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Planning support systems for the integration of land use and transport; new ways of using existing instruments

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1 INTRODUCTION

This paper will present preliminary results of a participatory Planning Support System development approach. To support the much needed early integration of land use and transport planning on a regional level, a PSS is developed based on an innovative development approach. The reader should not expect brand new technological innovations, because the approach is geared to seek ways in using existing tools and instruments in more useful way. First the backgrounds of this project are discussed. Then the roots of the development approach are discussed, leading to the approach itself. Some early planning products and PSS products are then presented after which the paper closes with a reflection, recommendations and conclusions.

2 INTEGRATING LAND USE AND TRANSPORT PLANNING

In the media and in politics we see a sharp increase in attention for climate change, (un)sustainable developments and suggestions to improve these situations. One of the issues which receives growing concern is the urbanisation which is apparent in the developed world (where a small majority of people live in cities) and which is explosive in the developing countries (i.e. China and India). Urbanisation is not a major problem in itself, but the (unsustainable) way most urban areas are organized is. Pollution (from industry, but increasingly from car transport), traffic jams, inefficient land use (i.e. urban sprawl) and decreasing public transport potentials are problems that are visible problems most cities face these days.

While we see that in most situations the land use (or spatial) planning of cities is separated from transport planning, the integration of these two planning processes is seen as crucial to overcome some, if not most, of the above mentioned unsustainability problems. The importance if this integration is recognized not only in academia (e.g. Banister, 2002; Banister, 2005), but also by important platforms of industry (e.g. WBSCD, 2001), by politicians and decision makers (European Conference of Ministers of Transport, 2002)and in spatial and transport policy documents (in the Netherlands for instance in: Department of V&W, 2005; Department of VROM et al., 2004).

Yet, in planning practice and especially on the regional scale (where, due to scale of modern cities and transition to a network society, urban issues are most evident), not much integrated land use and transport planning can be seen. Both institutional barriers and barriers with respect to the content of both land use and transport planning are underlying this. In this paper we will focus on the barriers related to content and how to overcome them. These barriers appear to be especially challenging in the earlier phases of planning (i.e. visioning and scenario building) (see also te Brömmelstroet et al., 2006). Yet, it is here, where significant changes for integration exist, while the degree of freedom is relatively large and minds are not set yet.

The issue of barriers related to content is related to the differences in the knowledge that is used and generated in the land use planning process on the one hand and transport planning processes on the other, and how and by whom this is done. In the literature there is no clear consensus about what precisely constitutes knowledge. Without taking part in this debate, we will use the distinction made by Nonaka and Takeuchi. They distinguish tacit and explicit aspects of knowledge. The explicit aspects are easily articulated, codified, and stored in certain media, while the tacit aspects consists often of habits and culture which is only known by an individual and that is difficult to communicate to the rest of an organization (Nonaka and Takeuchi, 1995). The interaction between these two aspects creates knowledge (often by planning professionals) that is used in the planning process.

Comparing land use planning with transport planning, we can recognize that both aspects of knowledge have clearly different characteristics in both fields. While transport planners use more quantitative information on flows, land use planners more often prefer to work with more qualitative notions of space (technical). Oversimplifying one can say that transport planners prefer to calculate and analyze while land use planners like to design and synthesize (tacit). It is these differences that form the barrier of content. The challenge is to find a common language that integrates (or forms a bridge between) these aspects.

With this notion, developing indicators and concepts that address both land use and transport issues (e.g. the concept of sustainable accessibility in: Bertolini et al., 2005) seems insufficient, because it only offers a link of the explicit aspects of knowledge. Attempts to bridge the gap by integrating land use and transport processes (e.g. structural meetings to discuss common issues) are on the other hand too much focused on the tacit knowledge aspects. Recent advances in the field of Planning Support Systems (PSS) seem to create opportunities to connect both worlds.

Following Klosterman, “PSS must not be seen as a radically new form of technology…it must take the form of an information framework that integrates the full range of current (and future) information technologies useful for planning” (Klosterman, 1997, p. 51, emphasis in original). It should facilitate interaction among planners, contain structured and accessible information and facilitate social interaction, interpersonal communication and debate that attempts to deal with common concerns (ibid., p. 51). This implies that a PSS should address both explicit and tacit knowledge aspects. The former by dealing with structured information and the latter by facilitating social interaction. Such a PSS offers a chance to deal with the content barrier that blocks the integration of land use and transport planning. However, as we will discuss below, the development of such a PSS is hampered by fundamental issues relating to the development process.

