten, diese unter Verwendung des Standardformats zu speichern, sind begrenzt. Aus diesem Grund wurden die Ideen und Konzepte von TourML berücksichtigt und zum Teil übernommen. Für die Integration aller gewünschten Informationen wurde der Ansatz gewählt, ein neues Format zu entwickeln, um die oben angeführten Nachteile aufzuheben und TourML zu erweitern.

Ausgehend von den Zielsetzungen für die konkrete Anwendung wurde als Beschreibungsformat der multimedialen Informationen für touristische Objekte der Standard SMIL gewählt. Damit sind einfache Bilder und Audiobeschreibungen, aber auch komplexe Abläufe mit Audio, Bild und Video-Komponenten möglich. SMIL ermöglicht also nicht nur die Integration dieser Medien in eine Objektbeschreibung, sondern vor allem auch die Gestaltung multimedialer Präsentationen dieser Objekte. Bei der Integration in das Datenformat wurde SMIL als abgeschlossene Komponente betrachtet und nicht erweitert bzw. verändert. Vorhandene SMIL-Objekte können somit direkt übernommen werden. Das Datenformat ermöglicht es, SMIL-Daten für jede Unterkategorie, der ein Objekt zugeordnet ist, abzulegen.

Auch die Anforderungen an die Speicherung geografischer Informationen zu touristischen Objekten können unter Einbindung eines Standards erfüllt werden. Hierzu werden die relevanten Teile von GML verwendet, um Objekte als Punkte, Polylinien und Flächen zu beschreiben. Damit können zwar nur die Ausdehnungen der Objekte in zwei Dimensionen abgebildet werden, eine Erfassung der räumlichen Ausdehnung in drei Dimensionen erscheint aber angesichts der Einsatzzwecke ohnehin als übertrieben. Die Geoinformationen werden unabhängig von den Kategorien, denen ein Objekt zugeordnet ist, auf Objektebene abgelegt.

4.3 Semantische Informationen

Zu jedem Objekt werden entsprechend seines Typs alle relevanten Informationen erfasst. Neben allgemeinen Daten wie Name und Kurzbeschreibung, die alle Objekte aufweisen, sind die übrigen Daten abhängig vom Objekttyp. Beispielsweise wird zu Unterkünften die Anzahl der Betten gespeichert, während diese Information für Sehenswürdigkeiten nicht sinnvoll ist. Für alle Objekte sind textuelle Beschreibungen vorgesehen, damit auch Information dargestellt werden kann, die nicht in vordefinierten Feldern Platz findet.

Im Zusammenhang mit mobilen Diensten werden in der Literatur häufig Ideen und Konzepte für Dienste diskutiert, die sich an die aktuelle Situation des Benutzers anpassen. Um derart kontext-sensitive Dienste zu realisieren, muss ein System den Benutzer und seine Umgebung erfassen und interpretieren können. Dazu müssen semantische Informationen über die beteiligten Objekte vorhanden sein. Das hier beschriebene Datenformat bietet grundlegende semantische Informationen über die Zuordnung der beschriebenen Objekte zu Kategorien und Unterkategorien. Über diese Zuordnung können wesentliche Merkmale und Funktionen von Objekten abgeleitet werden, die für alle erlaubten Kategorien und Unterkategorien vorgegeben und deren Bedeutungen definiert sind.

Über die Kategorisierung der Objekte ist es auch möglich, Filtermechanismen in Applikationen einzubauen, die touristische Daten, basierend auf dem dargestellten Datenformat, verwenden. Anhand der Kategorien entscheidet eine Anwendung, welche Gruppen von Objekten für einen konkreten Anwender interessant sind bzw. der Anwender kann die Gruppen selbst auswählen.

4.4 Einsatzmöglichkeiten

Die Eigenschaften des hier skizzierten Datenformats bilden die Grundlage für viele Anwendungsmöglichkeiten in touristischen Applikationen. Für den Einsatz bei der Implementierung eines mobilen Wanderführers sind vor allem die Suchmöglichkeiten von Interesse. Neben einer Stichwortsuche, die unabhängig von einem bestimmten Datenformat durchgeführt werden kann, ergeben sich noch weitere Möglichkeiten. In großen Datenbeständen kann es hilfreich sein, die Kategorisierung der Objekte einzusetzen, um den Suchraum schon zu Beginn der Suche einzuschränken und deren Antwortzeit zu verkürzen. Im Praxiseinsatz wird vor allem die Suche nach Objekten mit bestimmten Merkmalen, z.B. die Suche nach Hotels mit Hallenbad und Sauna auf Nachfrage treffen. Dazu werden einzelne Attribute der Objekte abgefragt.

Die detaillierten Informationen zur geografischen Lage eines Objektes können neben der Unterstützung von Suchabfragen auch für andere ortsbasierte Dienste eingesetzt werden. Beispielsweise wäre die Planung einer Tour zu den wichtigsten Sehenswürdigkeiten im Umkreis von 2 km damit denkbar. Neue Möglichkeiten ergeben sich auch, wenn sich Objekte innerhalb der geografischen Ausdehnung anderer Objekte befinden. Damit kann ohne weitere explizite Speicherung eine Teile-Ganzes-Beziehung nur über die Koordinaten und die Ausdehnung der Objekte abgeleitet werden. So lässt sich z.B. feststellen, ob sich ein Geschäft innerhalb eines Einkaufszentrums befindet.

5 ZUSAMMENFASSUNG UND AUSBLICK

Der vorliegende Beitrag beschreibt einen Vorschlag für ein Standarddatenformat zur Beschreibung touristischer OOI mittels XML, der im Rahmen der Entwicklung eines mobilen Wanderführers ausgearbeitet wurde. Neben einer multimedialen Beschreibung der Objekte mit Hilfe von SMIL werden sowohl geografische Ausdehnung als auch Koordinaten jedes Objektes unter Verwendung von GML erfasst. Alle touristischen Objekte werden in ein Schema mit sechs Haupt- und zahlreichen Unterkategorien eingeordnet, wobei jedes Objekt auch mehreren Kategorien zugeordnet werden kann. Das Datenformat bietet die Möglichkeit, Objekte umfassend und multimedial zu beschreiben und diese Informationen für verschiedenste Einsatzzwecke zu benutzen. Neben umfangreichen Möglichkeiten für Suchabfragen bietet das beschriebene Format vor allem die Möglichkeit, die damit erfassten Daten für beliebige Anwendungen wieder zu verwenden. Im praktischen Einsatz verringert sich somit der Aufwand für die Verwaltung der Daten sowie für Transformationen in proprietäre Formate.

Für die Weiterentwicklung des Formats wurden bereits einige Ideen gesammelt. Eine wichtige Erweiterung für den Einsatz in bestimmten Anwendungen ist die Einführung von mehrsprachigen Beschreibungen. Diese Anforderung ist zwar für den mobilen Wanderführer nicht gegeben, sollte jedoch für den allgemeinen Einsatz des Formats berücksichtigt werden. Weiters könnte auch untersucht werden, wie man die besonderen Möglichkeiten der Standards SMIL und GML zur Verbesserung des Datenformats einsetzen könnte. Beispielsweise bietet SMIL die Möglichkeit, innerhalb einer Präsentation auf Beschreibungstexte außerhalb der SMIL-Objekte zu verweisen.

Generell kann man davon ausgehen, dass sich die verwendeten Unterkategorien und die dafür vorgesehenen Attribute durch den praktischen Einsatz des Formats weiterentwickeln und konkretisieren werden.

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Kommunale Schutzverantwortung für Zielarten der Fauna in Baden-Württemberg: ein planungsorientierter Einsatz von Habitatmodellen

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1 EINLEITUNG

In Baden-Württemberg wird, aufbauend auf dem Zielartenkonzept Baden-Württemberg (ZAK RECK et al. 1996), das webbasierte „Informationssystem ZAK“ [102] entwickelt, in dem wesentliche Inhalte des faunistischen Teils des Zielartenkonzepts und weitere naturschutzfachliche Informationen planungsrelevant anwendbar zur Verfügung gestellt werden. Vorrangige Zielgruppen des gemeinsam mit der Landesanstalt für Umweltschutz (LfU) Baden-Württemberg konzipierten Informationssystems sind Mitarbeiter der Unteren Naturschutzbehörden bei den Landratsämtern und kommunale Planungsträger wie die Bau-, Grünflächen- und Umweltämter der Städte und Gemeinden. Mittelfristig sollen auch Planungsbüros, Regionalverbände u.a.m. die Verwendung ermöglicht werden. Das Tool wird als PHP-Abfragesystem der Oracle-Datenbank der LfU mit eingebetteten Web-GIS-Applikationen realisiert und kann mit den verbreiteten Web-Browsern aufgerufen werden. Das Planungswerkzeug wird voraussichtlich ab April 2005 zur Verfügung stehen. Ein ähnliches Informationssystem mit reduziertem Umfang wurde bereits für das Landesamt für Flurneuordnung und Landentwicklung in Baden-Württemberg entwickelt und ist dort im Einsatz (GEIßLER-STROBEL et al. 2003; JOOß 2002).

2 DAS ZIELARTENKONZEPT BADEN-WÜRTTEMBERG (ZAK)

Das Zielartenkonzept formuliert landesweit regionalisierte Rahmenziele zur Erhaltung und Wiederherstellung von langfristig überlebensfähigen Tier- und Pflanzenpopulationen heimischer Arten (Zielarten) entsprechend ihrer naturräumlichen Verbreitung. Es stellt damit den Fachbeitrag des Arten- und Biotopschutzes im Rahmen der Fortschreibung des Landschaftsrahmenprogramms Baden-Württemberg dar (HEINL et al. 1999). Kernstück des ZAK ist die Zielkategorie ‚Spezieller Populationsschutz’. Die Umsetzung erfolgte über die Auswahl von ca. 1.700 Zielarten als für Baden-Württemberg prioritär schutzbedürftige Arten aus den Artengruppen (für die Fauna) Vögel, Reptilien, Amphibien, Säugetiere, Fische, Neunaugen, Flusskrebse, Libellen, Heuschrecken, Tagfalter, Widderchen, Wildbienen, Sandlaufkäfer und Laufkäfer, Holzkäfer, Schnecken und Muscheln. Die Auswahl der Artengruppen erfolgte hinsichtlich einer ausreichenden Repräsentanz wichtiger Anspruchstypen und guten verfügbaren Kenntnissen zu Ökologie, Verbreitung und Bestandsentwicklung. Die Auswahl der Zielarten orientierte sich an den Kriterien Gefährdung, Schutzverantwortung, Seltenheit und ihrer Funktion als Schlüsselarten und naturräumliche Charakterarten. Die Zielarten wurden folgenden Schutzkategorien zugeordnet:

Landesarten (ca. 1250): landesweit höchste Schutzpriorität
- Gruppe A: vom Aussterben akut bedroht, Sofortmaßnahmen erforderlich
- Gruppe B: keine Sofortmaßnahmen erforderlich

Naturraumarten (ca. 450): besondere regionale Bedeutung, landesweit zweite Schutzpriorität

Als planungsorientierte Eingrenzung wurden 300 sehr empfindliche und anspruchsvolle ‚Zielorientierte Indikatorarten’ (ZIA) aus den Zielarten ausgewählt. Von Schutz- und Entwicklungsmaßnahmen für diese Arten sind die größten Mitnahmeeffekte für weitere (Ziel-) Arten zu erwarten, sodass sie als Kollektiv die Funktionsfähigkeit der Landschaft für die Erhaltung der biologischen Vielfalt repräsentieren.

3 DAS “INFORMATIONSSYSTEM ZAK“

Den Gemeinden Baden-Württembergs kommt im Rahmen des Ökokonto-Modells, der Erstellung und Fortschreibung der Landschaftspläne oder bei Biotopverbundplanungen hinsichtlich des Artenschutzes eine wichtige Funktion bei der Erhaltung und Förderung von Naturraum- und Landesarten zu. Von Seiten der Naturschutzverwaltung wurde immer wieder Bedarf an einer planungsorientierten und anwenderfreundlichen Umsetzung des sehr umfangreichen Zielartenkonzepts (ca. 1.300 DIN A 4 Seiten) geäußert. In das „Informationssystem ZAK“ werden aus den für Planungsvorhaben wichtigsten Artengruppen Vögel, Tagfalter/Widderchen, Heuschrecken, Amphibien und Reptilien alle Zielarten und aus den weiteren Artengruppen des ZAK die Zielorientierten Indikatorarten (s. Kap. 2) integriert. Alle im Tool enthaltenen Arten sind mit vier Datenbanken verknüpft:

Verbreitung in Ba.-Wü.: Vorkommen in 54 Naturräume 4. Ordnung oder 13 ZAK-Bezugsräumen (je nach Artengruppe)

Habitatprofil: positive / keine Verknüpfung mit 66 Habitattypen

Schutz-/Entwicklungsmaßnahmen: Maßnahme kann eine Art fördern, beeinträchtigen oder irrelevant sein (ca. 70 Maßnahmen)

Artenlexikon der LfU: Schutzstatus, Fotos, für ZIA: ‚Arten-Steckbriefe’

Für einen Programmdurchlauf wählt der Anwender die Gemeinde, in der sich das Planungsgebiet befindet und füllt eine Liste von 66 Habitattypen aus, die als Präsenz/Absenzinformation im Gelände zu erheben sind. Aus der Lage der gewählten Gemeinde in den Bezugsräumen der Artenverbreitung (räumliche Auswahl) und den gewählten Habitattypen (Auswahl nach Habitatprofil) ermittelt das Tool die Zielarten, die bei Planungen zu berücksichtigen sind (‚potenzielle Zielartenliste’). Diese Liste dient der Vorbereitung

[102] Das Projekt wurde durch das Ministerium für Ernährung und Ländlichen Raum (MLR) Baden-Württemberg in Auftrag gegeben und wird zusammen mit der Landesanstalt für Umweltschutz (LfU) Baden-Württemberg, der Arbeitsgruppe für Tierökologie und Planung, Filderstadt und Frau Dr. Geissler-Strobel, Tübingen bearbeitet.

der tierökologischen Untersuchung im Gelände, da der Schwerpunkt der zu untersuchenden Artengruppen ersichtlich wird und der Bearbeiter auf besonders seltene Zielarten aus allen Artengruppen aufmerksam gemacht wird. Nach der erfolgten tierökologischen Erhebung wird die ‚potenzielle Zielartenliste' entsprechend der Geländebefunde zur Liste der im Gelände nachgewiesenen Zielarten gekürzt. Anhand dieser nachgewiesenen Zielarten wird eine Abfrage der Maßnahmendatenbank vorgenommen und die Maßnahmen über ein Expertensystem in folgende Kategorien eingeteilt:

1. **Vorrangige Maßnahmen**: Förderung Landesarten Gruppe A/B/Naturraumarten und keine Beeinträchtigung der nachgewiesenen Zielarten.
2. **Weiter zu empfehlende Maßnahmen**: Förderung Landesarten Gruppe B/Naturraumarten und keine Beeinträchtigung der nachgewiesenen Zielarten.
3. **Zu vermeidende Maßnahmen**: Beeinträchtigung von Landesarten Gruppe A/B/Naturraumarten und keine Förderung der nachgewiesenen Zielarten.
4. **Maßnahmen mit Prüfbedarf**: Alle übrigen Fälle mit Zielkonflikten, Prüfung durch Tierökologe.

Die endgültige Auswahl und Lokalisierung der Schutz- und Entwicklungsmaßnahmen im Gelände erfolgt durch den beauftragten Tierökologen. In der Maßnahmenliste sind diejenigen gekennzeichnet, die der besonderen Schutzverantwortung der Gemeinde aus landesweiter Sicht entsprechen (s. Kap. 4). Neben dem Habitatpotenzial des konkreten Planungsgebiet wird damit auch dessen Lage im überregionalen naturräumlichen Kontext bei der Wahl der Schutz- und Entwicklungsmaßnahmen berücksichtigt..

Damit ermöglicht das „Informationssystem ZAK" eine fachlich fundierte Konkretisierung des tierökologischen Untersuchungsbedarfs für das jeweilige Planungsgebiet (Scoping). Der Untersuchungsumfang kann zu Gunsten der –tiefe sinnvoll reduziert werden, woraus eine höhere Qualität bei gleichen oder ggf. auch geminderten Kosten folgt. Zudem erfolgt eine Vorauswahl und Priorisierung von potenzialorientierten Habitatschutz- und -entwicklungsmaßnahmen. Das Planungswerkzeug leistet eine Integration von einerseits Daten die in Geländearbeit im konkreten Planungsgebiet zu erheben sind und andererseits der Berücksichtigung des überregionalen naturräumlichen Zusammenhangs. Dieser fließt über die Ergebnisse der Habitatmodellierung - den besonderen Schutzverantwortungen und Entwicklungsmöglichkeiten aus landesweiter Sicht – ein (s. Kap. 4). Damit entspricht die Konzeption des „Informationssystem ZAK" in hohem Maße der immer wieder aufgestellten Forderung nach einem räumlich differenzierten und an den örtlichen Potenzialen ausgerichteten Artenschutz. (AMLER et al. 1999, 23).

4 GEMEINDEBEZOGENE ERMITTLUNG BESONDERER SCHUTZVERANTWORTUNGEN UND ENTWICKLUNGSPOTENZIALE AUS LANDESWEITER SICHT

„We can't save it all, so where should we concentrate our efforts?" (GINSBERG 1999, 5) ist eine der zentralen Fragen des Naturschutzes. Allgemein anerkannt und weit verbreitet ist die Priorisierung von Schutzmaßnahmen basierend auf den Einstufungen der Arten in den Roten Listen, die aus den Bestandsentwicklungen abgeleitete Gefährdungen von Arten für politisch abgegrenzte Räume wiedergeben (z.B. global, Europa, BRD). In den letzten Jahren hat sich mit der Zuweisung von sog. ‚Schutzverantwortungen' für administrative Einheiten aus ihrer Lage im naturräumlichen und biogeographischen Kontext ein neuer Ansatz für eine weitere Differenzierung der Schutzprioritäten entwickelt. Abb. 1 verdeutlicht den Ansatz der Verwendung der Schnittmenge aus Rote-Liste-Arten und Arten mit besonderer Schutzverantwortung als die für ein Gebiet aufgrund seiner räumlichen Lage vorrangig zu berücksichtigenden Arten.

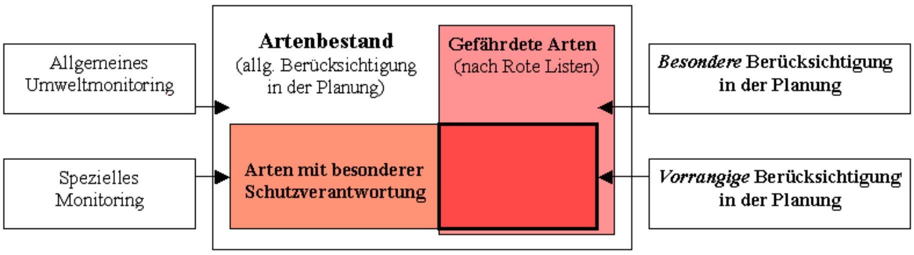

Abb. 1: Schema der Auswahl von Arten, die bei Planungen vorrangig bzw. besonders zu berücksichtigen sind (verändert nach TRAUTNER 2003).

Im Projekt „Informationssystem ZAK" wird ein spezifischer Ansatz entwickelt und im Planungswerkzeug umgesetzt, mit dem Gemeinden besondere Schutzverantwortungen und Entwicklungspotenziale für Zielarten bzw. -kollektive aus landesweiter Sicht zugewiesen werden. Die Methodik gliedert sich in zwei Ansätze: Für die relativ kleine Anzahl an ‚Landesarten Gruppe A' (Arten mit landesweit höchster Schutzpriorität laut ZAK die akut vom Aussterben bedroht sind) mit weniger als ca. 10 Vorkommen in Baden-Württemberg steht der Schutzgedanke im Sinne des Erhalts der Restvorkommen im Vordergrund. Die Umsetzung im Informationssystem erfolgt über die Nennung der Art/Arten für die jeweils gewählte Gemeinde. Diese Information beruht auf den punktgenauen Fundorten. Die Fundpunkte selbst werden nicht veröffentlicht, um eine zusätzliche Gefährdung zu vermeiden. Zur Klärung der Frage ob ein für die Gemeinde festgestelltes Vorkommen bei einem konkreten Planungsvorhaben tatsächlich zu berücksichtigen ist, hat sich der Anwender an die zuständigen Betreuer der Artenschutzprogramme zu wenden.

Für alle ca. 700 ‚Landesarten' der Fauna (Arten mit landesweit höchster Schutzpriorität laut ZAK) ist dieser Ansatz weder praktikabel noch inhaltlich angestrebt. Einerseits liegen nicht für alle Arten punktgenaue Verbreitungsdaten vor, zum anderen sollen dem Vorsorgeprinzip entsprechend, auch Lebensräume mit hohem Habitatpotenzial erhalten bzw. entwickelt werden, in denen eine Art zum Zeitpunkt einer Kartierung nicht nachgewiesen werden konnte oder keine aktuelle Kartierung vorliegt. Daher werden für einen Teil dieser Arten, unter Verwendung landesweit vorliegender GIS-Datensätze, Habitatpotenziale für ganz Baden-Württemberg abgebildet und diese in die Gemeindengeometrie übertragen. Über ein Ranking werden diejenigen Gemeinden ermittelt, die im landesweiten Vergleich besonders hohe Entwicklungspotenziale aufweisen und denen damit eine besonders hohe Schutzverantwortung für diese Habitate zukommt (s. Kap. 4.1). Aufgrund der Menge an Arten und der Verwendung ausschließlich landesweit vorliegender GIS-Datensätze, werden keine Einzelartmodelle entwickelt sondern Habitatpotenziale für Artenkollektive abgebildet, die sich aus der Zusammenfassung von Einzelarten zu ökologischen Anspruchstypen (i.S.v. Gilden, KRATOCHWIL & SCHWABE, 97) ergeben. Die Abgrenzung der Anspruchstypen und die Definition ihrer Ansprüche erfolgt ‚wissensbasiert' durch Tierökologen und umfangreiche Literaturauswertungen. Die räumliche Umsetzung geschieht in Form von GIS-basierten Expertensystemen. Einige Beispiele dieser ca. 30 bearbeiteten Anspruchstypen sind:

- strukturreiche Ackerlandschaften kont. Klimatönung	- Feldhecken
- extensiv genutztes Grünland mittlerer Standorte	- naturnahe Quellen und Quellbereiche
- Streuobstgebiete	- Streuwiesen
- strukturreiche Weinberglandschaften	- Tümpel, Hülen, Altwasser
- basenreiche /-arme Magerrasen	- Flachwasserzonen und Verlandungsbereiche
- Kalk- / Silikatfelsen und Geröllhalden	- Moore und Moorgewässer

Ergebnisse der wissensbasierten Expertensysteme sind dichotome (‚geeignet' / ‚nicht geeignet') und zunächst flächenscharfe Habitatpotenzialkarten für jeden bearbeiteten Anspruchstyp mit landesweiter Abdeckung. Aufgrund der großräumigen Analysen (Fläche Baden-Württemberg ca. 37.000 qkm) und der Vielzahl an bearbeiteten Anspruchstypen sind feinere Abstufungen der Habitateignung fachlich nicht vertretbar aber auch nicht angestrebt: Die flächenscharfen Potenzialkarten werden nicht als ‚absolute' Darstellungen der Habitatpotenziale in das Informationssystem ZAK übernommen, sondern in die Gemeindengeometrie umgesetzt und über ein Ranking der Gemeinden in relative Kenngrößen überführt. Auf diese Weise wird ein ‚unzulässiges' Hineinzoomen des Anwenders in Maßstabsebenen verhindert, auf denen die Potenzialkarten aufgrund der Genauigkeiten der verwendeten GIS-Datensätze nicht interpretiert werden dürften. Zudem ist die Umsetzung der naturräumlichen Situation in die administrativen Einheiten der Gemeinden bewusst angestrebt, um der Zielgruppe des Tools (Naturschutzverwaltung auf kommunaler Ebene) die Bedeutung des Naturraumpotenzials aus überregionaler Sicht zu verdeutlichen.

4.1 Umsetzung der Habitatpotenzialkarten in die Gemeindegeometrie

Die Umsetzung der flächenscharfen Habitatpotenzialkarten in die Gemeindengeometrie erfolgt über zwei Indikatoren:

Indikator 1: Anteil der Gemeinde an den landesweit größten zusammenhängenden Potenzialflächen
Indikator 2: Anteil der Gemeinde an kleineren aber stark vernetzten Potenzialflächen

Für Indikator 1 werden die ermittelten Potenzialflächen nach ihrer Größe sortiert und die größten zusammenhängenden Flächen ermittelt, die zusammen 25% der landesweiten Gesamtfläche des jeweiligen Anspruchstyps ergeben. Diese Flächen werden mit der Gemeindengeometrie überlagert, um diejenigen Gemeinden zu selektieren, die an dieser Auswahl - über einer Erheblichkeitsschwelle von 1 Hektar - Anteil haben (s. Abb. 2). Für Indikator 2 wird die Verbundenheit der Flächen untereinander modellhaft abgebildet und diejenigen Flächen ausgewählt, die gemäß Selektion nach Indikator 1 in geringem Umfang zu klein sind aber eine starke strukturelle Einbindung in das umgebende Flächengefüge (Konnektivität) erkennen lassen (s. Kap. 4.2).

Folgende Annahmen bezüglich Habitatqualitäten liegen dieser Vorgehensweise zugrunde: Große zusammenhängende Patches sind vorrangig zu schützen, da nur dort Arten mit großen Raumansprüchen überleben können und randsensitive Arten, die ungestörte Kerngebiete von Habitaten bevorzugen, bessere Überlebenschancen haben. Mit der Größe eines Habitats nimmt in der Regel auch die Diversität (z.B. Vegetationsstrukturen, Standortvielfalt) zu, was für viele Arten sogar als der eigentlich entscheidende Faktor der höheren Habitateignung betrachtet wird und nicht die Flächengröße an sich. In größeren Flächen ist die Ausbildung von Metapopulationen wahrscheinlicher, wodurch das Aussterben von Teilpopulationen kein endgültiger Zustand sein muss und zudem ein verstärkter Genaustausch zwischen den Populationen gewährleistet ist. Die ‚SLOSS'-Diskussion (single large or several small) hat gezeigt, dass kleinere Gebiete u.U. eine höhere Habitatdiversität aufweisen können als ein zusammenhängendes Gebiet vergleichbarer Größe. Aus diesem Grund und da mobilere Arten stark vernetzte Habitatflächen wie ein Habitat nutzen können, werden über Indikator 2 kleinere Gebiete mit hoher Vernetzung mit berücksichtigt.

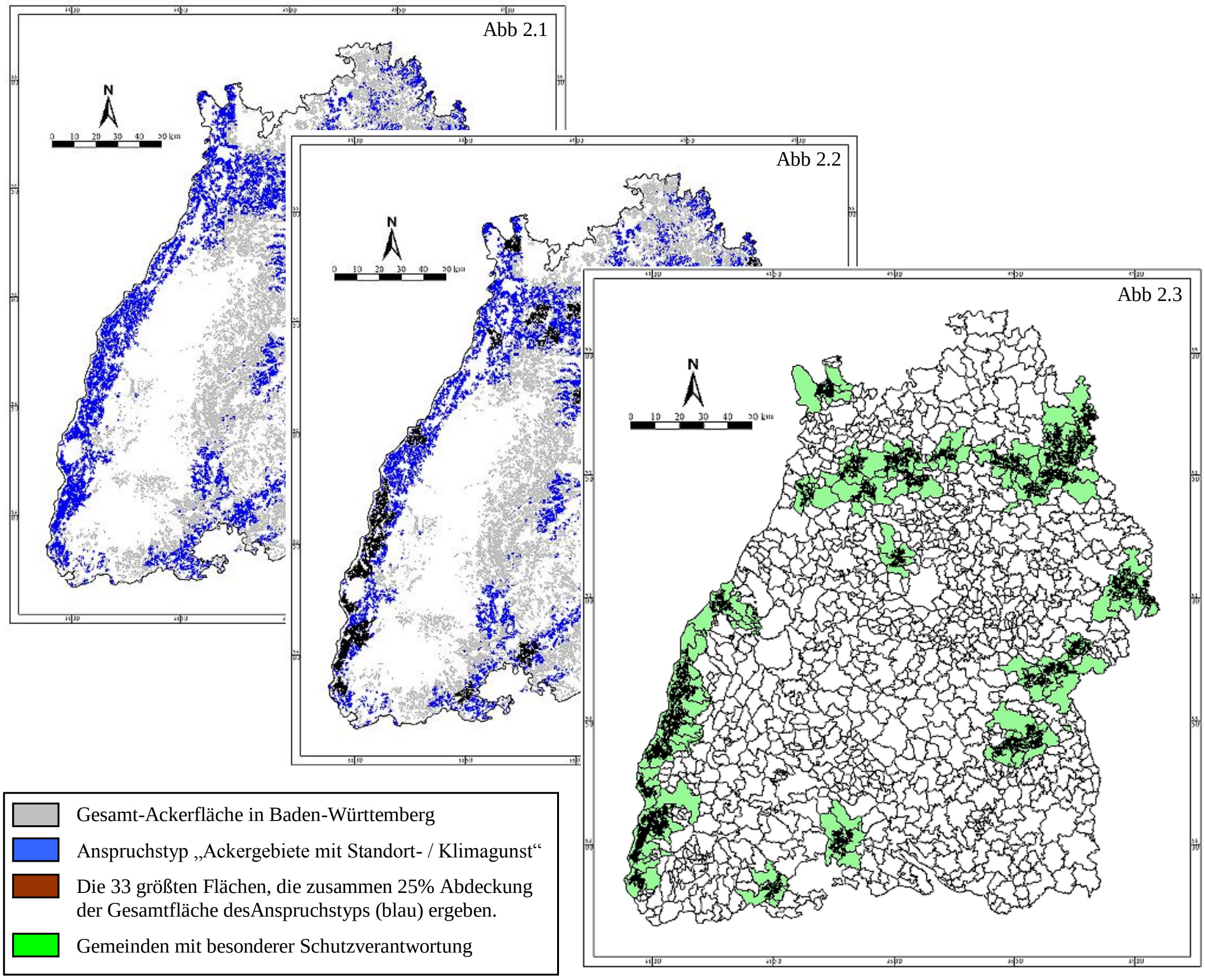

Abb. 2: Erläuterung des Indikator 1 am Beispiel des Anspruchstyps „Ackergebiete mit Standort- und Klimagunst“: Abb. 2.1 zeigt in Grau die Gesamtackerfläche Baden-Württembergs und in Blau den Teil, der über wissensbasierte Habitatmodellierung als Ackergebiete mit hoher Standort- und Klimagunst abgebildet wurde. In Abb. 2.2 sind in Schwarz die über das Rankingverfahren ermittelten größten Flächen des Anspruchstyps dargestellt, die summiert 25% der Gesamtfläche des Anspruchstyps (blau) ergeben. Abb. 2.3 zeigt in Gün die Gemeinden, die über 1 Hektar Anteil an den 33 größten Flächen des Anspruchstyps haben und denen damit eine besondere Schutzverantwortung aus landesweiter Sicht für diesen Anspruchstyp zugewiesen wird. Die Auswertung ist vorläufig, da Indikator 2 bei der Flächenauswahl noch nicht berücksichtigt ist.

4.2 Die Modellierung der Konnektivität von Habitatpotenzialflächen

Zur modellhaften Abbildung der Vernetzung (Konnektivität) der aus den Habitatmodellen hervorgegangenen Flächen (Indikator 2) wurde aufbauend auf der „Radialen Transektanalyse“ nach KUHN (1998), das Verfahren zur Konnektivitätsberechnung der „Radialen Sichtkantenanalyse“ (JOOß 2004b)entwickelt. Bei dieser in Abb. 3 verdeutlichten GIS-gestützen Methode werden alle Sichtkanten der umliegenden Flächen, die von einem ‚Focalpatch’ (FP) aus ‚gesehen’ werden können - d.h. nicht durch andere Flächen verdeckt sind - extrahiert (dicke Linien in Abb. 3). Diese Linien werden gerastert und die invers gewichteten Distanzen der Rasterzellen zum ‚Focalpatch’ aufsummiert (hier 8.78).

Aus tierökologischer Sicht stellt dieses Maß einen Erreichbarkeitsindex dar. Es kann als Wahrscheinlichkeit interpretiert werden, mit der ein Individuum, das ein Habitat ziellos verlässt – innerhalb einer arttypischen Wanderungsdistanz - in einer benachbarten Habitatfläche ankommt. Da bekannt ist von welcher Fläche eine Sichtkante jeweils stammt, können Indizes der Habitateignungen der Nachbarflächen wie Flächengröße oder Habitatqualität in Form von Ausschlusskriterien oder Gewichtungen in die Berechnung integriert werden. Zudem ist die räumlich explizite Berücksichtigung der Fläche zwischen den Habitatflächen möglich, in dem die Landnutzung hinsichtlich ihrer Traversierbarkeit artspezifisch bewertet wird. Hieraus können 3D-Oberflächen der akkumulierten Wanderungskosten erzeugt werden. Wird die Radiale Sichkantenanalyse in dieser ‚Kostenlandschaft’ ausgeführt, können über Schwellenwerte bestimmte Landschaftselemente wie Flüsse als unüberwindliche Barrieren wirken, da sie das Sichtfeld begrenzen und somit ‚dahinterliegende’ Flächen keine Sichtkanten beisteuern können. Andere Landnutzungen wie z.B. Nadelwald können bis zu einem artspezifisch gesetzten Wert an ‚Wanderungskosten’ eingesehen – also durchdrungen - werden, bevor sie ebenfalls als Barrieren wirken.

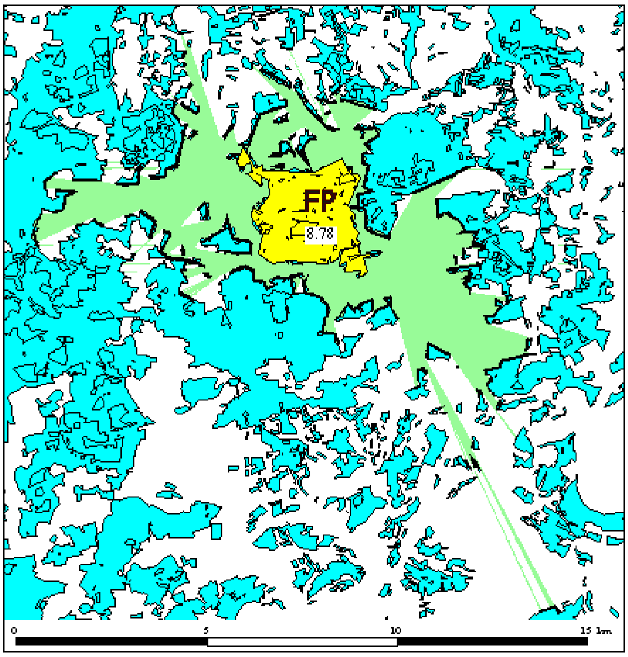

Abb. 3: Funktionsweise der „Radialen Sichtkantenanalyse“.

4.3 Zur Validierung der Habitatmodelle

Empirische Validierungen der im Projekt erstellten wissensbasierten Habitatmodelle werden im Rahmen einer Doktorarbeit durchgeführt. Die ermittelten Potenzialflächen und die daraus abgeleiteten Gemeinden mit besonderer Schutzverantwortung werden auf drei Maßstabsebenen mit faunistischen Verbreitungs- und Beobachtungsdaten überlagert und statistisch ausgewertet: Auf landesweiter Ebene stehen für die Zielarten der Artengruppen Vögel, Heuschrecken, Tagfalter/Widderchen, Amphibien und Reptilien Verbreitungsdaten bezogen auf 54 Naturräume 4. Ordnung und z.Tl. auf Gemeinden zur Verfügung. Auf regionaler Ebene werden mehrere tierökologische Studien mit Gesamtartenlisten für jeweils ca. 30-40 Untersuchungsgebiete und auf lokaler Ebene punktgenaue Detailerhebungen aus Planungsverfahren ausgewertet. Für die regionale Ebene stehen dabei die Anspruchstypen Streuobstgebiete und Kalk-/ Silikatmagerrasen im Mittelpunkt, da entsprechende Daten insbesondere für Vögel der Streuobstgebiete sowie für Tagfalter/Widderchen und Heuschrecken der Kalk- und Silikatmagerrasen zur Verfügung stehen.

Neben der Validierung der Habitatmodelle werden weitere verwandte Fragestellungen für die genannten Anspruchstypen und Artengruppen empirisch bearbeitet: Zur Prüfung der Hypothese der Zuordnung charakteristischer Artenkollektive zu Anspruchstypen werden Artengemeinschaften bezüglich Kombinationen von Habitatfaktoren wie Flächengröße, Habitatkonnektivität und -qualität, Höhenlage, etc. analysiert. Hinsichtlich der These des ‚Mitnahmeeffekts’ von Schirmarten für bestimmte Artenkollektive erfolgen Koexistenzanalysen der tierökologischen Studien, die auf regionaler Ebene zur Verfügung stehen.

5 DISKUSSION

Die bisherigen Ergebnisse der Habitatmodellierung zeigen, dass für die bearbeiteten Anspruchstypen fachlich vertretbare und im Hinblick auf das Anwendungsziel sinnvoll verwertbare Resultate erzielt werden können. Relativ zur Größe des Bearbeitungsgebiets (Landesfläche ca. 37.000 km²) stehen in Baden-Württemberg mittlerweile sehr hoch aufgelöste GIS-Datensätze landesweit zur Verfügung. Speziell die Biotopkartierung nach §24a des Landes-Naturschutzgesetztes mit über 350.000 Einzelflächen und sehr hoher räumlicher und inhaltlicher Auflösung stellt neben den flächendeckend vorliegenden Datensätzen wie dem Amtlichen Topographisch-Kartographischen Informationssystem (ATKIS), der standörtliche Kartierung, den geologische Einheiten, der Landsat-Szene der Landnutzung und dem Digitalen Geländemodell eine wesentliche Grundlage der Potenzialanalysen dar. Einzelne Anspruchstypen werden nicht in vergleichbarer Weise bearbeitet werden können (z.B. Arten extensiv genutzten, artenreichen Grünlands). Auf diese wird im „Informationssystem ZAK“ deutlich hingewiesen werden, um eine systematische Übervorteilung der gut bearbeitbaren Anspruchstypen zu vermeiden.

Die dargestellte Methodik hat nicht den Anspruch landesweit flächenscharfe Daten zu quantifizierbaren Habitateignungen zu generieren. Die ermittelten flächenscharfen Ergebnisse auf dichotomer Aussageebene (‚geeignet’ / ‚nicht geeignet’) werden durch die Umsetzung in die Gemeindengeometrie in gemeindebezogene Indizes überführt, anhand derer ein relatives Ranking der Gemeinden untereinander erfolgt. Die flächenscharfen Potenzialkarten werden nicht im „Informationssystem ZAK“ veröffentlicht. Mit dieser Vorgehensweise ist nach Meinung der Projektbearbeiter eine fachlich vertretbare Relation von Modellgenauigkeit zu Interpretationsmaßstab gegeben. Es wäre sicherlich falsch dem Anwender die flächenscharfen Potenzialkarten zur Interpretation auf beliebiger Maßstabsebene (z.B. durch Zoomfunktionen) zur Verfügung zu stellen. Die gemeindenbezogene Ermittlung von Schwerpunktgebieten in Baden-Württemberg für den vorrangigen Schutz und die Entwicklung der bearbeiteten Anspruchstypen aus landesweiter Sicht ist mit der dargestellten Vorgehensweise dagegen möglich.

Der vorgestellte Ansatz der Habitatmodellierung zielt auf die Unterstützung von Planungsentscheidungen im Sinne eines ‚decision support systems’ ab (BLASCHKE 2000, 18) - nicht jedoch als ‚decision making system’. Nicht die Konkurrenz zu tierökologischen Geländeerhebungen ist angestrebt, sondern im Rahmen des Scoping-Prozesses die großräumige Ermittlung von Gebieten, die aufgrund ihrer Größe und / oder Dichte an Habitatpotenzialflächen für Geländeerhebungen und die Umsetzung von Schutz- und Entwicklungsmaßnahmen besonders geeignet sind. Dadurch können tierökologische Untersuchungen fachlich fundiert konkretisiert werden, um den Untersuchungsumfang zu Gunsten der –tiefe sinnvoll zu reduzieren, woraus eine höhere Qualität bei gleichen oder auch geminderten Kosten folgt. Zudem kann der überregionale Kontext eines Bearbeitungsgebiets stärker in den Untersuchungen berücksichtigt werden, um einen Artenschutz zu unterstützen, der sowohl die lokalen Potenziale eines Planungsgebietes wie auch dessen Lage im naturräumlichen Zusammenhang berücksichtigt.