3 LAND USE AND TRANSPORT PSS: CHANCES AND BOTTLENECKS

A first quick scan of recently developed PSS that are aiming to support exactly the above mentioned early integration of land use and transport planning on a regional scale in the Netherlands shows that they many were developed (Al and van Tilburg, 2005), but not many of them were widely adopted in day to day planning practice. More often then not, they were only used in experimental situations or within they organisation that developed the PSS (te Brömmelstroet, 2006) [91].

This corresponds with insights in the wider field of PSS research. While the implementation of technological support tools for planning has been a rough patch for decades already, recent research shows that the situation for the new family of tools (the PSS) shows no deviation from this trend. In fact, developed PSS are often seen by planners as far too generic, complex, inflexible, incompatible with the ‘wicked’ nature of most planning tasks, oriented towards technology rather than problems, incompatible with the less formal and unstructured information needs, and too focused on strict rationality (see e.g. Batty, 2003; Bishop, 1998; Couclelis, 1989; Geertman and Stillwell, 2003; Harris and Batty, 1993; Innes and Simpson, 1993; Klosterman and Landis, 1988; Sheppard et al., 1999; Sieber, 2000; Uran and Janssen, 2003; Vonk, 2006). That is why the attitude of planners towards such PSS is characterized as ‘downright antagonistic’ by Harris (1999). It seems that it is not that the planners do not see the added value of PSS, but that the developed ones do not fit their specific needs. One of the major causes behind this gap appears to be the distance between the development of the PSS (i.e. by universities, knowledge institutes and consultancy firms) and the actual planning processes. This was already posed by Lee in relation to Large Scale Urban Models in 1973 (Lee, 1973). He suggested that, to improve the efficiency of future modelling efforts:

- Models should be transparent; just as likely to be wrong, but achieving consensus on assumptions can result in opposing parties agreeing on conclusions;
- Modelers should find a balance between theory, objectivity and intuition to keep contact with the policy problem;
- They should start with a particular policy problem that needs solving;
- They should build only very simple models.

In 1994, Lee noted that these guidelines still stood, because the modeling community had not changed its attitude in the meantime (and consequently the implementation gap still existed)(Lee, 1994). Similar notions can be found in a recent publication focussing on particular bottlenecks of PSS (Vonk, 2006). In addition, he suggests that communication of developers with practice should be improved to actively analyse the tasks that may be supported and an interactive learning process among all the relevant actors is recommended (Vonk, 2006, p. 96).

[91] Current research is focusing on a more in-depth analysis of this hypothesis and its underlying reasons. Preliminary results point in the same direction as hypothesised here.

In the case of this paper, the particular policy problem is the integration of land use and transport planning. It seems that here the same bottlenecks resulted in the above mentioned lack of implementation. Atop of general PSS bottlenecks (the lack of fit with user needs) the goal of integrating these two planning domains adds some extra challenges. We argued already that the characteristics of both the tacit and explicit knowledge aspects differ. There is also an increased risk of creating too complex information that is not accessible anymore for all planners. Both the land use and transport system are examples of complex systems. We seem only at the start of understanding some of the key processes in those separate systems, let alone all the possible interrelations and feedbacks between the two. In attempts of producing information that approaches reality, complex opaque 'black boxes' are the result Yet, especially in the early phases of planning (visioning, scenario building, debate and mutual learning), simplicity and transparency is key (te Brömmelstroet et al., 2006). It seems that finding the balance between complexity (that does justice to reality) and simplicity (that makes the information accessible) is the challenge of a PSS to support the integration of land use and transport planning. Adapting the famous saying of Albert Einstein; the PSS should be as simple as possible, but no simpler!

Finding this balancing point is something that should be done in close cooperation with the users of the PSS; the land use and transport planners. As will be discussed in the next section this has multiple advantages. Based on insights and concepts of the field of technological innovation (next section), we will present the development approach for a PSS that supports the integration of land use and transport planning. After this, results from a first case will be put forward.

4 ROOTS FOR A NEW PSS DEVELOPMENT APPROACH

In this section we will introduce the development approach that deals with the issues presented above. This approach is rooted in several concepts and insights from related fields. It goes beyond the scope of this article to address these roots in detail, but for the sake of argument, the most important notions are shortly introduced below. [92]

In the late 1980s-early 1990s insights in the defects of a linear understanding of technological innovation resulted in the research field coined 'the social shaping of technology (SST)' (MacKenzie and Wajcman, 1985). Important notions of this field are that implementation (where user needs and requirements are discovered and incorporated in the course of the struggle to get the technology to work in useful ways) is an important site of innovation (Williams and Edge, 1996, p. 874). It also conceived innovation as a complex social activity. Therefore, "an iterative, or spiral process that takes place through interactions amongst and array of actors and institutions involved and affected" (Ibid, p. 875) is proposed as alternative for the linear mode of innovation.