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1, 2, … Scheibenhardt? – Raumgerüst Region Karlsruhe 2030
Konzepte für eine gestaltende und langfristig haltbare Regionalplanung

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1 DAS UNVORHERSEHBARE UND DIE PLANUNG

Die Welt wird vernetzter, komplexer und unvorhersehbarer: Große Entwicklungslinien in Politik und Wirtschaft sind immer weniger vorherzusagen, Naturkatastrophen verändern plötzlich und überraschend heftig ganze Landstriche, Strömungen in der Gesellschaft, wie die Zukunft unserer Arbeitswelten oder Sozialsysteme, wandeln sich in immer kürzeren Zeitabständen. Nichts ist mehr sicher, vieles hängt von Unwägbarkeiten, von Vorlieben und Entscheidungen einzelner Personen oder von plötzlichen, aber dann wieder genauso vergänglichen Modeerscheinungen ab, so dass jede Form von übergeordneter Planung fragwürdig und fast schon überflüssig scheint.

Abb.1: Die Welt wird immer unvorhersehbarer. Was bringt die Zukunft? Schwierige Zeiten für Planung.

Vor diesem Hintergrund nehmen die Schwierigkeiten der Planung mit der Länge des zeitlichen Horizonts und der Größe des Betrachtungs- und Planungsraums erheblich zu. Die planende Disziplin tut sich in zunehmendem Maße schwer, überhaupt noch in die tatsächliche regionale Entwicklung einzugreifen. Diese „passiert“ anscheinend (und gleichzeitig offensichtlich!) von selbst: Die kleinen und großen Veränderungen auf dem Gemarkungsbereich jeder einzelnen Gemeinde erzeugen in ihrer Gesamtheit den realen Zustand der Region, der in der Fachwelt heftig diskutiert wird: zunehmende räumliche Uniformität und ein schleichend zu beobachtender Plastizitätsverlust, vor allem am Rande der verstädterten Bereiche. Der Gemeinde selbst, mit ihren eigenen Problemen und Aufgaben von Natur aus recht innenbezogen, erscheinen indes irgendwelche übergreifenden Ideen und Konzeptionen oft müßig und entbehrlich. Trotzdem ist ganz selbstverständlich nach wie vor eine Regionalplanung an der Tagesordnung, die erklärtermaßen eine geordnete strukturelle Entwicklung auf regionaler Ebene gewährleisten und für die nächsten zehn, fünfzehn Jahre Gültigkeit besitzen will, den tatsächlichen Geschehnissen oft aber doch nur frustriert „hinterherplant“.

Es stellt sich also die Frage, wie regionale Planungen und Konzepte aussehen sollten, die in der Lage sind, mit eben jenen Unwägbarkeiten und Problemstellungen umzugehen, die im herkömmlichen Sinn eigentlich unbeplanbar sind.

Die heutigen Planungskonzeptionen werden beherrscht von einer den Zufall möglichst ausschließenden „Idee der Rationalisierung, im Sinne einer absoluten Kontrolle, der Ausschaltung des Unvorhersehbaren und der gleichzeitigen Einrichtung einer ebenso perfekten wie definitiven Ordnung“, so André Corboz. Auf dem Weg in die Phase der „territorialen Stadt“ hingegen bedürfe es ganz eigener Entwurfsansätze: Konzepte im Sinne eines Städtebaus, der der Spieltheorie zugehörig ist, der zufolge „die Spieler sich entscheiden, ohne die einzelnen Gegebenheiten des Problems zu kennen, von denen einige bekannt sind, andere zufallsbedingt, wieder andere unbestimmbar“. [103]

Wir wollen diese Anregung aufnehmen, um sie mit einer inhaltlichen Komponente zu füllen, die in der bisherigen Praxis von untergeordneter Bedeutung ist, obwohl sie zum Umgang mit dem Unvorhersehbaren beitragen kann: die Gestalt und die Gestaltung des regionalen Raumes, die doch als fundamentale Grundlage der Wahrnehmbarkeit, Erlebbarkeit und Identifikation für Bewohner und Benutzer von höchster Bedeutung sind. Wir meinen, dass Planung sich schon im regionalen Maßstab analytisch und konzeptionell mit der Raumgestalt von Stadt und Landschaft auseinandersetzen muss, wenn sie ernsthaft mit den aufkommenden räumlichen Unwägbarkeiten zurecht kommen will. Denn was sich aus diesen unter Beibehaltung der bisherigen Ordnungsinstrumente entwickelt, zeigt sich schon recht deutlich in regionalen Gestaltdefiziten: sich immer stärker angleichende Siedlungsmuster, flächenhaft additives Siedlungswachstum, oftmals willkürliche Verteilung bestimmter Nutzungszonen, Missachtung lokaler Vorraussetzungen. Vor diesem Hintergrund und mit den dargestellten Rahmenbedingungen starten wir in das beschriebene Aufgaben- und Spannungsfeld.

2 1, 2, ... SCHEIBENHARDT? – RAUMGERÜST REGION KARLSRUHE 2030

2.1 Zielsetzung

Das erklärte Ziel von 1, 2, ... Scheibenhardt?[104] ist, nach alternativen Entwurfsmethoden für regionale Maßstäbe und lange Zeiträume zu suchen und dabei unkonventionelle, mitunter gezielt spielerische Mittel einzusetzen und anzuwenden. Am Beispiel der Stadtregion Karlsruhe wird versucht, sich von bekannten Denkmustern der Planung und Betrachtungsweisen der „Region“ zu lösen und über die starke Einbeziehung von morphologischen Grundlagen zu einem weitgehend prognoseunabhängigen und möglichst

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[103] Corboz, André: Die Kunst, Stadt und Land zum Sprechen zu bringen. S. 70ff

[104] Martin Berchtold, Christoph Durban, Philipp Krass, Markus Lang: 1,2,… Scheibenhardt? – Raumgerüst Region Karlsruhe 2030 – Morphologisches Entwerfen für lange Zeiträume. Diplomarbeit an den Lehrstühlen Städtebau, Prof. Markus Neppl und Landschaftsplanung, Prof. Hanns Stephan Wüst, Universität Kaiserslautern 2002. Informationen unter: www.1-2-scheibenhardt.de

ergebnisoffenen Konzept für die Stadtregion zu kommen. Dabei werden zwei Hauptziele verfolgt: zum einen die Entwicklung einer dem Raum entsprechenden Gestaltungsperspektive auf Grundlage lokaler Fähigkeiten und Besonderheiten, zum anderen die Verlängerung der Haltbarkeit von Planung. Dies soll erreicht werden über das „Sich-zu-Nutze-Machen" der besonderen morphologischen Eigenschaften der Region, das heißt Unterstützung der Planung durch raumeigene Begabungen und Widerstände – anstelle eines anscheinend allgemeingültigen, dem Gesamtraum „übergestülpten" Planungsprinzips, das diese Voraussetzungen ignoriert. Dies implementiert die gezielte Abkehr von nutzungs- und funktionsbezogenen Darstellungen (wie z. B. „Gewerbegebiet") und eine Hinwendung zu qualitativen Aussagen (wie z. B. „Körnigkeit" oder „Stabilitätslinien"), die nicht nur eine einzige, nutzungsbestimmte Planungskomponente abdecken und verschiedene mögliche Zukünfte zulassen.

2.2 Haltbarkeit durch Unbestimmtheit?

Das Ergebnis der Arbeit stellt entsprechend keinen Endzustand dar, sondern liefert ein stabiles Gerüst für langfristige räumliche Entwicklungen unter Rahmenbedingungen, die sich unvorhersehbar ändern dürfen, ohne dass dieser Umstand die Grundsätze der Konzeption zu verwischen in der Lage wäre. Das Gerüst muss daher offen für mögliche Veränderungen sein und flexibel für Anpassungen, sozusagen „unfertig" im Sinne eines „Halbfabrikats"[105]. So müssen an manchen Orten fixe, zwingende Regeln aufgestellt werden, die an anderer Stelle umfassende Freiheiten ermöglichen. Sämtliche Regeln und Prinzipien des Konzeptes dürfen dabei aber nur soweit bestimmt sein, dass sie den Möglichkeiten bzw. Fähigkeiten des Raumes entsprechen, aus dessen Eigenschaften sie abgeleitet werden, sprich: die Leistungsfähigkeit eines Raumes darf nicht überfordert werden. Dieser Zusammenhang erhöht die Haltbarkeit des Konzeptes erheblich.

Dazu muss ein erweitertes Raumverständnis zugrunde gelegt werden: der Raum als Palimpsest, der auf seinem kostbaren Material, dem nicht zu vervielfältigenden Boden, Spuren der Erdgeschichte sowie Hinterlassenschaften vieler verschiedener Benutzer, unterschiedlichen Nutzungen und häufiger Transformationen birgt, die teils unsichtbar, teils verschwommen, manchmal aber noch ablesbar sind: dem Raum eingeschriebene Besonderheiten, Eigenheiten und Stärken.

2.3 Morphologischer Ansatz

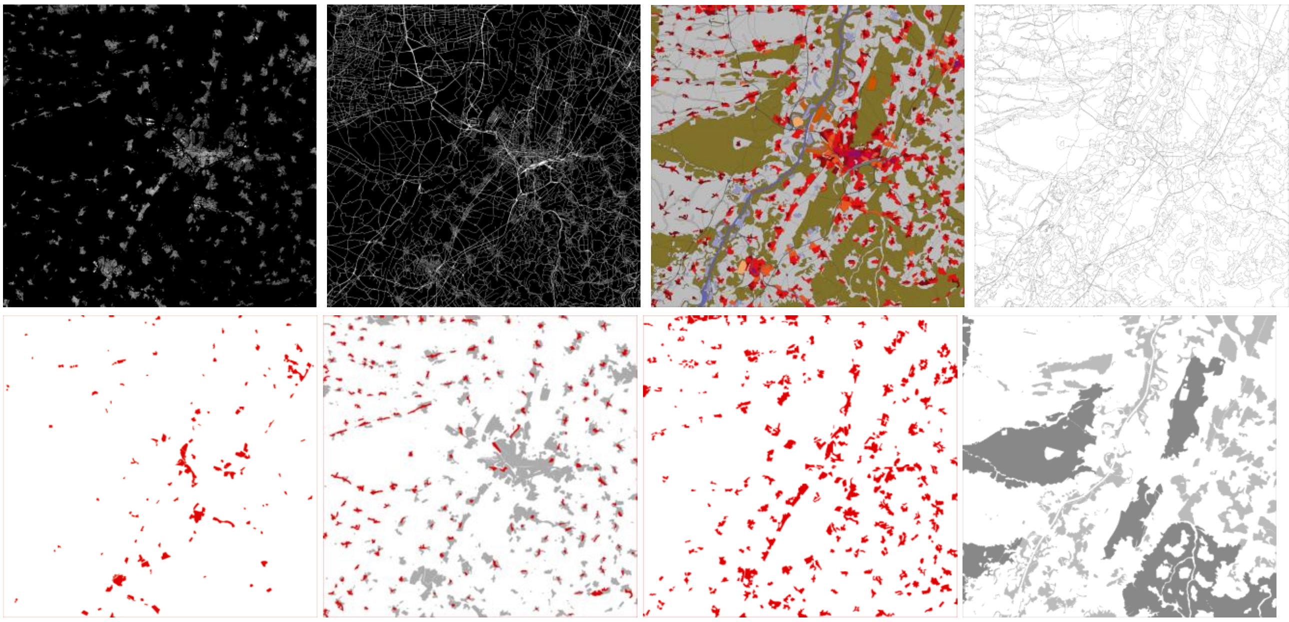

Abb.2: Regionale Schwarzpläne Siedlung und Verkehr, Gesamtschau der Einheiten, Grenzen als „Gerüst"
Verteilung der Einheit „Gewerbe", „Ortskern" mit allen Siedlungsflächen, „Ortserweiterung", verschiedene Typen „Wald"

Grundlage der räumlichen Analyse bildet die morphologische Basis: Siedlungs- und Landschaftsstrukturen sowie die Topografie werden nach ihrer Art und Verteilung untersucht. Elemente mit ähnlichen Eigenschaften werden zu Einheiten zusammengefasst (Siedlungstypen, Freiraum, Wald, Gewässer, Infrastruktureinrichtungen). Der gesamte Untersuchungsraum wird anhand dieser Einheiten dargestellt. Das Bild ähnelt den bekannten kartographischen Darstellungen und stellt den Status Quo der Region dar. Dieses Bild zeigt die Konfiguration der Region, die Anordnung der Einheiten zueinander. Genau diese Konfiguration ist das Besondere einer Region und unterscheidet sie von anderen, denn „Gewerbegebiete" und „Wald" gibt es auch in Hamburg oder Wien, jedoch in ganz anderer Anordnung. Entfärbt man diese flächige Einheitenkartierung so bleiben die Grenzen der Einheiten übrig. Diese Grenzendarstellung kann als das Skelett der Region interpretiert werden. Alle zukünftigen Entwicklungen werden von diesem Zustand ausgehen und das Skelett mehr oder weniger stark „verbiegen". Um die Bedeutung der Konfiguration klar herauszustellen, wurde das Skelett versuchsweise nach unterschiedlichen Prinzipien gefärbt. Im Ergebnis entstehen auf derselben Grundlage völlig unterschiedliche Bilder.

105 vgl. Raith, Erich: Stadtmorphologie, S. 201ff

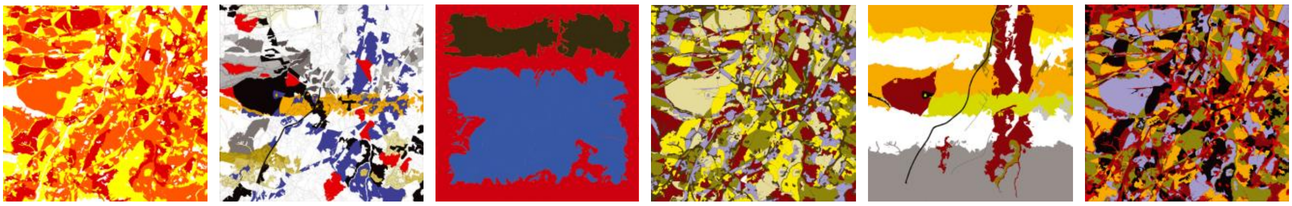

Abb.3: Verschiedene Bilder: Konfigurationen von Farben und Formen auf Grundlage desselben Gerüsts

2.4 Übersetzung in Eigenschaften

Diese Einheiten werden nun nicht mehr nach ihren Nutzungen, sondern anhand ihrer formalen und physiologischen Eigenschaften dargestellt. Unter Form wird hier die Struktur der Einheiten (Körnigkeit, Dichte, Durchmischung), ihre Dimension mit den sich daraus ergebenden Raumtypen, Raumkanten und Landmarks sowie die Richtungen der Einheitengrenzen verstanden. Die Rubrik der Physiologie untersucht die verhaltensbezogenen und prozessorientierten Eigenschaften der Einheiten; darunter fallen u. a. die Vielfalt und Intensität verschiedener menschlicher Aktivitäten und die Dynamik der Einheiten (Selbstveränderungspotenzial, Beseitigungswiderstand und Expansionsfähigkeit), die Aufschluss über ihre Transformationsfähigkeit geben.

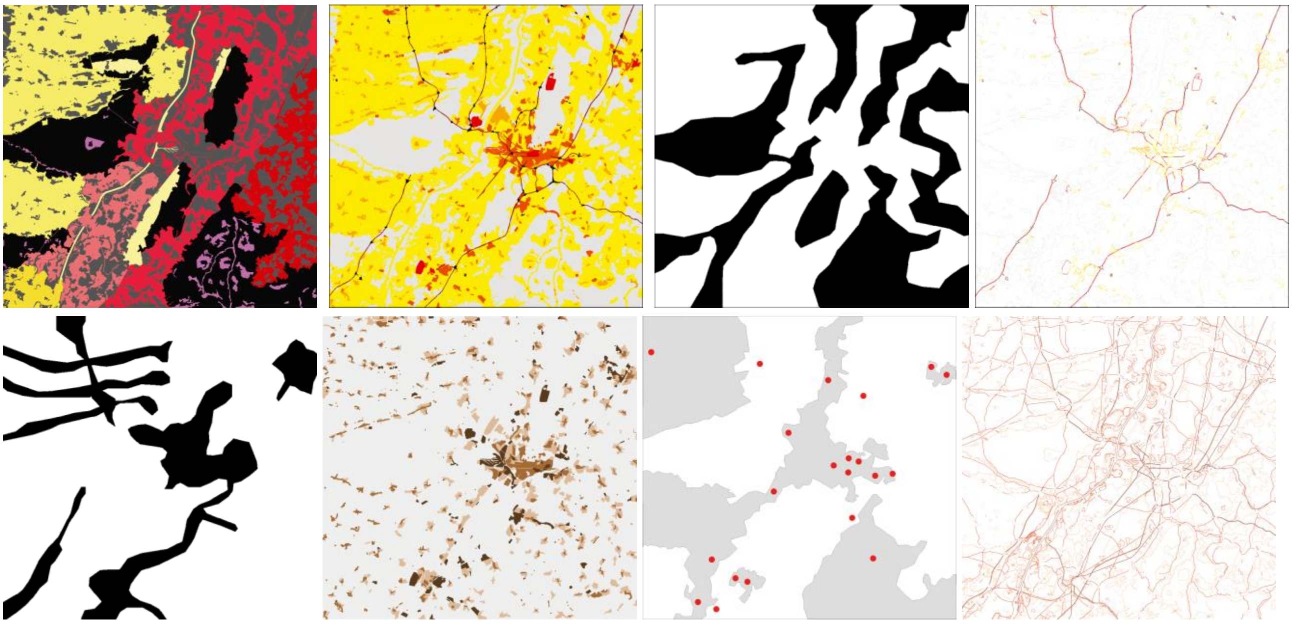

Abb.4: Konfiguration von Eigenschaften: Dimension und Raumtypen, Aktivitätenintensität mit Interpretationsskizze, Intensitätssprünge, Interpretationsskizze der Aktivitätenvielfalt, bauliche Durchmischung, Bedeutungselemente, Stabilitätslinien = Raumwiderstand

Die dadurch entstandenen Karten zeigen Konfigurationen von Eigenschaften, qualitative Aufnahmen der Region, und geben Aufschluss über ihren Charakter, sowie die Art und Verteilung von lokalen Begabungen. Manchmal entsteht so ein ganz neues Bild der Region. Interessante Orte sind darüber hinaus die Grenzen zwischen zwei Einheiten als Übergang von einer Einheit zu ihren Nachbarn, Dort zeigen die Analysen sehr deutlich Eigenschaftssprünge, -brüche und Linien unterschiedlicher Stabilität.

Die verschiedenen Analyselayer werden miteinander verglichen, übereinander gelegt und interpretiert. Hier kristallisieren sich sehr deutlich Teilräume mit ganz charakteristischen Merkmalen, Begabungen und Entwicklungsmöglichkeiten heraus. Diese bilden die Grundlage für die Erarbeitung des Raumgerüsts, das als langfristiger Rahmenplan für eine regionale Entwicklung gelesen werden kann.

2.5 Das Raumgerüst und wie man es liest

Das Raumgerüst ist ein Entwurf. Es entwickelt sich in einer Art transformatorischen Prozesses aus der Interpretation der durchgeführten Analysen und zeigt eine Möglichkeit, Regeln für räumliche Prozesse grafisch darzustellen. In diesem Gerüst werden nicht bestimmte Nutzungszuordnungen oder Funktionen ausgewiesen, sondern Raumprinzipien und Eigenschaften im Wortsinn „aufgezeichnet“, die vielfältige (funktionale) Belegungen zulassen. Eine je nach Standort unterschiedlich dichte Raumprinzipienaussage und die Definition der anzustrebenden morphologischen Qualitäten führen zu einer differenzierten Konzeption, die sowohl Orte mit äußerst wenigen Spielräumen (dies sind die Fixpunkte und Determinanten des Konzeptes), als auch Bereiche mit höchster Flexibilität schafft. Zu jedem Bereich gibt es verbale und skizzenhafte Erläuterungen, die Regeln, Prinzipien und Spielräume der Darstellungen verdeutlichen.