This new technology innovation paradigm resulted in a variety of technology development methods that replaced the, up to then central, waterfall development method, one of which is the Soft Systems Methodology (SSM) (Checkland and Holwell, 1998; Checkland and Scholes, 1990). This is a method developed to deal with ill-defined problem situations which have a large social and political component; so-called 'soft' problems. It is an iterative process in which developers and users (cooperatively and iteratively) go through seven stages, from defining the problem situation to taking action. SSM is a learning system about a complex problematic situation proceeding via debate (Checkland, 2001, pp. 67-70).

A second method in the light of SST is the Dynamic System Development Method (DSDM), developed by Stapleton and Constable (1997) based on the Rapid Application Development (RAD) concept (Martin, 1991). DSDM is founded on nine key principles underlie this technology development method of which the most important are; user involvement; a frequent delivery of products; delivering a system that addresses the current user needs; development is iterative and incremental and; testing is carried out throughout the project life-cycle (Martin, 1991).

In a recent book, Van den Belt introduces the concept of 'mediated modeling' as a problem solving approach (van den Belt, 2004). This concept is itself inspired by a large number of disciplines. It offers a method to develop a model in close cooperation between the modelers and the users. One of the key principles is that most learning takes place in the process of building the model, rather than after the model is finished (Vennix

[92] For a more elaborate discussion of these methods and their influence on our process approach, the reader is referred to (te Brömmelstroet and Schrijnen, 2007)

et al., 1997). A strong user involvement in the process of conceptualization, specification and synthesis of a model is therefore recommended. The method claims to increase the level of shared understanding, builds consensus about the structure of a complex topic, provides a strategic and systematic foundations for research and serves as a tool to disseminate gained insights.(van den Belt, 2004, p. 17)

All methods are based on the participation of the users throughout the development process. This offers several advantages. It creates an internal learning environment for the users, it generates extra knowledge about the issue at hand which will increase the instrumental quality and it creates extra ground for the resulting tool.

5 AN INNOVATIVE APPROACH FOR PSS DEVELOPMENT

Although there is no analytical research showing if these new technology development processes live up to their promises, it is plausible to assume that they (at least) will bring developed PSS closer to the user needs. Up till now, most PSS developments seem to have taken a technological deterministic approach, focusing on technical possibilities and supply side drivers. With the large number of developed PSS versus the large demand for them in planning practice (and the gap between them), the time has come to the social shaping of existing and future PSS. [93]

As “no two […] modeling process can be exactly the same […] nevertheless, certain elements are common to most mediated modeling projects” (van den Belt, 2004, p. 60), we have attempted to combine the lessons that can be learned from the three methods use in technological innovation and translated it into the particular situation in which we are developing a ‘land use and transport PSS’.

This approach is based on the following principles:

- **User involvement**: in the entire process, the model developers work in close cooperation with the land use and transport planners and stakeholders;
- **Iteration:** five stages are recognized (problem assessment, metamodel, functional prototype, final model and an integrated strategy), but iteration through learning effects is possible if not preferable (although there is a dominant direction, pictured as the orange arrows);
- **Frequent delivery of products**: every stage delivers its particular product (e.g. the metamodelstage delivers a process protocol which can be used in other processes);
- **From problem definition to taking action**: developing the model is accompanied by using it to come to an iterative land use and transport strategy. This creates learning effects for the model (i.e. through social shaping), keeps participants involved and provides tests for the model that has been developed so far;
- **Addressing current user needs**: the iteration of developing and testing it, makes user needs explicit and uncovers hidden needs in the process.
- **The process is supported by existing tools:** the method is not used to develop new tools from the scratch (in our opinion there is enough supply), but adapt already existing tools. As we addressed above, a PSS is seen as an information framework, so the development process is about finding new ways of using the existing tools to create useful information. An additional advantage is that this embeds the results in the organization.

The approach is shown in figure 1. This structure is largely based on the DSDM lifecycle, but strongly adapted to the specific needs and characteristics of PSS development.