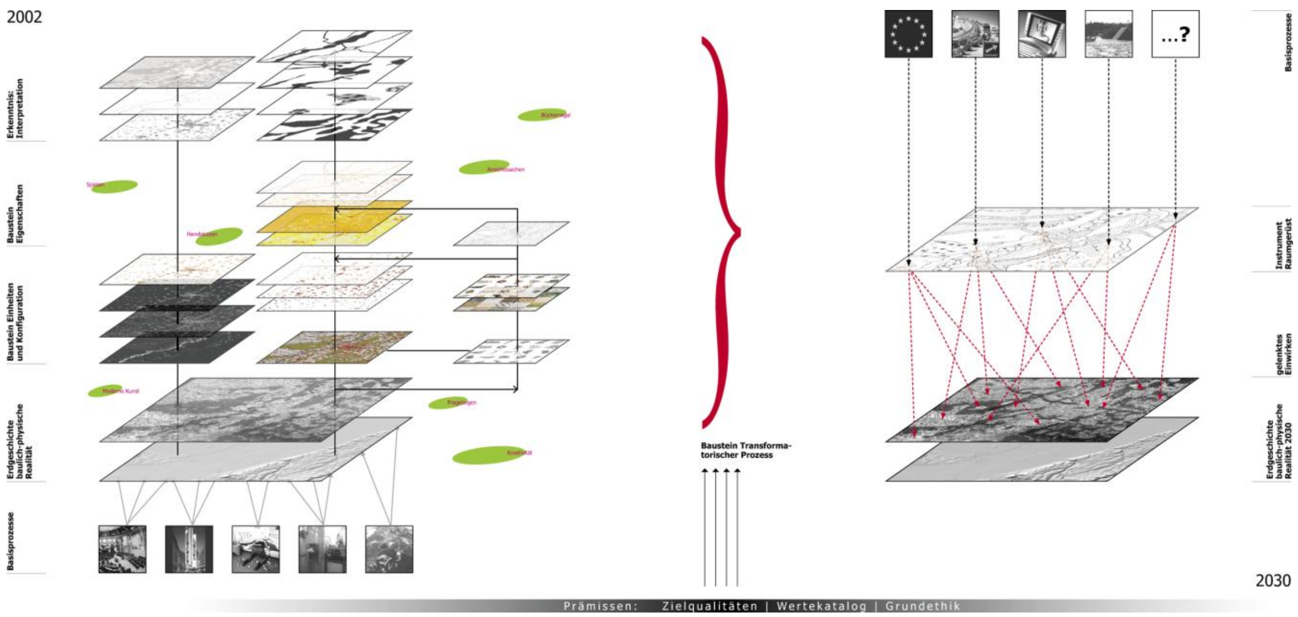

Abb.5: Vorgehensweise

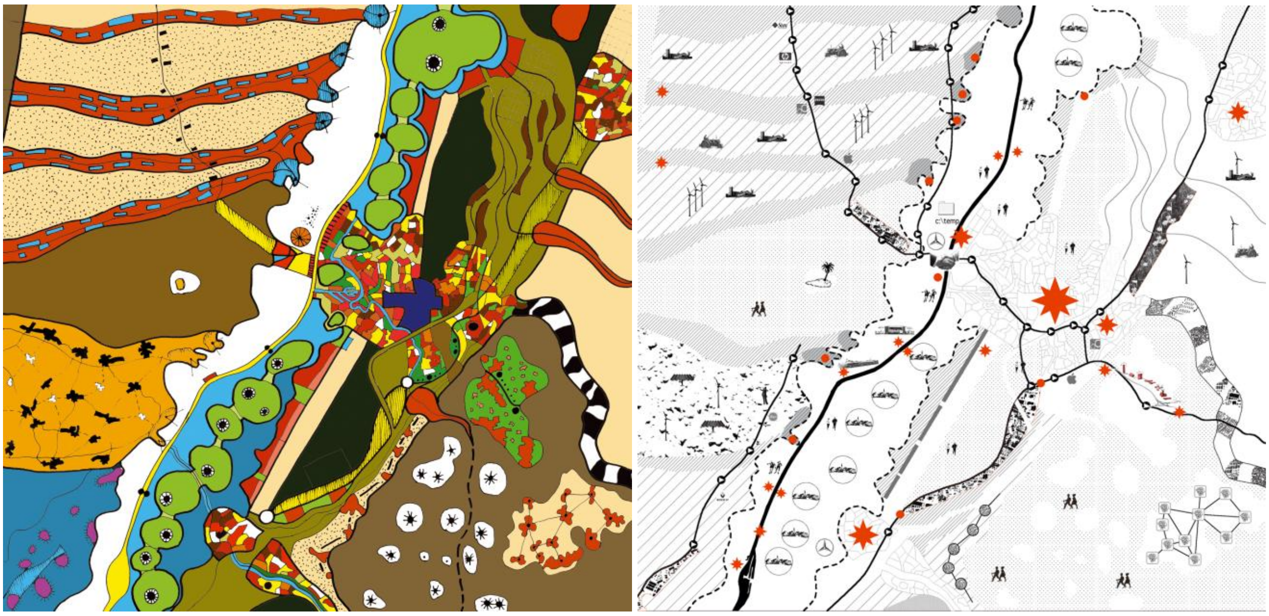

Abb.6: Raumgerüst Region Karlsruhe 2030, zwei Darstellungsformen

Das Raumgerüst ist wie ein Gemälde. Es „spielt" mit Formen und Farben in differenzierter Konfiguration und besitzt vielleicht durchaus ästhetische Qualitäten. Es abstrahiert, übertreibt, wo nötig. Es ist gleichermaßen interpretationsbedürftig, wie man es von einem Konzept langfristiger Beständigkeit erwarten sollte. Man erkennt Bereiche ähnlicher Formensprache und Farbgebung, dann wieder starke Brüche. Es gibt Elemente, die sich quer über den Ausschnitt ziehen, andere tauchen nur wenige Male auf. Doch hinter jedem „Pinselstrich" steckt eine Logik, ein Prinzip. Ein vom Planer gezeichneter Entwurf, durchaus subjektiv, aber auf Grundlage der Interpretation aller durchgeführten Analyseschritte. So lässt sich jeder Teilbereich letztlich von den je nach Raumcharakter unterschiedlich gewichteten Karten der Eigenschaftenkonfiguration ableiten, wie die nachfolgende Auswahl von Abbildungen verdeutlicht.

Abb.7: Bereich „Raumadern Südpfalz" des Raumgerüstes Karlsruhe 2030 mit Ausschnitten der Analysekarten
Dimension – Aktivitätenintensität – bauliche Durchmischung – Raumrichtungen

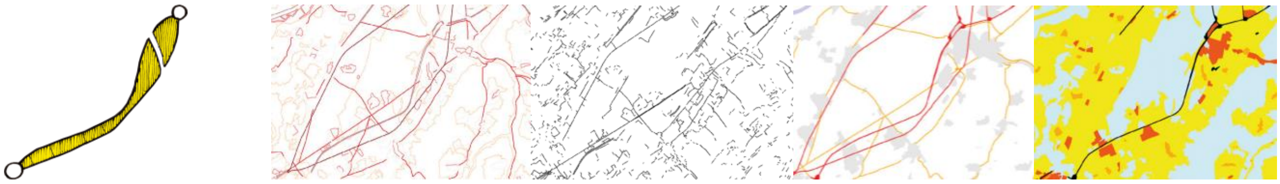

Abb.8: „Korridor“ zwischen Karlsruhe und Rastatt mit Ausschnitten der Analysekarten
Raumwiderstand/Stabilitätslinien – Raumrichtungen – Geschwindigkeiten – Aktivitätenintensität

3 ABSICHT

1, 2, … Scheibenhardt? stellt den Versuch dar, einen neuartigen, alternativen Entwurfsansatz für den Umgang mit Stadtregionen zu finden, und als das muss das Konzept „Raumgerüst“ auch bewertet werden: als erster Schritt in eine zusätzliche, auf qualitative Aussagen hin ausgerichtete Planungskultur; nicht als fertige Lösung, sondern als Anstoß, der kritische Resonanz hervorrufen soll.

Der Nutzen des Raumgerüsts besteht zunächst in der bildhaften Darstellung gestaltstruktureller Sachverhalte, die auf regionalem Maßstab meist so überhaupt nicht zum Tragen kommen. Es macht aus externer Sicht (bewusst ohne tagespolitische Befindlichkeiten oder verwaltungstechnische Sachzwänge) Vorschläge zur gestaltstrukturellen Entwicklung eines großen Gebietes über einen langen Zeitraum. Das Raumgerüst schafft einerseits durch die Definition grundlegender Raumprinzipien eine einfache und doch starke Ordnung, andererseits berücksichtigt, lenkt und kanalisiert es durch die Verwendung von flexiblen Eigenschaften langfristig das Unvorhersehbare und die Unordnung. Es kann dazu beitragen, die „Region“ aus einem andern Blickwinkel zu sehen. Es zeichnet ein – vielleicht ungewöhnliches – Bild der Region, das aufgrund seiner Darstellung sehr einprägsam ist und somit als Träger einer Vorstellung von räumlicher Entwicklung und einer Idee von „Region“ dienen kann. Das Raumgerüst soll schließlich Diskussionsgrundlage sein, um Kooperationen auf regionaler Ebene anzuregen.

Unsere weitere Arbeit wird sich künftig auf zwei Forschungsfeldern bewegen: zum einen die Fortentwicklung des methodischen Ansatzes und die Übertragbarkeit auf andere Räume und Regionen, zum anderen die Untersuchung der Chancen und Möglichkeiten, das Raumgerüst bei Planern, Entscheidungsträgern und Benutzern der Region bekannt zu machen und schließlich als Methode und Instrument zu etablieren. Zu letzterem sollen hier noch einige Gedanken gezeichnet werden, denn wer sind die Adressaten bzw. die Mitspieler eines möglichen Umsetzungsprozesses? Wer profitiert vom Raumgerüst, und inwiefern?

Das Raumgerüst spiegelt die Außenwahrnehmung externer Fachleute wieder. Aus dieser Warte kann es als Kommunikationsinstrument eingesetzt werden, um die qualitativen Aspekte eines Planungsraumes in einem einprägsamen Bild zu visualisieren und Sachverhalte in den Fokus zu rücken, die im tagespolitischen Planungsgeschäft unbequem sind. Aus der Überlagerung dieser Außensicht mit der Innenwahrnehmung der Einwohner und regionalen Entscheidungsträger ließe sich eine auf breiter Grundlage getragene regionale Planungsstrategie weiterentwickeln.

Die Region profitiert als Ganzes durch die Erhöhung der Diversität. In jeder Hinsicht wird eine größere Vielfalt unterschiedlicher Standorte definiert, die für alle Raumansprüche wesentlich attraktiver sind als durchgängige Uniformität. Die Region bekommt dadurch ihr besonderes Image, ihre besondere Prägung. Die einzelne Gemeinde erfährt eine erhebliche Aufwertung durch die Schärfung ihres ganz individuellen Profils. Der einzelne Bewohner der Region gewinnt durch klarere Identitäten und die Zugehörigkeit zu einem bestimmten Formencodex. Bewohner, Gemeinde und Region sind in derselben Weise positiv betroffen.

Gleichzeitig müssten vor allem die Gemeinden Veränderungen in Kompetenzverteilung, Rechten und Pflichten hinnehmen. Die Chancen der verschiedenen Gemeinden definieren sich nämlich sehr unterschiedlich und auf den ersten Blick – und nach geltender Staatsordnung – außerordentlich ungerecht. Oft werden Entwicklungsmöglichkeiten beschnitten, um an anderer, besser geeigneter Stelle die dortigen Fähigkeiten des Raumes auszunutzen und eben diese Entwicklungen zuzulassen. Andere Gemeinden befinden sich dagegen in bester Lage mit Expansions- und Entwicklungsmöglichkeiten. Zentralismus und Beschränkung an Fixpunkten und Determinanten auf der einen, Flexibilität und Selbstorganisationsprozesse in offenen Bereichen auf der anderen Seite: Das kann nur gerecht funktionieren, wenn sich Rechtsstrukturen, Mittelverteilung und Verwaltungsgrenzen in offeneren Konstellationen bewegen. Außerdem müssen Entscheidungsträger, Planer und Bewohner vor Ort als Mitspieler gewonnen werden, unter Federführung einer noch zu definierenden Interessensgemeinschaft oder Regionalinstitution am Bild der Region mitzuarbeiten.

In diesem Sinne fällt abschließend das Augenmerk noch ganz aktuell auf den „Verein Region Bern“ als Vorkämpfer einer ganz ähnlichen Idee: hier beginnt in diesen Tagen eine Ideenkonkurrenz, die externe, interdisziplinäre Fachleute ein Bild der Region Bern zeichnen und entwerfen lässt. Solcherlei Vorhaben weisen den Weg in die Zukunft einer regionalen Planungskultur, die Raumgestalt, Unvorhersehbarkeiten und langfristige planerische Haltbarkeit in einem großen Konzept zusammenführt.

🏆 reviewed paper

The potential of Community Mapping and Community Integrated GIS: A study in the Sofala Province, Mozambique

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1 INTRODUCTION

Accurate spatial information for rural Mozambique is lacking. Due to its long-term struggle with a civil war and its consequences maps are outdated and incomplete. Forced to tackle with disasters (cyclones, inundation, droughts, fire) and urgent required planning issues (health, infrastructure,…) mapping activities were recently undertaken.

Rural Mozambique is traditionally shaped by microscale land use patterns (<1 ha, for e.g. fuel wood, agriculture). Community members directly depend on the local environment and the local climatic conditions. The drivers of land use are not fully understood, because land use changes occur mainly at household and community level; thus must be studied at the local level. Linear aggregation of these pattern to a larger area is dangerous. Whereas individuals can easily control the set-up of their homes, this is not the case for the landscape scale. Here they depend on the assent of the other inhabitants and especially of the landowners if they want to conserve or even reshape certain settings of the landscape. From a psychological point of view, having an influence on shaping the community is crucial for a need-oriented, sustainable development of the community.

In the traditional system there is, generally speaking, a very distinct continuity in community development, but also largely distributed opportunities to participate in shaping the community—whereby the individual scope of action was strongly limited by collective rules. So we can say that the functions of home can be fulfilled in a collective way typical for a traditional system: the inhabitants can identify collectively with their landscape and the social interaction can take place within the traditional framework. A challenge arises when we simply map the physical outcomes of such a system and by using the land use pattern as a super indicator for the community 'behaviour'.

Current Mozambican land law regulations allow two stages of cadastral land recording called delimitation and demarcation, both involving community mapping and participatory GIS as tools. A number of organizations are working in Mozambique on the implementation of land use rights, which also includes community based land use and natural resources planning. Within this paper we describe the methodology of community mapping and its position within the scientific PGIS (participaroy GIS) debate. Finally conclusions and recommendations gained from practical experiences at field are drawn.

2 COMMUNITY MAPPING AND PARTICIPATORY GIS

2.1 Concepts and definitions

Over the last ten years a debate has evolved about the use of GIS for spatial planning in combination with participatory planning approaches. Conceptual and methodological discussions are ongoing and evaluations in regard to usability of these approaches are still underway. Terms and concepts are not always used the same way and standardized methodologies are still not available. Various terms for similar or related techniques are circulating such as Participatory GIS (PGIS), Public Participation GIS (PPGIS), Community-Integrated GIS (CIGIS; Weiner & Harris 1999), Community Mapping or Participatory 3-Dimensional Planning (P3DM).

PGIS methods are widely used in developed societies for urban community neighbourhood identification, problem prioritisation, and participatory planning. In developing countries applications are mainly centred on natural resource identification and management, hazard mapping and disaster risk management as well as simplified cadastral recording (McCall 2004; examples from Mozambique: Nhantumbo, et al., 2003; Steinbruch, 2003).

The authors of the paper distinguish between PGIS (Participatory GIS) as a tool, and PPGIS (Public Participation GIS) as planning context and/or organisational framework.

For the purpose of the undertaken work we use the following definition:

- "Community Mapping" is a method:
- to gain spatial information about the boundaries of communities
- as a means of participation in the sense of "consolidation"
- to understand the environment of communities and related spatial decisions (e.g. living closer/farer to/from a river, relationship to forests)

Consequently, community mapping can be seen as an example or a subset of participative GIS (PGIS)

"Community" can be defined by physical proximity to others and the sharing of common experiences and perspectives. The word has become synonymous with neighbourhood, village or town, although communities can also exist in other forms – e.g. through professional, social, or spiritual relationships (Weiner, Harris, Craig 2002). Participation may be understood as allowing the public to influence the outcome of plans and working processes. This concept is very general and may serve as a container concept covering all forms of participation in decision-making. In practice and especially from a GIS perspective one has to define the rights to participate, to object or to collaboratively decide. From a theoretical point of view Blaschke (2004) distinguishes between different kinds of participation levels: a) approaches focusing on a broad public b) a stakeholder centered approach. The empirical method in this paper is a compromise which includes many individuals but gives a priority to the meaning of some representatives 'elders' in the respective communities.

2.2 Participation in the Mozambican context

Since the 1970s and 1980s many African countries are undergoing political changes from highIy centralized to decentralised and democratic structures of governance – a process, which have been started in Mozambique in 1992 with the end of the civil war quite late. However, this political reformulation brought the legal base for participative approaches.

In Mozambique community and participative mapping provides the legally required documents for the delimitation of community land. It serves as a realistic solution to overcome the bottleneck of fast standard cadastral recording, which is a time-consuming process, as such requiring non-existing technology and qualified people.

"Control of resources implies the existence of boundaries, rights of exclusion, and the existence of institutions essential for exercising decision-making power..." (Nhantumbo, et al., 2003). Communities need to have basic information about the matter subject to planning, i.e. community land, natural resources, medical treatment, etc. Thus, spatial information about the community is fundamental.

To obtain spatial information, community boundaries or cadastral delimitations with different technical approaches were tested in Mozambique, all having the participative component in common. An extented work headed by Anderson (2000) looked at the usefulness of enlarged aerial photographs for land rights mapping in Southern and Central Mozambican semi-urban and urban areas. Today the pace of land development, private farming, and house constructions is much faster than the the update of spatial information. In fact, the coverage of aerial photographs in Mozambique has grown significantly over the last years but the pace of the update can't keep up with the rapid changes. Medium to high resolution satellite imagery seems to provide potential in the near future to serve land use planning and delimitations instead of or as a supplement to aerial photographs.

The Mozambican Land Law defines "local community as a group of families or individuals living in a distinct geographical area with the objective to assure common interests by protecting housing and agricultural areas, forests, cultural heritage sites, water access locations and areas for expansion." For the purpose of the paper and in accordance with the definition of Weiner et al. stated above the term community stands for the geographical area, while the term "community members" comprises all groups or individuals populating the area.

3 STUDY AREA

3.1 Background

Driven by a range of demands for community maps, mapping of the entire Province of Sofala (Central Mozambique) was conducted under the coordination of the Center for Geographic Information at the Catholic University of Mozambique in Beira. Community maps were requested for district and natural resources planning, flood hazard analysis, the establishment of a water well database, livelihood analysis and the investigation of spatial relationships of epidemics (e.g. Malaria, HIV/Aids).

Priority was given to a rapid mapping of community boundaries and public infrastructures. Product users and funding institutions were from the provincial government, academic environment and non-governmental institutions. Even though the approach was participative to access local knowledge, the primary target and user group were not the community members. Therefore incompatibility between neighbouring community boundaries was not raised as possible conflict and discussed with community members at this stage.

3.2 Administrative Structures in Mozambique

Mozambique is administratively structured from top to down into provinces, districts, administrative posts, and communities/municipalities. The size of a district ranges between 630 and 7500 km2. Municipalities are further divided into bairro (suburb), unidade (unit) and quarteirão (block). The size of one quarteirão comprises about 150 families. The relationship between size and number of families usually does not undergo great changes in urbanized areas, because the number of families is limited by the number of houses/apartments in the area. In rural areas, ca. 99 % of the entire province of Sofala (67760 km2) persist the former traditional structure consisting of regulado (chiefdom), communities and community centres (sede da localidade).

For statistical purposes the Mozambican territory is, divided into census areas (area de enumeração), which correspond to about 150 families.

3.3 Review of map material

The existing database of Mozambique consists of maps based on the interpretation of aerial photography taken during Portuguese colonial time in scales of 1:50,000 (from 1968/1969) and 1:250,000 (reviewed 1986). These maps are outdated as regards to names and existence of locations as well as general infrastructures mainly due to wars and political changes but also due to rapid population growth in some areas and natural disasters in other areas. Using these maps the National Directorate of Geography and Cadastre (DINAGECA) produced generalized digital maps in a scale of 1:250,000.

Because of errors and incompleteness some international organizations produced their own topographical surveys of the entire country, e.g. by GPS measurements from helicopters (USAID addition to census data 1999).