[93] As argued by em.prof. Ottens in a keynote speech at the International Workshop Modeling and Decision Support for Urban Planning held at the School of Urban Design, Wuhan (China)

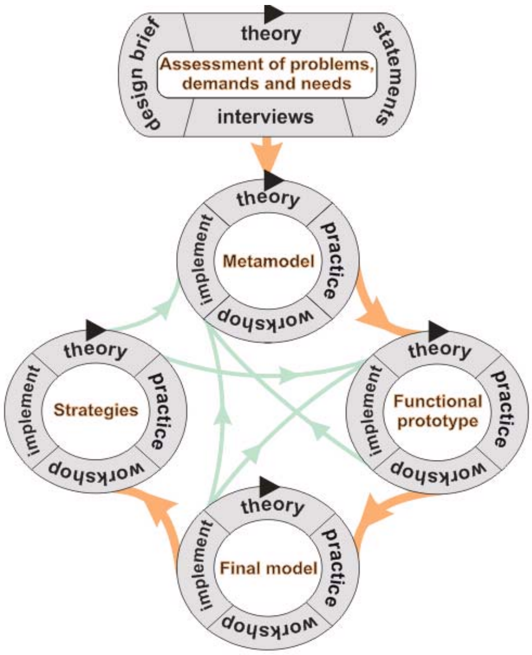

Figure 1 : Project architecture of the Amsterdam case

The PSS development approach is started with a focus on the definition of the specific planning problem at hand (in this case the early integration of land use and transport planning on a regional level). Also the group of participants has to be identified (here, the group has to comprise land use as well as transport planners and preferably also some stakeholders or decision makers) and introductory interviews have to take place, to gain insights in the view points of the problem and expectations of the PSS development process and the result of this process. This phase usually results in a problem definition and a first design brief for the PSS.

Then, a series of workshops is started in which simultaneously a planning product and a PSS is developed. This combination is important, because it creates a continuously testing ground for the intermediate results and creates mutual learning effects (remember: most learning takes place in the process of PSS-building!). Working with the PSS also generates new insights in the user needs. The first phase focuses on a process protocol (coined a metamodel here); which steps have to be followed in which order to come to an integrative land use and transport planning product and what does that integrated land use and transport planning product look like? In a second phase, the participants have to identify which information is useful and understandable in each step. It is this workshop that creates a first version of the common language. In a discussion, the modelers and users have to find out what kind of information works and what kind does not. Functional prototype is chosen as title of this step, because it results in a first version of a planning framework combined with information (a PSS in Klosterman's definition), that has to reflect a consensus of the group of participants. In the third phase, this prototype is put to the test: the group of participants has to work with the PSS to come to an integrative planning product (defined by themselves in the first phase). Depending on how the group has defined the functional prototype, this phase can exist of multiple workshops. The last phase is improving the PSS and drawing up the planning product.

As the approach shows (figure 1), there is a dominant direction, but there are many feedback loops. One can imagine that during the phase of testing the prototype, new insights in an ideal sequence of planning steps are gained (learning by doing).

6 THE METHODOLOGY APPLIED: THE CASE OF AMSTERDAM

In 2005, the transportation planning department of Amsterdam (dIVV), requested the University of Amsterdam to cooperate in a project to increase the usefulness of their transport model. It is the only Dutch municipality with their own fully functional transportation model; GenMod. Despite this unique situation and despite the fact that recent test results show that the quality of the outcomes of the model is the best available in the Netherland, the model is not used to its full potential (especially in strategic phases of the planning process). Several of the above mentioned issues seem to be at play here. The transport model;

- offers explicit knowledge with characteristics that do not fit the characteristics of tacit knowledge in these strategic phases of planning;
- does not fit the user needs of the strategic planners, but is focussed on a technical and supply oriented rationale;
- is too much focussed on supporting transport planners (so geared to there tacit and explicit aspects), while at the strategic level there is a need for a common land use and transport language;

Improving this situation can be seen as a technical challenge, resulting in a process in which the model developers rebuilt the model to improve the model in such a way that it can face the three above mentioned issues. However, a development approach in which the land use planners and transport planners were closely involved seems to be more efficient in this context. This idea was also supported by the model developers and group of strategic transport planners at dIVV. The land use department of the municipality of Amsterdam (dRO) together with the City Region of Amsterdam (a cooperation of sixteen municipalities including Amsterdam and Almere) also expressed their support for such a PSS development approach. In short: the goal of the approach was to transform the existing transport model (and other existing tools of the planning departments) into a full PSS that supports the early integration of land use and transport planning in the region of Amsterdam.

6.1 The process and progress so far

With a group of approximately ten to fifteen participants we started the PSS development process in April 2006 with a kick off meeting. The group consisted of (depending on the different phases) two to four transport modelers, four to five transport planners, two land use planners from dRO and one from the City Region of Amsterdam and a varying group of stakeholders and scientists (of the University of Amsterdam, the University of Utrecht and the Technical University of Delft). In each workshop, a transport modeler or external expert gave a presentation on certain information and model possibilies (i.e. different kinds of accessibility maps).

At the moment of writing we have been together in five workshops and are working towards the final PSS and integrated planning product(s), which will be the focus of the sixth and final workshop[94].. Below we will present the products as they are developed until now. We will also shortly describe how these products were developed.