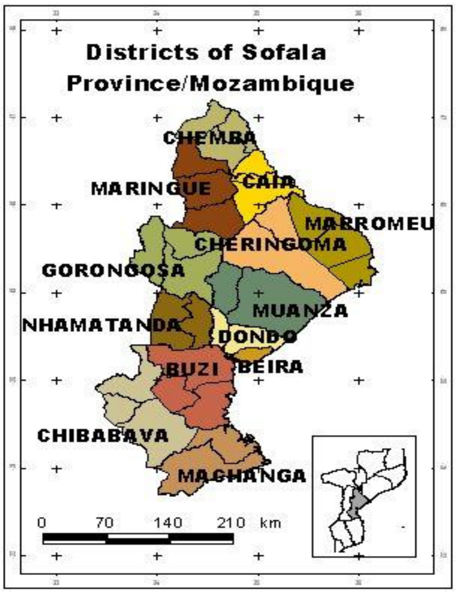

Figure 1: Available Administrative Boundaries of Sofala Province (Districts, Administrative Posts)

In existing maps, administrative limits are only documented down to the administrative post (Figure 1). The same accounts for statistical recording. Some community centres are mapped as point features, whereas the database is incomplete and unreliable regarding names, spelling and position. In some instances, complete villages disappeared due to disasters such as floods and new centres of dwelling appeared, both planned or unplanned. Recent ortho-rectified panchromatic Landsat satellite images with a 15 m resolution are available, which serve for on-screen mapping, e.g. of rivers.

4 METHODOLOGY

The methodological approach was restricted by the time given and by budget constrains. Established field mapping methods were combined with PGIS and the use of satellite imagery. The method requires field staff experienced in cartography, use of GPS and social communication with community members. The finalization of field material requires basic GIS infrastructure, skills in on-screen digitization from satellite images and knowledge in GIS applications. Any other group with the same basic requirements can repeat the work, one of the implied goals was that the methodology developed shall be repeatable and transferable.

4.1 Traditional Mapping and Participative GIS

Three groups of geographers conducted the primary data collection in 10 out of 13 districts of Sofala Province over a period of eight months (between June 2003 and September 2004). Data was collected as point themes in the field using handheld GARMIN etrex GPS. The small handheld units were preferred because of their simple use and their robustness. Although the use of the differential GPS would have led to more precise measurements, immediate distinction between feature types and easy up and download of huge amounts of data, it was found too complicated for lowly qualified field technicians and the recharging of batteries would have mostly been impossible due to the absence of electricity in many of the rural areas.

The field team closely worked together with local governmental and traditional authorities. A group of elders usually belongs to the traditional authorities, which can be regarded as the living memory of the community population. Before work can commence the local authority needs to be contacted. In the meetings representatives of the group of elders were mostly present. The field team gave an introduction to the planned community mapping and intended methodology. The field team also asked for support and availability of community members to participate in the mapping. Usually three community members were selected by the local authority and joined the mapping. The community terrain was mapped through walking and driving along the community boundaries as indicated by the local community members. The data were collected with a GPS. Information about public infrastructures was requested in semi-structured interviews, coordinates captured with the GPS and recorded on pre-prepared forms. Map boundaries were at the same time documented in field base map sheets and immediately evaluated and re-confirmed by the accompanying community members.

4.2 Data Enhancement and Map Scales

It was impossible to walk up the entire areas. Furthermore, access to rivers, which usually form the physical limits of communities, is very often impossible, due to the dense vegetation cover and the abundance of wild animals. Therefore, in most cases only key and corner points were collected.

GPS data were downloaded into a GIS. Several single points were then converted into polygons to obtain the community areas. To enhance the quality of the mapped community limits, the collected data were laid over a panchromatic Landsat satellite image (Resolution 15 m) and boundaries manually corrected by digitising the visible physical feature, such as a river (Figure 2). Landsat satellite images have become an accessible alternative source for a number of analysis, since in many cases images can be downloaded free of charge from the internet. This method should generally be suitable for urban boundary mapping if satellite data with higher spatial resolution (SPOT 5, Ikonos, Quickbird ….) were available. .

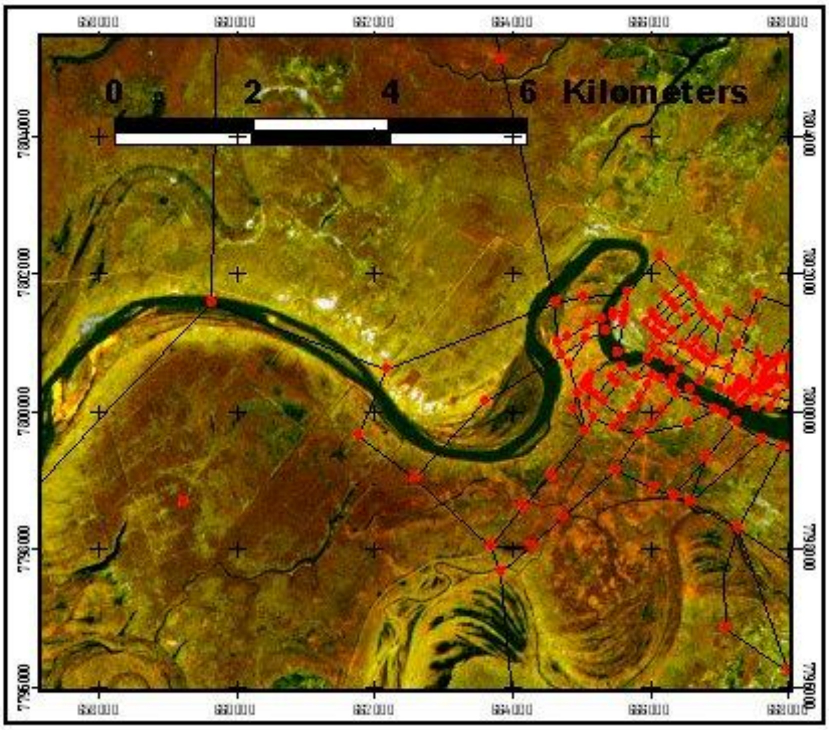

Figure 2: GPS key points, derived polygons underlain by panchromatic Landsat image (Buzi Vila)

This mapping process results in map scales of up to 1:75,000. Thus newly captured locations of public infrastructure as well as the community limits cannot be combined with the generalized topographical maps of a scale of 1:250,000 as provided by the National Directorate of Geography and Cadastre of Mozambique. Therefore in the cases where roads form the community limits, these roads were mapped in addition to the GPS data.

Further to the community mapping spatial census block data (area de enumeração) of the rural areas of Sofala Province were obtained from the National Institute of Statistics. We digitised the areas although the quality and state of updating process of their base material is very poor and incomplete (Figure 3). The areas of the quarteirões of the City of Beira were immediately updated during the fieldwork (Figure 4 and Figure 5).

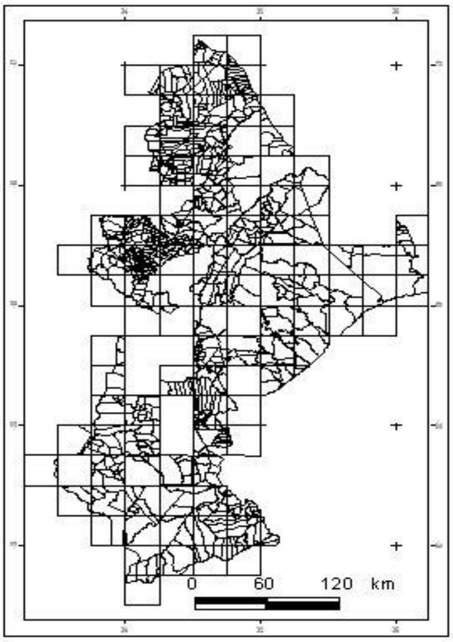

Figure 3: Census blocks of rural areas of the Province of Sofala (1 block corresponds to ca. 150 families)

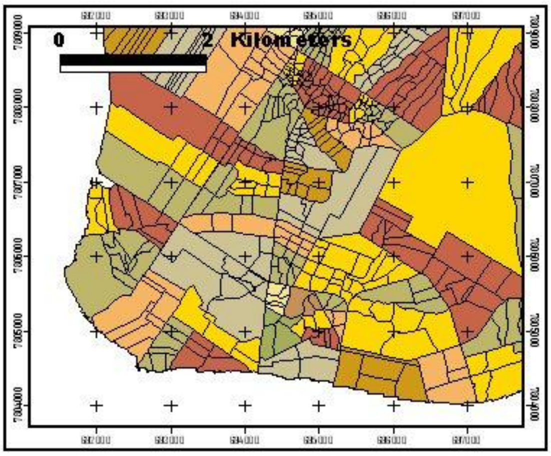

Figure 4: Core area of City of Beira: Division into units (Unidade)

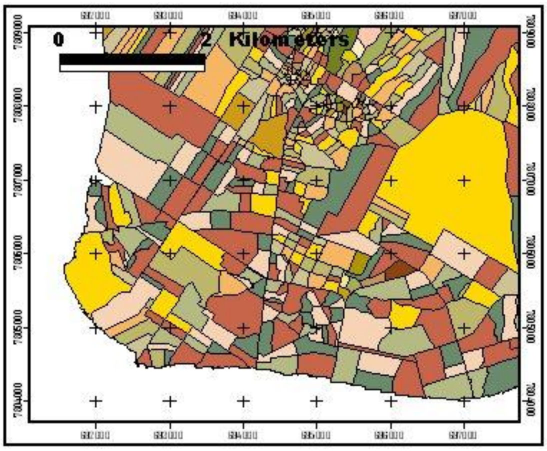

Figure 5: Core area of City of Beira: Division into blocks (Quarteirão), which corresponds to the census block of 150 families per area

4.3 Quality Improvements in Cartographical and GIS contents

After having completed the field survey and the data processing it was necessary to return to the communities in order to re-evaluate the maps and – if necessary – to adjust them. Incompatibilities in adjacent community boundaries need to be reviewed in a broader participative process. Specifically the existence or absence of public infrastructures has to be checked to assure that the database is complete at this point in time.

Users of the community maps further suggested the collection of additional social and health indicators while in the field, such as school types, number of pupils, gender, sanitary conditions, and so forth. Furthermore existing digital data of the hydrology and road network were mainly based on the 1:250,000 topographical map and must therefore be re-collected at a higher spatial resolution to provide the level of detail and accuracy as required in the community maps.

5 RESULTS

The mapping of the community boundaries is a fundamental first step towards a land cadastre and towards disaster risk management, land use, resources and district planning in Mozambique. This activity is in line with technical regulations of the legal frames of Mozambique. It is the first mapping process of this spatial extent. All comparable endeavours were bound to single communities or semi-urban to urban areas around province capitals conducted by several organisations (ORAM, GTZ, WLF; Anderson, 2000).

The mixed methodology of PGIS, traditional topographical mapping and usage of satellite images was prooved to provide rapid, cheap and reliable products.

Current problems with the status of the community mapping products are:

missing second phase

updating not secured

different scales

limited accessibility in difficult terrain

6 CONCLUSIONS AND RECOMMENDATION

Although land use issues and community-based resource management are highly ranked priorities in Mozambique, no overall plan exists of how to implement community participative land delimitation at a decentralized local level (Nhantumbo, et al., 2003). The rapid evolving land use activities and the flexibility, which the Technical Annex of the Regulations of the Land Law provides in the use of methods of land delimitation leads to a variety of legal documents. Produced document types range from verbal description to participative sketch maps over single GPS-measured points and drawings on copies of topographical maps. Although this provides a short-term solution under centralized conditions, it will yield in incompatible patchwork not manageable at the local level. The final aim should be a documentation, which include georeferenced map products. Another aspect is that local resource management requires spatial database management, which leads to the justification of using PGIS.

Based on the experience gained during the work the limiting aspects of this community mapping methodology can be summarized as follows:

Lack of awareness and willingness at governmental institutions

Governmental institutions are trying to keep the power in their hands. Even with legalised structures in acquiring base line data one has to go the “official” way which can be bureaucratic and frustrating

Lack of funding necessary for conducting field surveys and their regular update

Mapping of the land is not a building which can be built somewhere and decorated by a name. As funding is quite difficult in developing countries it is the basis for sustaining a long-term impact by including a GIS

Lack of capability to use maps for planning

Many stakeholders are not used reading maps, in fact they are illiterate. Cartographic concepts and the understanding of a complex world has to be facilitated

Lack of understanding, that GIS is more than just producing colourful maps

Many people just think of maps to be produced and are not aware of the analytical potential a GIS provides and the neccessity to link it with plausible datasets

To overcome some of the points listed above it is necessary to provide practical examples of sophisticated GIS applications in community resource management as well as district planning. It is further necessary to develop an accepted, well-defined methodology of community mapping, which should be documented in guidelines.

In addition to this, it is necessary to teach and communicate the concepts of GIS and cartography/geography to all involved stakeholders. It is inevitable to speak a common language, before analysing the complex interlinked physical and sociatal community characteristics. However, this might be an ongoing process, which can sometimes be a frustrating and energy consuming process. It will have to be repeated continuously as participants change frequently, but it is a necessary prerequisite before we can harvest the usefulness and power of a GIS.

On the other hand the potential for PGIS is quite high and provides improvements as regards to baseline databases. It helps to address multiple realities, to understand the apperception of the environment in which a community lives. The greatest potential lies in the “traditional objectives” of a GIS to provide information for a better decision support by monitoring and planning of the environment.

In addition to this, capacity building has to be ongoing and has to involve the local people,too . To communicate information through maps can be very straining for the involved persons. In this regard it is also a challenge to find adequate links between local, cultural conditions and technology (virtual realities to transmit complex information among population with low level of education and analphabetism). While in the North problems of piracy of valuable local knowledge and recognition of local knowledge ownership and intellectual property rights are important in the current PGIS discussion practicalities are more dominant in the context of developing countries. There are clear issues of availability of hardware, software, and accessibility to data and to reliable energy supply in the sort of local communities. Attention has to be paid to such practical issues from the planning stage of PGIS if success is to be attained. Nevertheless, we conclude that a sound a theoretical foundation and a methodological framework are absolutely necessary in the PGIS context in developing countries. But the most burning question goes beyond the mapping stage: valuable PGIS should be community driven and owned in a sense of custodial GIS applications. Only very few examples worldwide go the cumbersome road to educate community members with the aim that they will finally be able to be responsible for the information making the community mapping procedure a long-lasting intervention. PGIS is more than mapping. It does not end with the mapping of the boundaris of communities and physical and socio-economic and socio-cultural entities, but it starts with it.

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Planning and Dealing with the Unpredictable

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1 APPROACH

My purpose is to address the symposium topic literally and to discuss each implicit idea from a critical standpoint. This should stimulate the forthcoming debate.

CORP 05 implies that our models - figments of our imagination – are more 'real' than the world we are living in. Or are they? Conversely, is our world so 'unreal' that only models can provide reliable guides to 'reality'? Yet can they? If models are to make planning and dealing with the 'unreal' world less unpredictable who is expected and competent to design and use them?

2 'REAL' MODELS

Models are representations, simulations, tools of prediction, symbols, to name but a few. In this sense they are 'real' – internally consistent, true to themselves, but they are not 'reality'. They are not 'objective' and ultimately fulfil a purpose.

Models as *representations* have a standpoint. They are selective and represent only specific aspects of the 'real world'. They may be real tools but they project an incomplete, 'unreal' world

Closest to the physical static 'real world' (and by world, we mean the planet here) are geographic – topographical atlas globes and maps as found in atlas books. The latter are a more abstract representation, (orthogonal) projections onto a two dimensional plane of a three-dimensional physical world. With all the sophistication added by computer technology, this is true of GIS and GPS. Satellite images from which panoramic views can be constructed are homological transformations from a bird's eye view and they can produce different types of perspectives (for example with three flight points or flight points at infinity).

Such maps ('real' models) can represent any kind of data in virtual space, e.g. geological age, population, economic wealth, etc. Cartography can be put to dramatic effect by representing ratios such as inhabitants per km2 or income per capital in physical two-dimensional proportionality, such as some UNICEF maps. Many other projections have been developed (e.g. Peters projection), each to illustrate a particular point of view, such as less distortion of certain parts of the earth.

Static 3-D models of cities, for example, are reduced in scale and, although better understood by the general public, they are still an abstract representation of the 'real' physical world.

Models can be *simulations* . They can simulate a particular virtual 'reality' of a construct of the 'real world' (here by world we mean the place of everyday life). Examples are dynamic computer models which simulate a three-dimensional, 'virtual' reality of a development project for a new, moved through urban area. This technique is also used in simulators to teach pilots to fly. The snag is that although they add a 'time-dimension' by moving through the model, they are projected onto a 2-D screen and thus project an 'unreal' world. Only when they fly do pilots or astronauts experience the 'real' world.

Models can be used as '*tools of prediction*'. For example, they can show alternative architectural and urban design solutions for a specific area and predict how many inhabitants and workplaces they would contain. They can be used as *tools of prescription*, imposing single solutions to single problems. Models may rely on theories borrowed from other fields of knowledge. This is the case for many types of planning models. Borrowing from physics, gravity models were constructed to predict the physical development of cities. With growing computer power digital models became increasingly sophisticated and abstract. Other models were built by borrowing from mathematical probability and later from quantum and chaos theories.

Models as *symbols* can be as powerful as 'scientific applications'. Artists use them to represent what they conceive as their 'real' world or how they make sense of the 'unreal' world. PR firms use them during political campaigns to decry the 'unreal' world of their opponents; advertisers to make their products a 'must' of what they present as the 'real' world.

3 'UNREAL' WORLD

There may be a 'real 'world, or 'real' worlds out there (e.g. physical: a planetary system; spiritual: a religious realm; socio-cultural: family life) but there cannot be an objective agreement on what a unique 'real' world is, or might be. Individuals experience it existentially, while society lives it through normative constructs: theories, ideologies, customs and restrictive rules of behaviour - rights and obligations. The 'real' world of everyday life is subjective for each of us, based on our experience, memory of the past, learnt knowledge, expectations, aspirations and dreams. For a given society and individuals who belong to it, the 'real' world is a social construct with which they are expected to comply, or against which they rebel. Construed in this way such a 'real' world has some 'objectivity' and could be represented in a 'real' model. However, what is one group's 'real' world may well be another's 'unreal' world. On the whole, human beings make sense of the 'unreal' world by using their instincts, emotions, intellect and imagination –intuitive or trained - within a given context of nature and nurture.

Collectively, from its origin mankind has tried to make the 'unreal' world 'real' for itself by observing, explaining, understanding and interacting with it, initially as hunter-gatherers. When mankind settled down into agriculture it started to manipulate the 'unreal' world to its own 'real' ends. With industrialisation, mankind believed that nature was there to be tamed. In modern times, mankind involved in accumulation while squandering nature indiscriminately in the belief that the 'real' world will regenerate itself, or new technologies will come to its rescue. Conversely, for many environmentalists the 'real' world is doomed by global warming, due to detrimental human action. The ‘real’ political debate between such conflicting positions is rolled out with reference to ‘real’ models of what each interest group sees as the ‘real’ world, constructed according to their respective theories, ideologies or beliefs. Politicians, for example, tend to construe single problems for which they expect models to produce single solutions.

For civil society, such visions or problems tend to constitute an ‘unreal’ world. It is full of contradictions, conflicts, perverse effects, arbitrariness, justified by a multitude of constantly shifting ‘real’ models based on incompatible theories. Perhaps what mankind is experiencing on the threshold of the 21st century is a ‘*sur-real*’ world captured in ‘*sur-real*’ models.

4 DEALING WITH UNPREDICTABILITY

Let us unravel this assumption a little further by addressing the notion of *unpredictability*. Predictions can be applied to anything, especially in the ‘unreal’ world, thus there is no ‘unpredictability’ as such. What is unpredictable are events, incidents, happenings which do not fit into prior expectations of the ‘real’ world.

For example, monsoons are predictable, because long range history traces their recurrent occurrence. The recent tsunami in the Indian Ocean was not predicted, although earthquake monitoring stations, in Hawaii for example, had picked up the tremor. Predictions of the local consequences did not occur because the information infrastructure was not in place (for local political reasons). A real devastation, the effects of the earthquake and ensuing tsunami took place very much in the ‘real’ world of those affected. The ‘unreal’ world was possibly the one of the policy makers who refused to join the warning system for fear of damaging their tourist industry.

In this situation what would *planning for the unpredictable* have meant in practice? Existing warning stations are able to detect tremors even in areas where they are unlikely. At short notice they are able to predict consequences such as tsunamis and their unfolding. What role could or should planning or modelling play in dealing with the consequences of unpredicted disasters? One option is scenario building, or speculative black box brainstorming. However, if outcomes were predicted to be remote, it is unlikely that politicians would have allocated their extremely scarce resources to preventive measures. The proof is that they are not even doing this for predictable monsoons with devastating effects on people and resources, season after season.