6.2 Developed PSS products

The first product that was created was a process protocol for an ideal land use and transport integration process. To come to such a protocol, first the participants described the current process and where they saw threats or opportunities for a better integration (figure 2a). From this exercise it became clear that especially the integration in very early phases was both problematic as well as opportunity rich. Planning is seen as a cyclical process (projects – vision – projects etc.). Especially at the vision level there is no common language, resulting in visions from a land use perspective (often meeting critique later on by the transport planners) and vice versa. It would also increase the creativity if external stakeholders would be included in these early phases.

After this problem orientation, an ideal type process was sketched (in a plenary discussion). The results of this discussion were interpreted by the researchers of the University of Amsterdam, who presented a process protocol in the next workshop. Again, this protocol was discussed, and led eventually to the one depicted in figure 2b. Important notions are that a first planning step should focus on generating urban scenario's based on issues as accessibility and sustainability (and starting from an existing urban program). In this step, existing land use constraints (e.g. ecological protected areas) have to be on the table, to make th design process not too idealistic from a transport – land use perspective.

These scenarios are tested on their network implications in a second planning step. This will lead to an optimizing design exercise in which the scenarios are evaluated and infrastructure measures can be introduced. A last step is looking at the differences and similarities between the developed scenarios, to learn what robust choices are for the future land use and transport systems; which choices work in all scenario's

[94] This workshop is scheduled for the 11th of May, so the results can be included in the CORP presentation

and which ones are really sensitive for small changes. Learning effects can lead to reconsideration of choices that were made earlier in the process.

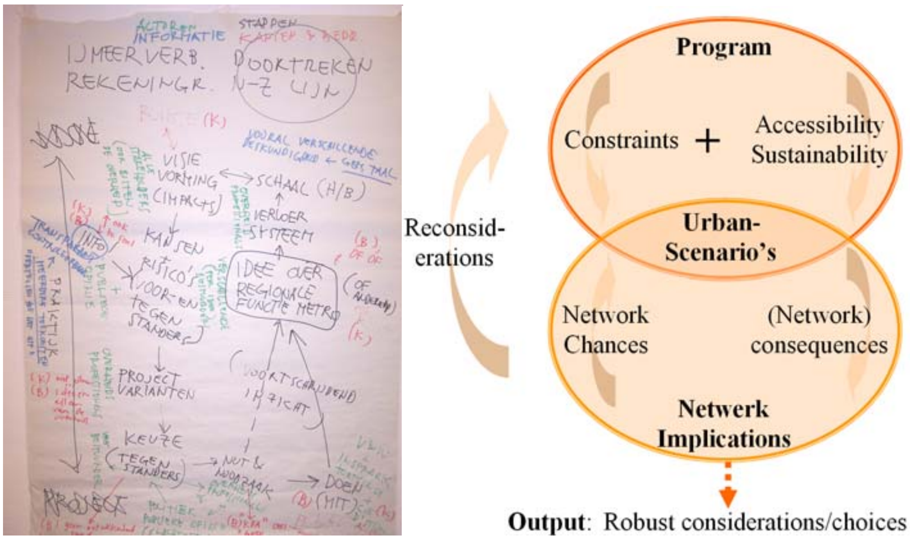

Figure 2: the process protocol (2a= the process problems; 2b= the ideal process protocol)

From the above description of the process protocol, the different kinds of information can already be distinguished. This was the next phase in the PSS development process.

A first step towards the functional prototype was to map the preferred information characteristics of the participants. In an individual exercise they had to rank characteristics on a scale of importance. This revealed that user needs (figure 3) really differed from the current characteristics of GenMod. The planners in the early phases of integrated land use and transport planning need fast knowledge that links to their tacit knowledge. They consider characteristics as "detail" and "precision" to be less relevant. GenMod should be used to "test insights" and "create new ones" instead of delivering "hard facts" and "evaluating" existing plans and projects.