5 TOOLKIT: MODELS

Models, ‘real’, ‘virtual’ or ‘unreal’, are only a tool, as deliberated in David Harvey’s seminal work.[106] They cannot guarantee to be acted upon, nor that those responsible will be *dealing with the unpredictable*. So what is the purpose of models, who should devise them and, most crucially, would or should they distinguish between means and ends and would they be able to identify unforeseen side effects ?

Anyone, politicians, planners, ‘modellers’ can predict whatever they like (build *scenarios*), using any assumptions and any methods of projection. How close such predictions come to the unplanned unfolding of the world - ‘real’ or ‘unreal’ - depends - at least to some extent - on the ‘predictable’ (known, recorded, monitored, understood) *past*.

Yet, even the past does not belong to a ‘real’ world. Facts, data and records need *interpretation* to make sense when they are used as background to any type of modelling (trend extrapolation, forecasting, prediction, perspective, scenario, speculation).

Assuming that *predictions* are about the *future*, *facts* about the *past*, and *events* about the *present*, how do models which originate at the intersection of the future and the past incorporate time and space as analytical factors and what characterises them? Paul Drewe[107] shows that dealing with unpredictability involves time as an essential variable of spatial models. Time was considered more unpredictable than space in planning models until ‘9/11’ transformed space in an instant.

Common sense characteristics of time and space

Time	Space
Flexible	Fixed
Less predictable	More predictable
Fast pace of change	Slow pace of change
Key factor in politics	Key factor of planning
Time affects: Action in concrete world (everyday life)	Space is basis of: Construction of abstract models (virtual reality)
Chronological time shapes the ‘real’ world	Representation of space produces ‘unreal’ models

What part should observation, analysis and interpretation play as regards time and space; and what position would observers, analysts and interpreters hold? The moment may have come to revisit the nature and purpose of models and those who devise them.

The Anglo-Saxon world favours inductive empiricism and confirmative verification when manipulating selective data sets and quantitative facts. Popper added falsification as a condition of scientific verification. Continentals prefer to construct ex-ante

106 David Harvey. 1969. Explanation in Geography, Edward Arnold

107 Paul Drewe. 2005. What about time in urban planning and design in the ICT age? CORP05

assumptions and apply deductive rationalism to critically assess them. In both cases, links tend to be tenuous between their findings and policy relevance. New ways of thinking could resort to a heuristic approach instead of binary opposites, relying on intuition instead of reductionist manipulation of statistics, and focusing on qualitative rather than quantitative analysis which tends to draw on exogenous data sets mined for different purposes. Perhaps inspiration could come from other academic disciplines like psychology or biology. For example, Malcolm Gladwell defends the usefulness of snap judgements.[108] The findings of current research on the human brain could also become an inspiration.

6 DEALING WITH UNCERTAINTY

There is a need to define what a new generation of 'real' models should contribute to planning the 'unreal' world, how they would handle unpredictability economically, efficiently and effectively or, better still, come to terms with uncertainty. This is important because decision makers, as well as stakeholders investing in the future of the built environment prefer plans to address *uncertainty* rather than unpredictability.

What constitutes 'uncertainty' for them is unexpected change of known circumstances and their assumed evolution. Akin to capitalists who paradoxically dislike risk-taking they expect planners to lay down certainty in fixed plans and given rules. However, over recent times, unexpected changes have taken unprecedented forms and scales which neither customary plans nor models can capture. Growing fear of uncertainty, regardless of whether it is instinct or propaganda driven, imposes new urgency on the search for certainty or the protection against uncertainty.

Let us go back for an instant to the unorthodox association between 'real' with 'model' and 'unreal' with 'the world' in this year's CORP 05 topic. Is this cross-over of concepts deliberately or unconsciously reflecting the apparent confusion – or uncertainty – inherent in the passage from the 20th to the 21st century?

Rudderless eclecticism seems to grip this turn of the century - just like the turn of the last century and the one before that. Will the relativism of post-modernity be overtaken by a backlash of domination, control and oppression, or will the seeds of scientific discovery of the 20th century assist 21st century societies to live in better harmony with each other and the planet? Similar options were open after the profound changes which had preceded eclecticism at the turn of the 18th and 19th centuries.

The French and the American revolutions at the end of the 18th century influenced enlightenment against religious backwardness and dominance of hereditary aristocracy. But that was followed by eclectic and contradictory romanticism, an incoherent and inconsistent but indispensable concept in practically all areas of human endeavour, as analysed perceptively by Georges Gusdorf.[109] At that time, the protagonists of progressive change aimed at a perfect society built on tolerance, common sense and self-rule.

Similar idealism came to the fore after the fundamental changes at the turn of the 19th century discussed by Barbara Tuchman[110] in her synchronic and multi-sectoral history from 1880 to 1914. Both the seeds of scientific knowledge for technological innovations and events which led to drastic social change date back to the end of the 19th century. During the eclectic turmoil of the turn of the 20th century old ideas were discarded and new lifestyles adopted which are also reflected in architecture, literature, music and the arts, not least in surrealism.

The ground to the eclecticism at the turn of the 20th century was laid by Jacques Derrida's[111] deconstructivism and Michel Foucault's[112] heterotopia, characterised by coexistence in an impossible space, together with life in a large number of possible worlds ('real' or 'unreal' or surreal perhaps?). Charles Jencks added fragmentation, discontinuity and collage to postmodern architectural design.[113]

The further back and the better history is known the more it may spawn ideas about certainty, or at least broad options for the long term future. It might be tempting to superimpose Kondrachev's long range curves of development and technological break-through on these centenary-apart eclectic periods as a basis for new types of models and conceptual frameworks. They may be appropriate to deal with uncertainty in the long term future. Initially though, they may have to concentrate on the extreme turbulence and uncertainty of our globalising world, as well as on discontinuity in space and time, and verify the 'paradox of choice' which stipulates that less is in effect more.

7 TOOLKIT: PLANNING

By definition what is planned is predicted, thus planning the unpredictable is nonsensical. It may be more pertinent to plan for uncertainty. In our 'unreal' world conditioned by global warming according to some, we have to cast our predictions wider than hitherto. Disasters - man-made as well as natural – may occur much more frequently in future. We think nothing of bombing rogue states, conventionally or, why not, with nuclear weapons. Pandemics are brewing and genocide is rife, often in countries and among people least able to cope. Natural calamities occur at random and more frequently. In these changing circumstances what is the role of planners in an 'unreal' world and what can 'real' models contribute to stem perceived problems and improve situations? How can the gap be closed between state-of-the-art analysis and action by those with power and responsibility?

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[108] Malcolm Gladwell. 2005. Blink, the power of thinking without thinking. Penguin

[109] Georges Gusdorf. 1982.Fondements du savoir romantique, Payot, Paris

[110] Barbara Tuchman. 1981. The Proud Tower, Bantam

[111] Jacques Derrida. 1997. Responsibilities of Deconstruction. Warwick Journal of Philosophy

[112] Michel Foucault. 1969. L'archeologie du savoir, Editions Gallimard

[113] Charles Jencks. 1977. The language of postmodern architecture, Academy Editions

Let us imagine some responses to well rehearsed examples of major imminent disasters. A tsunami originating from a rock collapse in the Canary Islands has been predicted for some time. The models assessing its path predict devastating effects on the East coast of the USA. Many proven measures form part of the toolkit of disaster relief agencies to intervene after the event. Apart from modelling the physical event itself, what could planning contribute to attenuate or help prevent the consequences of such a natural catastrophe? Most crucially, would politicians act in anticipation? 9/11 has shaken the world. It signalled that drastic and large scale attacks may have become a feature of today's 'unreal' world everywhere. So far, responses of those in charge to deal with potential man-made calamities were prohibitive and retaliatory in addressing symptoms rather than causes. Will this approach be able to prevent future man-made disasters?

Considering there is no guarantee but only a probability that disaster predictions could come true, what preventive steps are decision makers taking? Who from central government down to neighbourhood councils and individuals should act, how and when? Who should coordinate interventions, inform and involve civil society? Clearly, neutral desktop planning is not enough. According to Lucius Burckhardt[114] planning is distribution or re-distribution of suffering. It is thus political and technical decisions are irremediably intertwined with deontological ones; there is no distinction between planners and planned; and all human actions, as opposed to animals, are political, subjected to interpretation. Throughout his writing and teaching he denounced the false consciousness with which planners plan and the planned endure plans. The question of whether the role of planners and forecasters has to change remains pressing. Has the time come for them to focus far more on implementation, to interact pro-actively with decision makers and perhaps even to take up the task of campaigning and awareness raising?

8 CONTEXT

Whatever modifications are proposed to internalised planning approaches or intellectual constructs, they need to take into account current changes of the societal context. Both new roles of planners and new models of thinking depend on the changing context of the 'unreal' world. Yet, views on socio-economic changes, their relative importance and their causes differ widely. Without rehearsing the trends towards globalisation and centralisation, and conversely fragmentation and polarisation, some current world perspectives are mentioned here as context of new models of thinking. The proposed United Nations reform is a relevant context because it re-confirms the need of a generally accepted global intergovernmental organisation. Alarmingly though, what has changed in the UN discourse, arguably under the influence of the USA, is that development is no longer linked to democracy but to security.

Many geo-political analysts recognise the predominance of USA's hegemony, although critical opinion doubts its sustainability. To name but two voices: Noreena Hertz[115] sees the death of democracy in the silent hegemonic take-over by global capitalism, while Emmanuel Todd[116] predicts that the demise of the American system will stem from its isolationism and unsustainable debt. Others fear entropy. They see sameness in fundamentalism, whether it spreads as a threat from the American bible belt or within Islam and consider Europe too weak to oppose a third way. In his 'three dustbins' theory Fred Halliday[117] attributes the need to discard unchallenged ideas to the legacy of the cold war. According to him, unless the arrogant West (G7), shabby dictators (Russia and China) and naïve protesters (anti-global movement) undergo the Vilanova test of 'tough thinking' the world is unable to overcome its conflicts. Implicit in all these contextual scenarios is the danger of irretrievable discord and the need for change towards more geo-political stability and certainty.

9 NEW MODELS OF THINKING

Against this background of geo-political perceptions, can a new generation of models devise scenarios with validity for global application? Models of thinking tend to stem explicitly or implicitly from at least partial consensus of opinion. It could be argued that those brought together by CORP 05 share some common vision. Owing to their subjective points of departure there are often unbridgeable gaps between different models. Possibly, the belief that scientific knowledge can produce absolute, objective and universal truth has been overwhelmed by postmodern relativism. However, models of tomorrow could make a virtue of relative perception of time, space and place, together with flows or connections between them. Such models would remain subjected though to their own axiomatic, technological constraints, confined areas of investigation and professional points of view. At best they could command wider authority on the strength of their internal consistency and forcefulness of argument.

These types of models may no longer be construed as objective or 'real' as they do not analyse and 'guestimate' (guess and estimate) the 'unreal' world from a universal vanguard position. Rather than producing universally applicable truths or proscriptive recommendations, their findings could have new conceptual and/or utilitarian purposes. They could come up with new social constructs and thus contribute to novel approaches and understanding. Most importantly, they could become a powerful tool in helping to change *mentalities*.

10 PERSONAL VIEW

From my experience,[118] there is a good prospect for such changes to happen. Work in unusual circumstances with partners from diverse places with different professional, cultural and academic backgrounds can challenge initial positions. Cross-border

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[114] Lucius Burckhardt. 2004 (1957-2001). Martin Schmitz & Jesko Fezer (eds). Wer plant die Planung? Architektur, Politik, Mensch. Martin Schitz Verlag

[115] Noreena Hertz. 2002. The Silent takeover. Global capitalism and the death of democracy, Arrow

[116] Emmanuel Todd. 2002. Apres l'empire. Essai sur la decomposition du systeme americain, Gallimard

[117] Fred Halliday. It's time to bin the past. In: The Observer, 30 January 2005.

[118] Judith Ryser. 1984. IRC: International Researchers' Cooperation on economic change and the local planning process. Critical assessment: into origins, aims and achievements. WP 110 IRC series, Bartlett UCL and UN/ECE urban and regioanl research seminar proceedings.

arguments provoke intellectual and emotional 'decentration' [119] and shifts in points of view. Changes often occur unexpectedly and spawn perspectives novel to all concerned. The mutual influence of sharing ideas in synergy makes participants reassess their contextual perceptions and change their own behaviour. Unpredictable interactions, whether akin to consensus building or conflict generation, uncover 'residual' areas of uniqueness as well as apparently immutable positions. These require longer term negotiations or surprise events to change. Sometimes the process of cooperation itself can become the content of models. Crucially, cross-cultural model building requires time, not least to benefit from evolving Zeitgeist.

This methodology of cross-cultural inter-professional knowledge generation is very much connected to approaches which recognise the importance of both context and action, such as Juergen Habermas'[120] theory of communicative action, Anthony Giddens'[121] theory of structuration and the 'sociology of social transaction' devised by French speaking scholars. A perhaps over-ambitious research project attempted to test whether such (comparable?) conceptual frameworks, developed in three different languages and cultures (German, English, French), could be applied to international action research horizontally, in parallel, or whether it was necessary to construct a meta-methodology first.

Nevertheless, what were very experimental inter-cultural communicative approaches helped to assess the substantive objectives of models and their probability of robustness and success. The most important outcome of this process was that it managed to change the mentality of those who participated in it.

Possibly, a similar methodology of model building could be adopted for other international cooperative projects. Drawing on the broad knowledge base of its cosmopolitan participants the CORP 05 conference is well placed to explore the complex changes which affect today's 'unreal' world. It could become a key task of this 'Competence Centre of Urban and Regional Planning' to produce pertinent proposals for the future use of information and communication technologies and to devise powerful 'real' models in support of those involved in urban development and spatial planning.

Judith Ryser, London, February 2005

- Judith Ryser.1984. IRC: International Researchers' Cooperation on economic change and the local planning process. Communication, comparison and the transfer of knowledge, WP 111 IRC series, Bartlett UCL and UN/ECE urban and regional research seminar proceedings.
- Judith Ryser. OFAJ. 1994. Intercultural communication and social transaction: towards European consciousness. OFAJ (Franco-German Youth Office)

[119] In Jean Piaget's sense, elaborated in his theory of developmental psychology.

[120] Juergen Habermas. 1981. The theory of communicative action. Polity Press

[121] Anthony Giddens. 1984. The constitution of society. Polity Press. Christopher G A Bryant & David Jary (eds). 1991. Giddens' theory of structuration, Routledge

Danger of getting lost: Optimize a path to minimize risk

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Abstract: There is a difference between the simplest and the shortest path. Dijkstra (**1959**) published an algorithm for a least cost path. I extend this algorithm to produce the path with least risk of getting lost. The path that has the shortest description or smallest number of turns is not always the path leading most certainly to the destination. The simplest path (**Duckham, 2003**) can be longer than the shortest path, but there is less risk to make a wrong decision and to get lost. How do I measure risk? Every intersection has a risk; the more streets connect the higher is the risk of selecting the wrong one. The cost associated with the wrong decision is the length of the segment to the next intersection. I assume the traveler will discover the error at the next intersection and return to the intersection where he made the wrong turn. The path with least risk has the lowest sum of risk times cost of wrong decisions along the path. I interpret this as the path where the traveler most likely arrives at his destination.

To test the algorithm I chose the area between the train station Südbahnhof and the building of the Technical University in the Gusshausstraße, an area 4 by 9 blocks. There are intersections of different geometry and this area illustrates examples of the three different paths and the differences between them.

1 INTRODUCTION

The analyses for the risk value of a path provide a basis for a pedestrian navigation system in a city. A traveler who does not know the city can decide on the display of a pocket pc which way he wants to take to reach his destination. He can decide between the shortest and the simplest path and the path with least risk. For every possibility the pocket pc calculates the risk value. On the display the three possibilities to walk with their risk values are listed. By touching the screen the traveler decides which way the program should map on the display.

The theme “risk for pedestrian navigation” is a section of my research within the NAVIO project founded by the FWF.

2 STRUCTURE OF THE PAPER

In the third section I explain the differences between the shortest path, the simplest path, and the path with the least risk. There is the possibility that the simplest path and the path with least risk are identical but it is not in every case. The only criterion in the shortest path is the length of the path. The simplest path is a combination between simple description and as few turns as possible. The path with the least risk is the aim of my calculation where the possibility to get lost is minimal.

In the fourth part I show the formula of my calculation to get the risk value of the decision points and the further step to get the risk value of a whole path.
Section five shows the area where I made the tests and singles out the three different paths.
In section six I show the calculation for the risk value with the example of the shortest path.
The results of my calculation and the comparison between the three paths I present in the seventh section of this paper.
Further work will be done within the scope of the project I am working on and my PhD is the content of section eight.

3 DIFFERENCES BETWEEN THE SHORTEST PATH, THE SIMPLEST PATH, AND THE PATH WITH LEAST RISK

A path is leading from a starting point to a goal. This path I split in decision points that are intersections and street segments. An agent is a person who follows the path and decides which one he wants to take.

- The **shortest** if he is in a hurry,
- the **simplest** if he does not want to get a long description and make many turns, and
- the one with **least risk** if he wants to have least risk of getting lost.

The agent has to make a decision where to go at every decision point he reaches. Streets between two decision points are street segments. The length of segments is measured in units.

3.1 The shortest path

The shortest path is the path with minimal length.

Description turns and risk are not relevant. The description can be complicated and there can be many turns.

3.2 The simplest path

This path has the shortest description. The path should have the least possible turns and a simple description. In most cases the simplest path is longer than the shortest path. The agent needs less information because less decisions must be made. The more streets are at one decision point the more complicated is the description.

3.3 The path with least risk

This is the path where the possibility to get lost is minimal. Number of streets on an intersection is not important if the distance between the intersections is shorter than at the other paths. The description and the number of turns do not influence the final result of the risk value of this path.

4 LEAST RISK PATH

I split the path in decision points and street segments as I have explained in the introduction from section three. With these street segments I make the calculation of the risk value of the path. The risk value of a decision point consists of the number of streets on an intersection. An exact explanation follows in the next chapter.

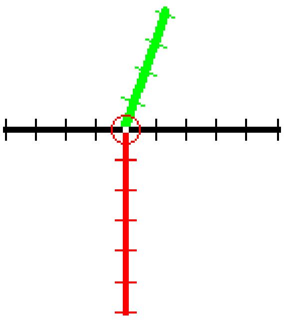

Figure 1. Example for an intersection with decision point and 4 streets segments

Figure one shows an intersection and comprises

- a red line => the way the agent came,
- a green line => the way the agent should go,
- two black lines => the two possibilities for wrong decisions and
- a red circle => the decision point.

For understanding the calculation in this paper it is important to know which assumption the agent who uses the results has:

- He is a foreigner and has never been in the test area before (he does not know any landmarks).
- If he makes a wrong decision he recognizes this at the next decision point and returns to the last decision point where he was still on the right way.

To find differences between the three paths I had to think about a possibility to evaluate the paths. Therefore I looked at the risk of getting lost and found out that it is possible to calculate risk values for the decision points. My formula for the risk value of a decision point includes the length of the paths that would be wrong and the possibilities of choice.

$$\boxed{\frac{2 * \Sigma \text{ length of wrong choices}}{\text{possible choices}}}$$

Abb. 1.: Formula for calculating the risk value of a decision point.

The explanation of this formula and the calculation follows in section 6 of this paper. For getting the risk value of the whole path the results of all decision points must be added. This result must then be added to the result of the added street segments of the right path.

Path with least risk does not mean that there is no possibility to get lost. In other words, if the agent orientates with road signs that are part of the description then the agent can recognizes if he is wrong at the next decision point. The value of the least risk path is composed of decision points with less risk values than the other paths. The indirection if he makes a wrong decision is not as long as on the other paths. This becomes clear with the shorter street segments of the wrong paths on the path with least risk.

5 TEST AREA

An area in Vienna was chosen for testing the calculation. This area includes the blocks between the station Südbahnhof and the building of the Technical University of Vienna in Gusshausstraße. The map below shows only the street network of this area, the starting point, and the goal.

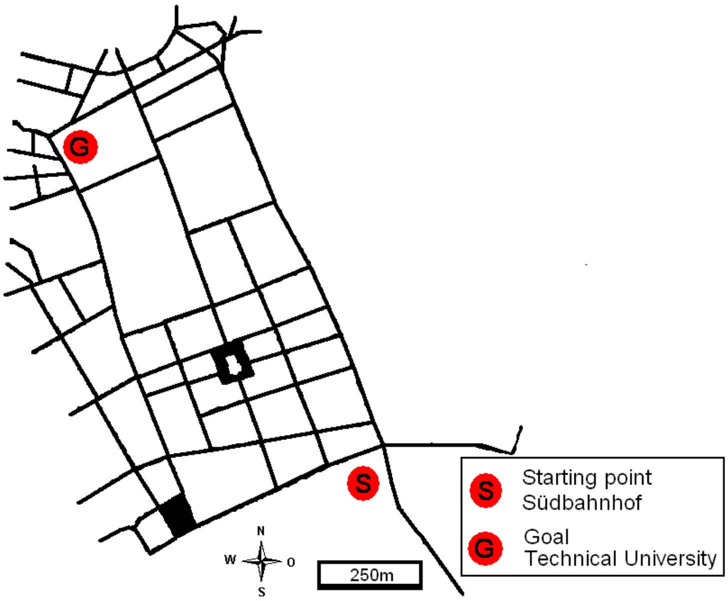

Figure 2. Test area in Vienna

The test area is nearby the University because there is a complexity of possibilities of different paths and crossings. For finding out differences between the paths I calculated the risk value for different paths and compared the results. The three paths below are the shortest path, the simplest path, and the path with least risk of this area.

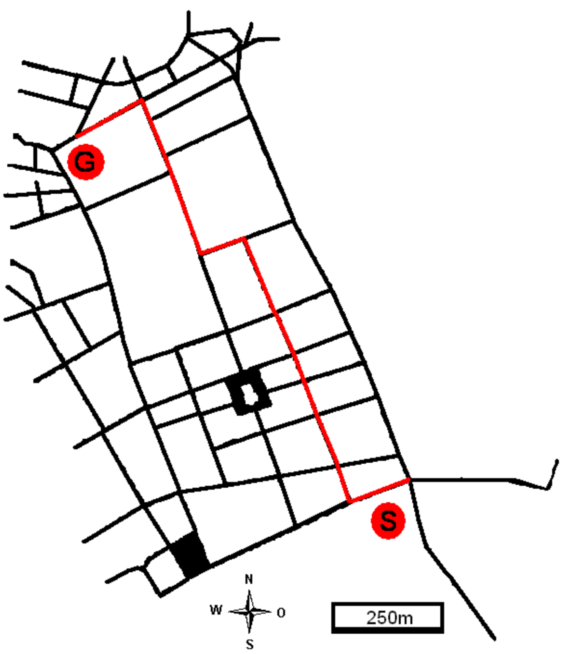

Figure 3. Test area in Vienna marked with the shortest path

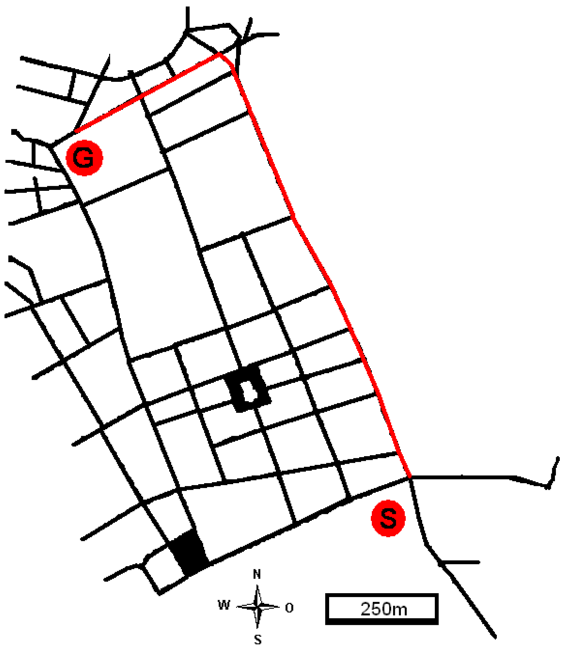

Figure 4. Test area in Vienna marked with the simplest path

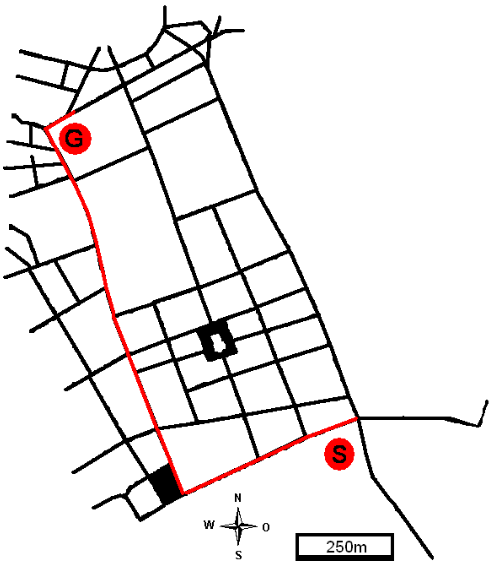

Figure 5. Test area in Vienna marked with the path with least risk

In Figure 3 the shortest path from the station to the building of the University is marked. In the description there are four turns and most of the decision points are crossings with four streets.
The simplest path with only one turn and a short description is in Figure 4. Most of the decision points are crossings with only three streets. This path has only one turning point.

Figure 5 shows the path with least risk. There are more turns as the simplest path has and less than the shortest path. The number of decision points is larger than on the other paths. The following section shows the calculation of the three different paths.

6 CALCULATION OF RISK VALUE ASSOCIATED WITH TWO PATHS

In the following figure the shortest path is marked with all the values I need for the calculation. For the explanation to show how I calculate the risk value of a path I chose this example. In the next section I compare the results from the simplest path and the path with least risk with the result of the calculation for the risk value of the shortest path. The description of the calculation for all three paths is the same. Thus there is no need to present all three calculations detailed in this paper.

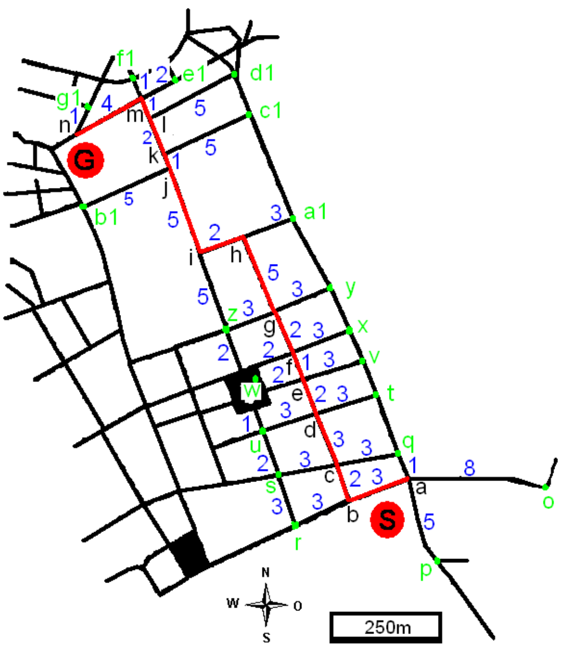

Figure 6. Test area in Vienna marked with the shortest path and the base values for the calculation

The red line is the shortest path and the black letters mark the decision points on this path. The green letters are decision points where the agent realizes that he made a wrong decision. From this point the agent returns to the last decision point where he was still on the correct way. The blue numbers are the values of the street segments. These values are the added street segments that are shown in figure one.

In the following table the risk values of the decision points are calculated.

- In the first column are the letters of the decision points of the shortest path.
- The number of streets means how many streets are on this decision point. Number a is an exception because the agent starts in the middle of this decision point. There is no street he came along.
- Choice is split in two numbers. The first number shows between how many roads the agent can decide and the second number shows the number of wrong decision possibilities. Not included is the street the agent came along.
- All possibilities to walk are in the next column. There is the decision point and all possibilities to move from there. The red one shows the right path.
- My calculation is in the next column and shows how I calculate the risk value of a decision point. I add the values of the wrong street sections and multiply the result by two. This result I divide by the possibilities of choices the agent has on a decision point including the one that is correct.
- The final result of this calculation is the risk value of the decision points.

Decision point	Number of streets	Choice/ wrong choices	Possibilities to walk	Calculation	Risk value of the decision points
a	4	4 / 3	**a-b=>3** a-p=>5 a-o=>8 a-q=>1	(2*14)/4	7
b	3	2 / 1	**b-c=>2** b-r=>3	(2*3)/2	3
c	4	3 / 2	**c-d=>3** c-q=>3 c-s=>3	(2*6)/3	4
d	4	3 / 2	**d-e=>2** d-t=>3 d-u=>3	(2*6)/3	4
e	4	3 / 2	**e-f=>1** e-v=>3 e-w=>2	(2*5)/3	3,3
f	4	3 / 2	**f-g=>2** f-x=>3 f-w=>2	(2*5)/3	3,3
g	4	3 / 2	**g-h=>5** g-y=>3 g-z=>3	(2*6)/3	4
h	3	2 / 1	**h-i=>2** h-a1=>3	(2*3)/2	3
i	3	2 / 1	**i-j=>5**	(2*5)/2	5

			i-z=>5		
j	3	2 / 1	**j-k=>1** j-b1=>5	(2*5)/2	5
k	3	2 / 1	**k-l=>2** k-c1=>5	(2*5)/2	5
l	3	2 / 1	**l-m=>1** l-d1=>5	(2*5)/2	5
m	4	3 / 2	**m-n=>4** m-f1=>1 m-e1=>2	(2*3)/3	2
					53,6

Table 1. Risk value of the decision points of the shortest path

An example:
On decision point b are 3 streets. The agent comes along one street and has the choice of two streets. One of them is the correct one. b to c would be the correct one and has the street segment value 2. b to r is the wrong one and has the street segment value 3. In this case I have only one street segment value for the calculation. Otherwise I would have to add them. This result, 3, I have to multiply by two because the agent has to go this path two times if he is wrong. This last result I have to divide by the number of choices the agent has at a decision point. The risk value from decision point b is 3.

Table number two explains the way how to get the risk value of the whole path. Hence I have to add the values of the street segments of the right path. This result I add to the value I have got from the calculation for the risk value of the decision points. The result of this sum is the risk value of the whole path.

Values of the street segments	
3	
2	
3	
2	
1	
2	
5	
2	
5	
2	
1	
4	
32	Sum of the values of the street segments
53,6	Sum of the values of the decision points
85,6	Total risk value of the whole path

Table 2. How to calculate the risk value of the whole path

This calculation for the shortest path is only to show how to calculate the risk value of a path. I have also calculated the values for the simplest path and the path with least risk and will compare the results in the next section.

7 RESULT

The following table shows the differences between the results of the shortest path, the simplest path, and the path with least risk. In the first column are the results of the added risk values of the decision points. The second column are the results of the added street segments and in the third column these both results are added. In the last column are the numbers of turns on the different paths.

Risk values of the decision points	Length of the street segments	**Risk value of the whole path**	Number of turns	
53,6	32	**85,6**	4	Shortest path
40	33	**73**	1	Simplest path
34,4	35	**69,4**	2	Path with least risk

Table 3. Comparison of the risk values between the shortest path, the simplest path, and the path with least risk.

The results of the calculation point out the differences between these three paths.

The risk value of the decision point of the shortest path is the highest. The value in the second column is important for the shortest path: length of the path.
For the simplest path the description must be as simple as possible. In column four are the number of turns to show that the simplest path has the simplest description with only one turn. The risk value of the decision points of the simplest path is lower than the value for the shortest path. The path with least risk is the longest but the risk values of the decision points are lower than the values of the other two paths. After adding the risk values of the decision points with the length of the street segments the risk value of all paths show that the path with least risk is the safest possibility to reach the destination.

8 FURTHER WORK

Because the NAVIO project should provide solutions for indoor and outdoor navigation I will work on the part indoor navigation next. I thought already about the possibility how to transfer my way to calculate the risk value of a path through a city to a three dimensional map of a building. In the next month I will do research on the subject including literature and projects about indoor navigation and transform my calculation to three dimensional navigation.

9 CONCLUSION

This method for calculating the risk of a path and to differenciate between the three paths discussed in this paper came up by looking at the Dijkstra algorithm. Reading literature about the simplest path and how to calculate the cost of paths was also helpful in calculating the value of the least risk path. I wanted to combine the length, the cost, and the risk of a path in one calculation. Thus I looked at the map with the test area that is shown in part five. The result is the formula for the risk value for the decision points and the calculation of a risk value for a complete path. With this result I can compare the three different paths that are explained in part three.

The most interesting path for me is the one with least risk. I found out that this path can be the longest but the risk value of the decision points is less than the risk values of the shortest and simplest path. The risk value of the path does not depend on the length nor the simple description. It depends on the length of the street segments that would be wrong. For the assumption that the agent recognizes at the next decision point that he is wrong the description has to include road signs with the names of the streets. With the information I get from a map like information on street network and scale I can calculate the risk value of every path and compare the values. I intend to design some tests to see whether this measure of risk correspondes to actual error rates or perception of risk by travelers.

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Berechnung und Analyse von Residualbevölkerungen in Schrumpfungspopulationen

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1 ZUSAMMENFASSUNG

Das Gebiet des heutigen Bundeslandes Mecklenburg-Vorpommern gehörte immer schon zu den am dünnsten besiedelten Gebieten Deutschlands, Die derzeitige Einwohnerzahl von 1,73 Millionen hei einer Einwohnerdichte von 75 EW/km2 ist jedoch das Ergebnis eines dramatisch zu nennenden zusätzlichen Bevölkerungsverlustes von 11% seit 1990. Die derzeit gültige Landesprognose geht von einem weiteren Verlust von noch einmal 13% der Bevölkerung bis 2020 aus. Es ist klar, dass das Ausmaß dieser Schrumpfung eine Vielzahl von Problemen aufwirft und noch aufwerfen wird. Dazu gehören Fragen der Organisation von Infrastruktur, wie z. B. der Verwaltung, des Schulbetriebes, der ärztlichen Versorgung und des Nahverkehrs. Diese schon an sich komplizierten Fragen werden zudem noch durch den Umstand verschärft, dass die im Land zurückbleibende Bevölkerung, nach W. WEIß 2003 „Residualbevölkerung" genannt, in mehrerer Hinsicht Disproportionen aufweist, z. B. Überalterung, Frauenmangel in den fertilen Altersgruppen, Frauenüberschuss bei den reiferen und alten Jahrgängen, überhöhter Anteil an Jugendlichen ohne Schul- oder Berufsabschluss, die überdurchschnittlich hohe Arbeitslosigkeit usw.. Die jungen Bevölkerungsgruppen im Alter bis 20 Jahre werden auf ein Sechstel sinken während gleichzeitig die der 60-Jährigen und älteren auf über ein Drittel ansteigen.

Um die sich abzeichnende Entwicklung detailliert zu beschreiben und so einen wesentlichen Beitrag zur Entwicklung von Strategien zur Lösung wenigstens der gravierendsten Probleme der nahen Zukunft zu ermöglichen, wurde ein Konzept entwickelt, das die Anzahl, die regionale Verteilung sowie die Alters- und Sexualstruktur der Residualbevölkerung in einem Prognosezeitraum zu beschreiben in der Lage ist. Dieses Konzept umfasst die Entwicklung eines auch regional einsatzfähigen mathematischen Prognosemodells der Bevölkerungsentwicklung, ein mathematisches Modell zur Erfassung und Prognose der Haushaltsstrukturen im Land und eine sozialgeographische Studie zur Untersuchung der Gliederung der Residualbevölkerung auf Gemeindebasis und der daraus zu erwartenden Probleme, Die drei Bestandteile des Konzeptes sind derzeit unterschiedlich weit umgesetzt. Die Beschreibung der Residualbevölkerung auf Gcmeindebasis ist nicht abgeschlossen, sondern ein Untersuchungsgegenstand bis Mitte 2005. Im Vortrag wird das Konzept daher für regionale Einheiten in der Größenordnung der Landkreise und der kreisfreien Städte vorgestellt. Der Schwerpunkt wird auf die Vorstellung des mathematisch-demographischen Prognosemodells und der Diskussion der damit errechneten Ergebnisse gelegt.

2 METHODIK UND ORGANISATION REGIONALER BEVÖLKERUNGSPROGNOSEN

Das Bundesland gliedert sich in 12 Landkreise und 6 kreisfreie Städte. Die Regionalplanung, insbesondere die Erarbeitung der Regionalpläne, erfolgt durch die 4 Regionalen Planungsverbände „Westmecklenburg“, „Mittleres Mecklenburg“, „Mecklenburgische Seenplatte“ und „Vorpommern“, die aus den jeweiligen Landkreisen und kreisfreien Städten gebildet sind und somit die kommunale Ebene repräsentieren. Brauchbare Bevölkerungsvorausberechnungen müssen Prognosen für die Alters- und Geschlechtsgliederung der Bevölkerung auch hinsichtlich ihrer Verteilung im Lande abgeben. Um dies zu leisten, gibt es zwei grundsätzliche Möglichkeiten. In der „top down“ – Variante werden die Prognosen für ein Land anhand vorgegebener Muster auf regionale Einheiten herunter gebrochen. In der „bottom up“ –Variante berechnet jede Regionaleinheit ihre Prognose, die zu einer Landesprognose aufaddiert werden kann. Beide Varianten haben ganz offensichtliche Mängel. Daher liegt es nahe, einen iterativen Prozess anzustoßen, der sich zusätzlich auf die Struktur der Planungsverbände abstützt. Dieser Weg wurde beschritten (Vgl. Abb. 1).

Dabei wurden zunächst Annahmen für die Landesprognose getroffen und berechnet. In einer so genannten „konzertierten Rechnung“ werden alle Daten und die Ergebnisse unter Annahme stabiler Wanderungsmuster an die Planungsregionen heruntergereicht. Die Planungsregionen haben untereinander die von ihnen erwarteten Wanderungsmuster abgestimmt. Auf der Basis ihres so festgelegten „Wanderungskontingents“ hat jede Planungsregion ein Wanderungsmuster für ihre Kreise und Städte prognostiziert und daraus Bevölkerungsvorausberechnungen für diese regionalen Einheiten abgeleitet und weiter gegeben. Zur dynamischen Auflösung der anfangs statischen Wanderungsmuster hat dabei besonders die Überlegung beigetragen, dass die Fortzüge aus den Städten in das Umland nicht unvermindert weiter anhalten können und die erste nach der politischen Wende im Umland groß gewordene Generation aus vielerlei Gründen den Weg zurück in die Städte suchen muss.

Eine detaillierte Beschreibung der Abbildung 2 erfolgt im Abschnitt „Das mathematische Modell“.

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Abbildung 1

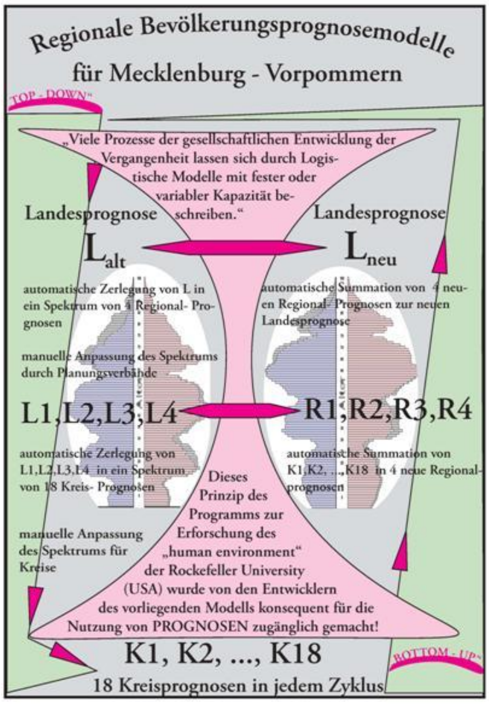
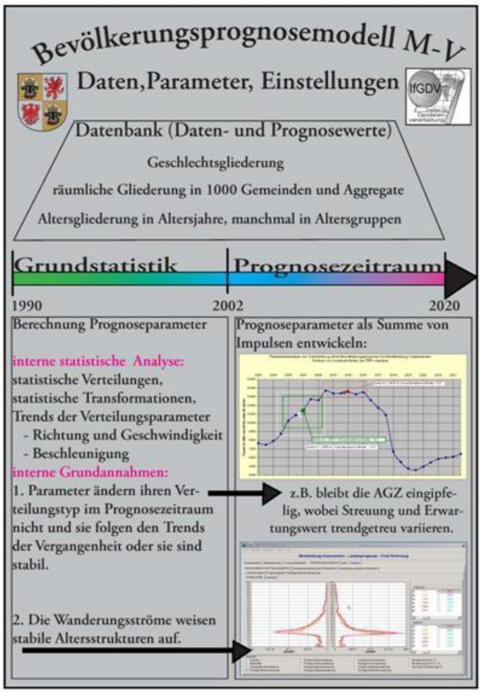


Abbildung 2



Die Landkreise und kreisfreien Städte hatten in diesem Konzept Einspruchs- und Mitspracherechte hinsichtlich der zu erwartenden Bevölkerungsverteilung, insbesondere bei der Beurteilung von Wanderungen innerhalb ihrer Planungsregion (Suburbanisierung). Die anschließende Summation der Ergebnisse führte auf verbesserte Prognosen für die Planungsregionen und deren Summe wiederum zu einer neuen Landesprognose Lneu. Die Analyse der Abweichungen zwischen Lalt und Lneu führt zu einer sehr interessanten Fragestellung.