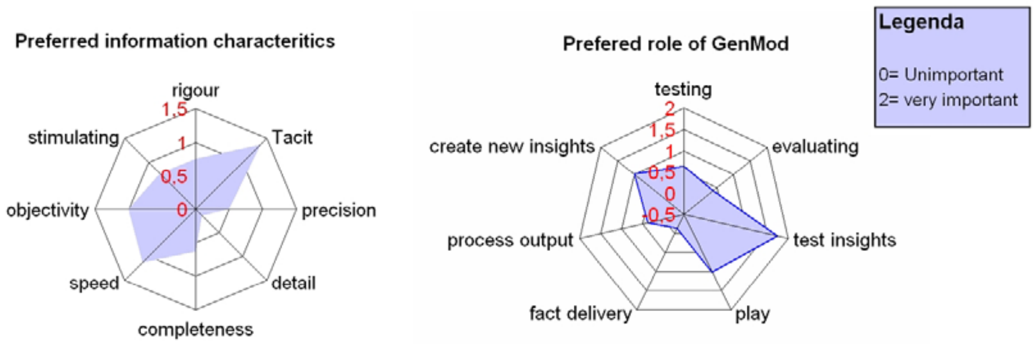

Figure 3: Preferred user characteristics (left = information; right = GenMod)

The second step towards the prototype is judging all kinds of existing information. In a workshop, the participants rated and discussed all kinds of maps and figures that could be useful. A selection of those was made and used in further sessions.

The resulting prototype is shown in figure 4. These are examples of input and output GenMod and other instruments have to work with to support the integrated land use and transport planning process; it is the first version of the PSS. In the first planning step, spatial maps are key. For the design of urban scenarios the participants want to know the spatial situation of indicators as accessibility (the number of people or jobs accessible from each zone within a reasonable travel time) and sustainability (the number of people or jobs reachable within a crow flight distance[95]). Also spatial restriction maps have to be made (by the GIS department) to show design taboos (and question them!?). Then GenMod has to deal with an abstract design based on the program (houses and jobs) located within the Amsterdam Region. With that, the model has to

[95] This indicator is seen as a proxy for sustainability, because it shows the number of activities within reach by slow modes as walking and bycicles (ENG: proximity, NL: Nabijheid).

calculate network consequences, network chances and a number of indicators, which show the change with regards to a basic scenario. This creates an understanding of which choices are good and which are bad (and a sense of robustness).

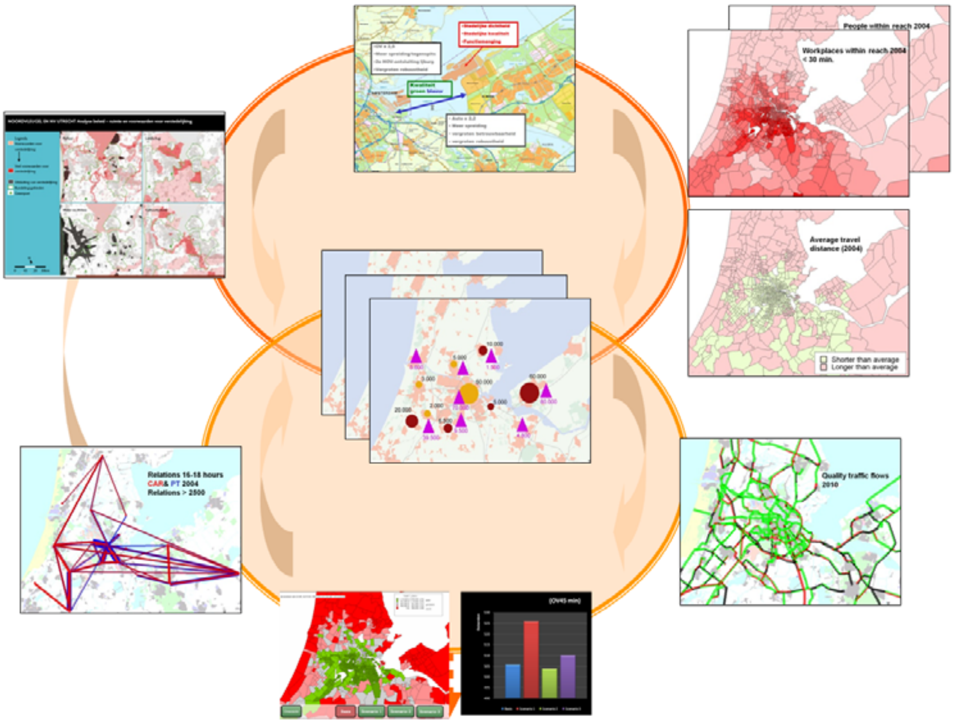

Figure 4 : Functional prototype: the process protocol with types of information support

6.3 Developed land use and transport products

As noticed above, we are in the process of producing integrated land use and transport planning products. At the moment of writing, the planners want to create a shortlist of robust land use and transport projects that have a positive impact on the accessibility of the region and that have this positive impact in different possible futures (robustness). This shortlist should be accompanied by a document containing the discussions, debates and choices that occured during the workshops. It has to present the learning that has taken place in the workshop, especially on interrelations between land use and transport (i.e. if we want to develop workplaces at location A in 2010, public transport project B has to be developed earlier). Working towards such a list, the current intermediate planning products are a range of different (original and optimized) scenarios.

It is important to re-state that the planning product is not a single ‘best’ scenario, but a set of robust strategic land use and transport choices. Nevertheless, we show one of the scenarios as illustration in figure 5. The red rounds represent 10.000 houses, the yellow ones 10.000 jobs.

Figure 5: One scenario in two steps (left = after first design step; right = after second optimizing design step (including infrastructure projects))

7 REFLECTING ON THE AMSTERDAM CASE

Although the participants are very positive about the learning effects of the workshops and of the new PSS, it is not yet clear if this PSS and the planning products will be more successful that earlier attempts. However, we did monitor the impressions of all participants after each workshop (through a personal survey). Form the results of these surveys we can draw some early reflections.

The transport model developers have learned to present the outcomes of GenMod in different ways. During the development process it became clear that the characteristics of the calculations as well as the output (as explicit knowledge) had to be qualitative rather than quantitative. The developed scenarios were so abstract that interpreting them to fit in the model was highly ambiguous and thus hard numbers could not be cracked. A learning point for the modelers was that this did not hamper the design process, because all participants were fully aware of these facts and even preferred such qualitative information.

The land use and transport planners are also very positive of the process. They see that the information helps them to design integrated visions for the region. There is little discussion about the information itself (something which can be witnessed in many other design efforts). It seems that all participants are very well aware of the assumptions and shortcomings of the used information, so they can focus on using it to discuss planning issues. It has also become clear that for both input and planning output, the planners are more satisfied with relative simple information characteristics than with sofisticated model outcomes. They do not want the PSS to help them to develop THE planning scenario, but to facilitate a discussion in which their own (land use and/or transport) knowledge of the region is challenged and sharpened. The demand for a shortlist of projects and their interrelations proofs this point.

Yet, we also faced some difficulties during the process. One group that designed a scenario was almost entirely absent at the following workshop. This hampered the mutual learning process and eventually resulted in a lower number of scenarios that continued the process. So, it seems crucially important to ensure that all participants have the commitment to come to every workshop.

It also seems to be crucial that the owner/developer of the models are present at the workshops and have a vested interest in its progression. The progress depends on them for calculations and generation of information. It also increases the learning effects, because the modelers can take part in discussions about the information (in the beginning of the process). They can explain certain things, or learn from the fact that some things are not understandable for the planners.

8 CONCLUSION AND RECOMMENDATIONS

Due to its 'work in progress' nature, this research does not yet lead to hard conclusions. Yet so far, we can already see that developing PSS in close cooperation with the users (i.e. the land use and transport planners) really creates a lot of learning dynamics. Although naturally, it depends largely on the people that take part in such a process, it would be very interesting to see how this process works in environments based on other planning problems.

It is also necessary to monitor the results of such a process. How do the planning results disseminate into the wider planning community and how are the lessons learned translated in future attempts or in using the software (creating a workbook as a collective memory seems to preferable.

A final recommendation is too extend these PSS development approaches to include other participants besides planners: decision makers, stakeholders and maybe even the general public.

9 REFERENCES

Al, J., and van Tilburg, W. (2005). "Basisboek Instrumenten Regionale Bereikbaarheid." Rijkswaterstaat AVV, Rotterdam.
Banister, D. (2002). Transport Planning, Spon Press, New York.
Banister, D. (2005). Unsustainable Transport: City Transport in the New Century, Routledge, London.
Batty, M. (2003). "Planning Support Systems: Techniques That Are Driving Planning." Planning Support Systems in Practice, S. Geertman and J. Stillwell, eds., Springer, Heidelberg, v-viii.
Bertolini, L., le Clercq, F., and Kapoen, L. (2005). "Sustainable Accessibility: A Conceptual Framework to Integrate Transport and Land Use Plan-Making. Two Test-Applications in the Netherlands and a Reflection on the Way Forward." Transport policy, (12), 207-220.
Bishop, I. D. (1998). "Planning Support: Hardware, Software in Search of a System Computers." Environment and Urban Systems, 22(3), 189-202.

Checkland, P. (2001). "Soft Systems Methodology." Rational Analysis for a Problematic World Revisited: Problem Structuring Methods for Complexity, Uncertainty and Conflict, J. Rosenhead and J. Mingers, eds., John Wiley &Sons, LTD, New York, 61-90.

Checkland, P., and Holwell, S. (1998). Information, Systems and Information Systems: Making Sense of the Field, John Wiley & Sons Ltd., Chicester.

Checkland, P., and Scholes, J. (1990). Soft Systems Methodology in Action, Wiley, Chicester.