Es entsteht nämlich die Frage, ob es realistisch ist, dass bestimmte heute beobachtete Trends, z. B. der selektiven Abwanderung in bestimmten Altersklassen, soweit aufrecht erhalten werden bis einzelne Altersklassen „leer laufen". Gerade diese Annahme ist es, die dazu führt, das die aus Sicht der Landesprognose erwarteten Bevölkerungszahlen sich nicht ergeben können. Die Verfasser erwarten nun, dass sich im Ergebnis der demographischen Entwicklungen eine „Residualbevölkerung" einstellen wird, die zur Abwanderung nicht in der Lage ist. Vor allem werden das die „Schwachen" sein, die keine reale Chance haben oder sehen, ihre soziale Stellung durch Abwanderung zu verbessern. Um diese Hypothese zu stützen, werden derzeit besonders die Entwicklungen des Bildungssektors und bei den Schul- und Berufsabschlüssen sowie das Problem der Langzeitarbeitslosigkeit untersucht.

3 ERGEBNISSE DER REGIONALISIERTEN BEVÖLKERUNGSVORAUSBERECHNUNG

Die Berechnungsergebnisse zeigen im Zeitraum von 2002 bis 2020 regionale Bevölkerungsverluste von über 30% an. Die berechnete starke regionale Streuung der Bevölkerungsverluste geht einher mit starken regionalen Differenzierungen des Jungenkoeffizienten (25% -32%), des Altenkoeffizienten (38% - 52%) und der Sexualproportion (0,946 – 1,047). Das wird besonders wegen der noch gravierenderen Unterschiede in wichtigen Altersgruppen zu regionalen Disproportionen führen. Dieser Prozess aus Schrumpfung und regionaler Umverteilung sowie der Herausbildung von extremen Gliederungsstrukturen wird von Problemen begleitet werden auf die sich die Verwaltung, die Wirtschaft oder auch nur der Justizapparat einstellen müssen. Im Folgenden können nur einige Ergebnisse und Folgen der prognostizierten demographischen Entwicklung vorgestellt werden.

I. fortschreitende Überalterung

Der Alterungsprozess besteht aus zwei Komponenten:

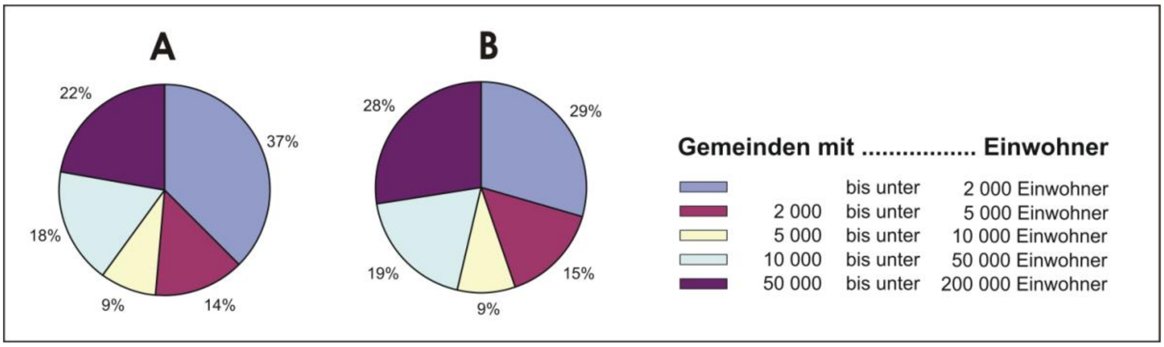
- Zunahme des Anteils der über 60-jährigen an der Bevölkerung,
- Erhöhung der Lebenserwartung (Erhöhung der Lebenserwartung bei Männern auf 77,3 Jahre und bei den Frauen auf 83,1 Jahre bis 2020).

Diese Prozesse vollziehen sich in Ost- und Westdeutschland gleichermaßen. Das Problem liegt insbesondere darin, dass ländliche Räume aufgrund dieser demographischen Ausgangssituation wesentlich „schneller altern" als Agglomerationen. Mecklenburg-Vorpommern ist demzufolge ein Vorreiter für die demografischen Prozesse, die Deutschland insgesamt in den nächsten Jahrzehnten erreichen werden.

II. Frauenmangel in den fertilen Altersgruppen

Analysiert man das Verhältnis von Männern und Frauen in den Altersgruppen 15 bis 45 kann man Männerüberschüsse von mehr als 40% feststellen. Ursache dafür sind die wesentlich höheren Fortzugszahlen bei Frauen gegenüber Männern- insbesondere in der Altersgruppe der 18-25jährigen. Auffällig ist in diesem Zusammenhang, dass die Männerüberschüsse insbesondere in den Gemeinden bis 2000 Einwohner zu verzeichnen sind (Abb.3).

Abbildung 3: Anteil der Gemeindegrößenklassen A: am Männerüberschuss B: an der Bevölkerung 2003



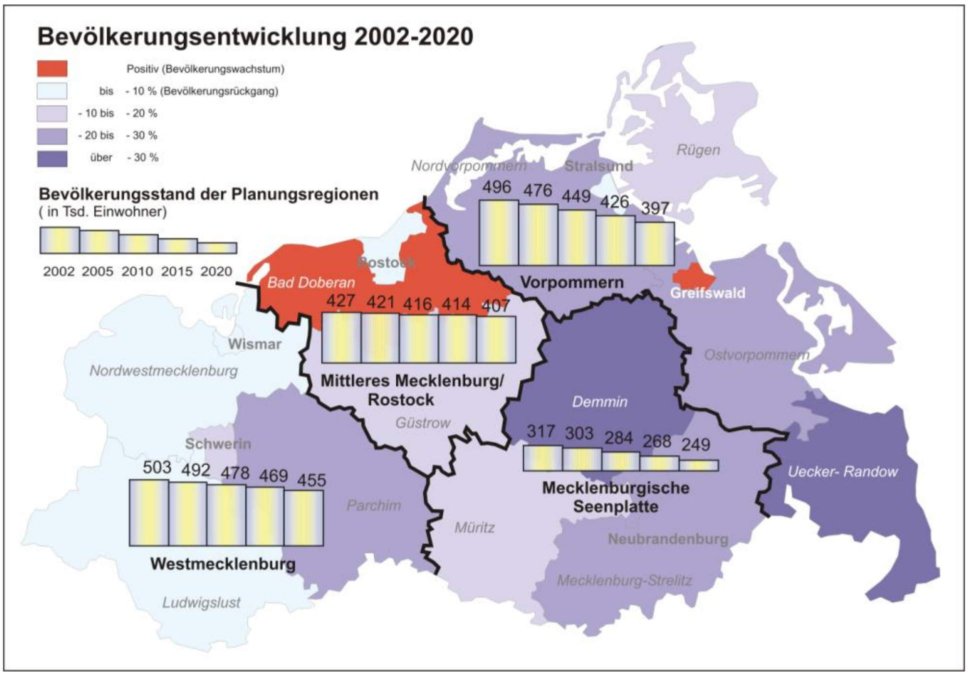
Quelle: Statistisches Landesamt Mecklenburg-Vorpommern; eigene Berechnungen

Die Konsequenzen dieses selektiven Abwanderungsprozesses sind bisher kaum untersucht. Setzt sich dieser Prozess aber weiter fort, sind Rückgänge in der Anzahl der Frauen im fertilen Alter von über 50% gegenüber den heutigen Bestandszahlen wahrscheinlich. Der Trend wird noch dadurch verstärkt, dass der Zuzug von Frauen in den betreffenden Altersgruppen wesentlich geringer ist als der von Männern.

II. Starkes regionales Gefälle bei der Bevölkerungsentwicklung in Mecklenburg-Vorpommern

Schrumpfung vollzieht sich in Mecklenburg-Vorpommern natürlich auch nicht gleichmäßig. Regionen mit einer relativ stabilen Bevölkerungsentwicklung stehen Regionen mit Bevölkerungsverlusten von bis zu 35% gegenüber. Auf der Abb.4 ist das West-Ost-Gefälle deutlich sichtbar. Die Planungsregion Westmecklenburg profitiert in diesem Zusammenhang von der geographischen Nähe zu den Bundesländern Niedersachsen und Schleswig-Holstein sowie dem Stadtstaat Hamburg. Täglich pendeln aus dieser Region ca. 29.000 Personen in die genannten Bundesländer (ca. 42% der Auspendler aus Mecklenburg-Vorpommern).

Abbildung 4



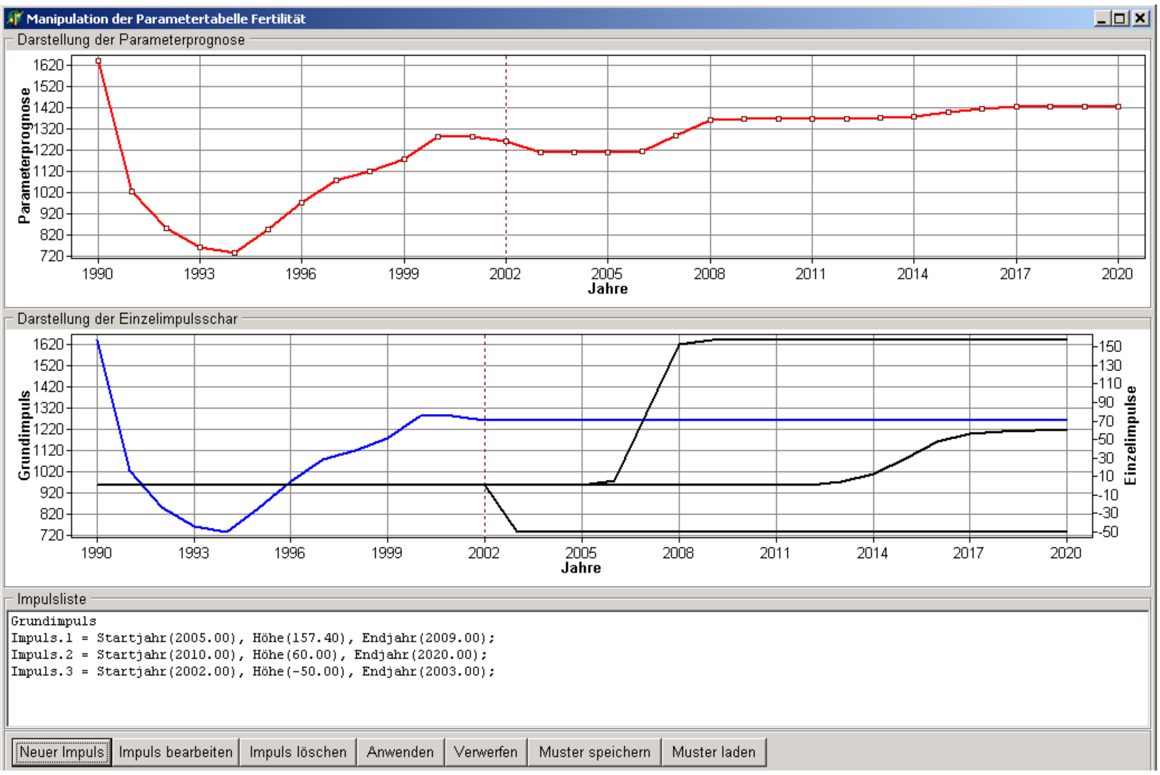
4 DAS MATHEMATISCH-STATISTISCHE MODELL

Berechnungsergebnisse solcher Brisanz stoßen unweigerlich auf Akzeptanzprobleme. In solchen Fällen geraten immer zuerst die zu Grunde liegenden Analysemethoden unter Kritik. Deshalb ist es besonders wichtig, dass die Methoden transparent, die Annahmen plausibel und die Modellrechnungen nachvollziehbar angelegt sind. Von besonderer Wichtigkeit ist auch, beliebige alternative Annahmen in „Echtzeit", d. h. während einer Diskussion, durchspielen, auswerten und präsentieren zu können. Im Vortrag werden im Zusammenspiel mit dem Auditorium Beispiele dafür gegeben, dass die vorliegenden Modelle diese Ansprüche erfüllen. Für die Entwicklung des Modells wurde die Aufgabe neu parametrisiert. Die beschreibenden Parameter für die Bevölkerungsstruktur und -dynamik lassen sich in zwei Gruppen einteilen. Die erste Gruppe umfasst die „Prognoseparameter", das sind die Parameter, deren Entwicklung der Anwender frei manipulieren kann. Die zweite Gruppe umfasst die von uns so genannten „einfachen Parameter", die im Modell verdeckt entweder statisch gesetzt oder vor jedem Rechnungslauf automatisch aus dem statistischen Datenmaterial neu berechnet werden. Bei der Abgrenzung dieser beiden Gruppen ist es wichtig, das Anwendungsspektrum zu kennen. Für die Berechnung amtlicher Prognosen wurde daher eine Modellvariante implementiert, die stärker von Summenparametern geprägt ist. Beispielsweise ist dort die mittlere Lebenserwartung Neugeborener als Prognoseparameter gewählt worden, während die Berechnung der Sterbetafeln anhand von Warteschlangenmodellen im Modell gekapselt wurde.

Die wichtigsten grundlegende Methodik des Modells ist in der Abbildung 2 dargestellt. Die Prognoseparameter werden vom Anwender des Programms als Summen von logistischen Funktionen, die hier auch Impulse genannt werden, in die Zukunft projiziert. So steht für jeden Zeitpunkt in der Zukunft ein kompletter Satz von Prognoseparametern zur Verfügung aus dem die Bevölkerungsstruktur und ihre räumliche Verteilung erzeugt werden können.

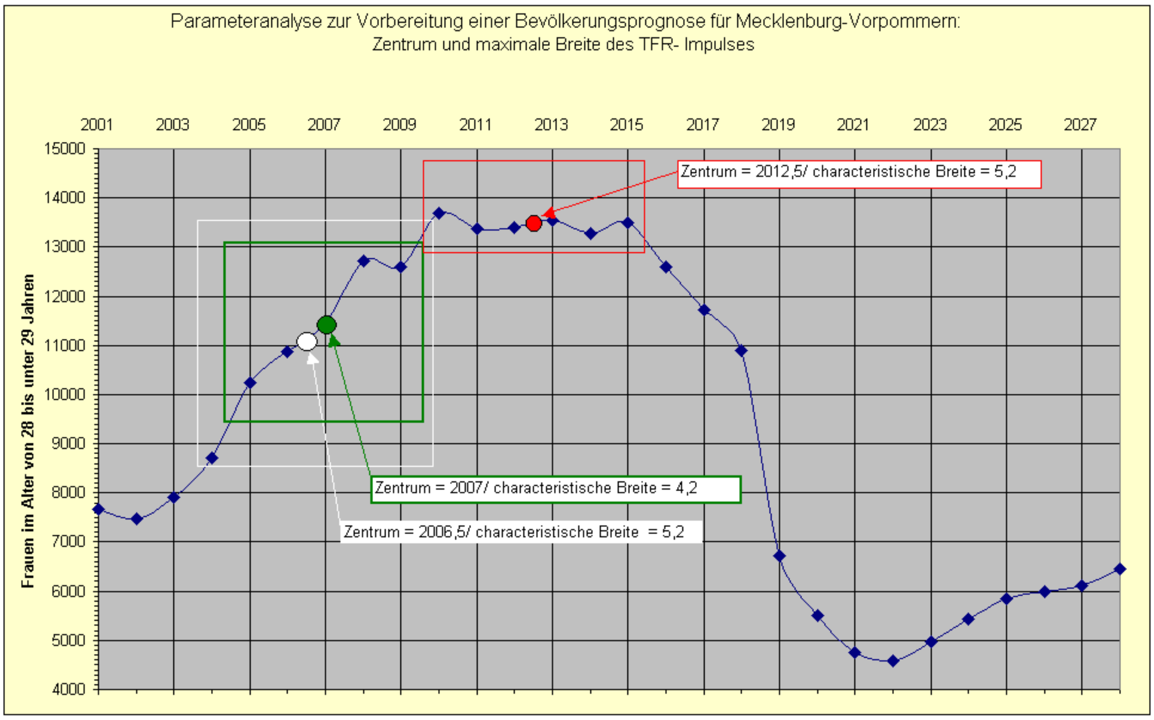
Abbildung 5 zeigt einen Bearbeitungsbildschirm des Prognoseprogramms, in welchem die totale Fertilitätsrate prognostiziert wird. Bis zum Jahr 2002 sind die statistischen Werte eingetragen. Ab dem Jahr 2003 ist im oberen Fenster der prognostizierte Verlauf dieser Kennziffer dargestellt, wie er sich als Summe der unten dargestellten drei Impulse ergibt. Impuls.1 besagt: „Eine signifikant wirksame Änderung der Prognoseziffer wird mit dem Jahr 2005 einsetzen und im Jahr 2009 weitgehend abgeschlossen sein, wobei sich die totale Fertilitätsrate in diesem Zeitraum um 157,40 erhöhen wird.".

Abbildung 5



Impulse haben eine Kapazität K (Abb. 5: K = 157,4), ein Wachstumsintervall dt (Abb.5: dt =2009 – 2005 = 4) und ein Wirkzentrum tm (Abb. 5: tm = 2007). Gegenüber der Interpolation von Entwicklungen mit anderen Ansatzfunktionen erlaubt die Verwendung der Impulse eine klare inhaltliche Definition und auch Interpretation. Zudem bietet die Technik eine ideale Möglichkeit, politische Maßnahmen und Entscheidungen im Modellkontext mathematisch zu formulieren und hinsichtlich ihrer Auswirkungen durchzurechnen.

Abbildung 6



Die Idee, gesellschaftliche Entwicklungen als Summen aus Einzelimpulsen zusammenzusetzen, stammt von S. AUSUBEL und P. MEIER 1996. Sie wurde im Zusammenhang mit dem „Program of the Human Environment" der Rockefeller University, New York (Vgl. http://phe.rockefeller.edu/LogLab und dort vor allem die zahlreichen Beispiele!) zur Analyse von Prozessen der Vergangenheit entwickelt. Die Vortragenden haben das Prinzip der Zerlegung bestimmter, in vielen gesellschaftlichen Bereichen anzutreffender Zeitreihen in Summen von Impulsen konsequent in die Zukunft projiziert. Durch den gewählten Ansatz lässt sich das Problem einer Bevölkerungsprognose oder allgemeiner das Problem von Prognosen gesellschaftlicher Entwicklungen darauf zurückführen, im Prognosezeitraum Impulse auszumachen oder gezielt zu setzen und ihre Wirkung auf die Prognoseparameter abzuschätzen. Hierfür geben wir das folgende Beispiel (Vgl. Abb. 6). Die bisherige Entwicklung der Geburtenziffer (Anpassung der Altersspezifischen Geburtenziffer an das Niveau der alten Bundesländer in den Jahren 1990-1995) kann durch verschiedene Maßnahmen beeinflusst werden. Die Effektivität solcher Maßnahmen kann durch die richtige Wahl der Impulsparameter simuliert werden. Wenn z. B. daran gedacht werden würde, ein Geburtenförderprogramm für Mecklenburg-Vorpommern aufzulegen, so zeigen altersstrukturelle Überlegungen und Variantenrechnungen, dass dies am meisten Sinn machen würde, wenn die Maßnahme ein Wirkintervall von ca. 5 Jahren hätte, wobei der größte Teil der Mittel in den Jahren 2012 und 2013 (Impulszentrum der Maßnahme) eingesetzt werden sollte. Weitere hier nicht reflektierte Beispiele sind die Anpassung der Impulse an die Wanderungsparameter, die das demographische Echo der Geburtsjahrgänge 1990 und folgende ab dem Jahr 2008 berücksichtigen. Entwicklungen im Rahmen der EU-Osterweiterung beeinflussen die Anzahl der Zuzüge aus dem Ausland; wegen der geringen Verweildauer dieser Migranten werden dadurch auch die Fortzüge in andere Bundesländer beeinflusst. Das zum Modell gehörende Softwareprogramm besitzt eine Auswerteumgebung, die Zusammenfassungen der Ergebnisse in unterschiedlicher Tiefe direkt bereitstellt - als Tabellenwerk im PDF- Format, als Daten- und Graphikauswertung im EXCEL-Format sowie kurze oder ausführliche Berichte im WORD- und PDF-Format .

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