Couclelis, H. (1989) "Geographically Informed Planning: Requirements for Planning Relevant Gis." 36th North American Meeting of Regional Science Association, Santa Barbara.

Couclelis, H. (2005) "“Where has the future gone?” Rethinking the role of integrated land-use models in spatial planning" Environment and planning A, (37), 1353-1371

Department of V&W. (2005). "Nota Mobiliteit." Department of V&W, Den Haag.

Department of VROM, Department of LNV, Department of V&W, and Department of EZ. (2004). Nota Ruimte, Department of VROM,, Den Haag.

European Conference of Ministers of Transport. (2002). "Implementing Sustainable Urban Travel Policies. Final Report." Paris.

Geertman, S., and Stillwell, J. (2003). Planning Support Systems in Practice, Springer, Berlin.

Harris, B. (1999). "Computing in Planning: Professional and Institutional Requirements." Environment and planning B : Planning and Design, 26(3), 321-331.

Harris, B., and Batty, M. (1993). "Location Models, Geographical Information and Planning Support Systems." Journal of Planning Education and Research, 12, 84-98.

Innes, J. E., and Simpson, D. M. (1993). "Implementing Gis for Planning - Lessons from the History of Technological Innovation." Journal of the American Planning Association, 59(2), 230-236.

Klosterman, R. E. (1997). "Planning Support Systems: A New Perspective on Computer-Aided Planning." Journal of Planning education and research, 17(1), 45-54.

Klosterman, R. E., and Landis, J. D. (1988). "Microcomputers in United-States Planning - Past, Present, and Future." Environment and Planning B-Planning & Design, 15(3), 355-367.

Lee, D. B. (1973). "Requiem for Large-Scale Models." Journal of the American Planning Association, 39, pp. 163-178.

Lee, D. B. (1994). "Retrospective on Large-Scale Urban Models." Journal of the American Planning Association, 60(1), 35-40.

MacKenzie, D., and Wajcman, J. (1985). "The Social Shaping of Technology : How the Refrigerator Got Its Hum." Open University Press, Milton Keynes.

Martin, J. (1991). Rapid Application Development, MacMillan Publications Corp., New York.

Nonaka, I., and Takeuchi, H. (1995). The Knowledge-Creating Company : How Japanese Companies Create the Dynamics of Innovation, Oxford University Press, New York.

Sheppard, E., Couclelis, H., Graham, S., Harrington, J. W., and Onsrud, H. (1999). "Geographies of the Information Society." International Journal of Geographical Information Science, 13(8), 797-823.

Sieber, R. (2000). "Gis Implementation in the Grassroots." URISA journal, 12, 15-29.

Stapleton, J., and Constable, P. (1997). Dsdm: A Framework for Business Centered Development, Addison-Wesley, Boston.

te Brömmelstroet, M. C. G., Hoetjes, P., and Straatemeier, T. (2006) "Linking Information to Strategic Planning Processes." International Workshop Modeling and Decision Support for Urban Planning held at the School of Urban Design, Wuhan University. China, October 21-23

te Brömmelstroet, M. C. G. (2006). "Properly Equip the Warrior, Instead of Just Manning the Equipment: A First Step in a User-Oriented Pss Development Approach as Support for the Integration of Land Use and Transport Planning." Progress in Design & Decision Support Systems in Architecture and Urban Planning, J. P. van Leeuwen and H. J. P. Timmermans, eds., Eindhoven University of technology, Eindhoven, 35-50.

te Brömmelstroet, M.C.G and P.M. Schrijnen (2007), "Developing a meaningful PSS for land use and transport integration: first experiences from working with a Community of Practice", 10th International conference on Computers in Urban Planning and Urban Management, Brazil, 11-13 July, 2007 .

Uran, O., and Janssen, R. (2003). "Why Are Spatial Decision Support Systems Not Used? Some Experiences from the Netherlands." Computers, Environment and Urban Systems, 27, 511-526.

van den Belt, M. (2004). Mediated Modeling: A System Dynamics Approach to Environmental Consensus Building, Island Press, Washington.

Vennix, J., Andersen, D., and Richardson, G. (1997). "Group Model Building: Adding More Science to the Craft." System Dynamics review, 13(2), 187-201.

Vonk, G. (2006). Improving Planning Support; the Use of Planning Support Systems for Spatial Planning, Nederlandse Geografische Studies, Utrecht.

WBSCD. (2001). "Mobility 2001 - World Mobility at the End of the Twentieth Century and Its Sustainability." World Business Council for Sustainable Development (Prepared by MIT and Charles River Associates), Geneva, Switzerland.

Williams, R., and Edge, D. (1996). "The Social Shaping of Technology." Research policy, 25(1), 865-899.