The Issues of System and Data Interoperability for a European Tourist Information System

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ABSTRACT

The objective of the GEORAMA project is to develop a geo-navigational web portal that serves sportsmen, tourists, and the local population by offering relevant spatial and thematic information in several European tourism regions. The web service aims at promoting the access to public and private information related to countryside and mountain tourism by offering digital maps and additional data on the web and enabling the potential visitors to plan their visits.

To provide the necessary information, various data from selected tourist regions all over Europe had to be acquired, coming in different formats and from different sources. In order to meet specific requirements and conventions regarding legal, economic and technical aspects, the datasets have to be pre-processed before their integration into a map viewing application. The map viewing application presented here is able to deal with geographic data of all kinds and is open and easily extensible.

1 INTRODUCTION

Interoperability is an important issue in European projects dealing with the integration of data into information systems. The term interoperability refers to the ability of software modules to communicate. In a European funded *eContent* project ("GEORAMA") Austria, Belgium, Finland, Greece, Italy, and Portugal are represented by selected tourism regions either in mountainous, countryside, or eco-tourism related areas. In the project a web portal with a map viewing application is developed that integrates digital maps and data in order to enhance local development of mountain and countryside communities by concurrently preserving competitiveness of the tourism industry.

The overall aim of the project is to encourage users to access public and private data and to promote the access and dissemination of data via new technologies according to the latest initiatives towards a European "information society". The service makes a contribution to increase the value added potential of public and private data. The technical aspect of this project demonstrates the interoperability between systems and data from various sources. The methodology of data collection and acquisition in participating project countries, problems encountered as well as requirements on basis data are shown up in section two of the paper.

The legal framework for involved datasets regarding rights of use, copyright regulations and license agreements is dominated by individual solutions varying from nation to nation. These issues are discussed in the third section of the paper. The project aims at finding a solution for a harmonization among project partners leading to a legal standard for provided and re-used data. The same is considered for different pricing models of mainly public data where GEORAMA wants to increase the awareness for the need of standardized pricing policies.

Section four describes how data from heterogeneous sources are published in the Internet with the GEORAMA map viewing application. For this application standardization efforts of the Open GIS Consortium are exploited. The Open GIS Consortium (OGC) is a voluntary association of organizations from government, university, and private industry. The consortium took the initiative for promoting interoperability in the geospatial community by developing specifications of services. The service employed in this project is the web mapping service (WMS), which supports the publication of maps on the Internet and is not bound to specific data formats or software systems.

The result of the efforts taken to establish a map viewer for geographic data from various European countries are presented in section five. The main outcome is a prototype of a web mapping application that is based on the specification of the OGC and therefore permits data interoperability. The closing sixth section of this paper gives a conclusion and an outlook.

2 DATA ACQUISITION

Data acquisition and data collection from the selected tourism regions were focused not only on geographic datasets but also on content or thematic data. In this paper, when talking about web mapping and system interoperability only geographic datasets are targeted, although some aspects (e.g., legal framework) are related to both types of data. In order to avoid confusion about the terms in this specific context, a short explanation is given.

- Geographic data

  Geographic, topographic, or geodata is data which describes phenomena directly or indirectly associated with location. Examples are topographic base maps, aerial images, digital elevation models (DEM) or topological elements like points (e.g., location of infrastructure, buildings, museum, etc.), lines (e.g., hiking routes, streets, rivers, etc.) or polygons (e.g. area of skiing resort, lakes, etc.). Topology of objects or elements means that the relationships of one spatial element are stored with respect to another. The processing, preparation, and visualization of data is performed within a Geoinformation System (GIS). Geographic data are usually stored in a certain data format and coordinate system.

- Content data

  Content data, also known as thematic data, is generally defined as "raw information" like texts, graphics, sound, video, or any other multimedia elements. In case of GEORAMA, content or thematic data is considered as ancillary information about tourist regions or activities originally without any direct spatial relation (opening hours of museum, number of lifts in skiing resorts, descriptive texts about hiking routes, etc.). Although a direct spatial relation is not necessarily required, nearly every content dataset can be geo-referenced by linking the attributes to spatial objects.

In order to store the great amount of various content data in a structured way, a content database management system will be situated centrally on side of the portal.

Since in some cases the assignment of provided datasets to either content or geographic data is not clear, there will always be some sort of “fuzzy tolerance” between both data types. The question arises, if textual descriptions, images, etc. relating to a geometric feature like e.g., a route are directly or non-directly spatially related. Two possibilities are feasible. These elements can be stored as independent objects or as attributes of geo-objects.

2.1 Specified data requirements

The geographic data for the GEORAMA map viewing application has to fulfil certain requirements and conventions, which were specified for the project. These requirements are referred to the value of data that is characterized by information density, the issue of data update and maintenance as well as data formats, cartographic guidelines and multilingualism.

2.1.1 Information density

A valueable geographic dataset for the project’s purposes requires more than just topological information: It must offer relevant ancillary attributes in regard of tourist services. The example in Fig. 1 demonstrates route data for the activity “trekking” in the Austrian project region *Hinterstoder* where additional information like difference in altitude, time required, difficulty, season and many other attributes are collected and stored.

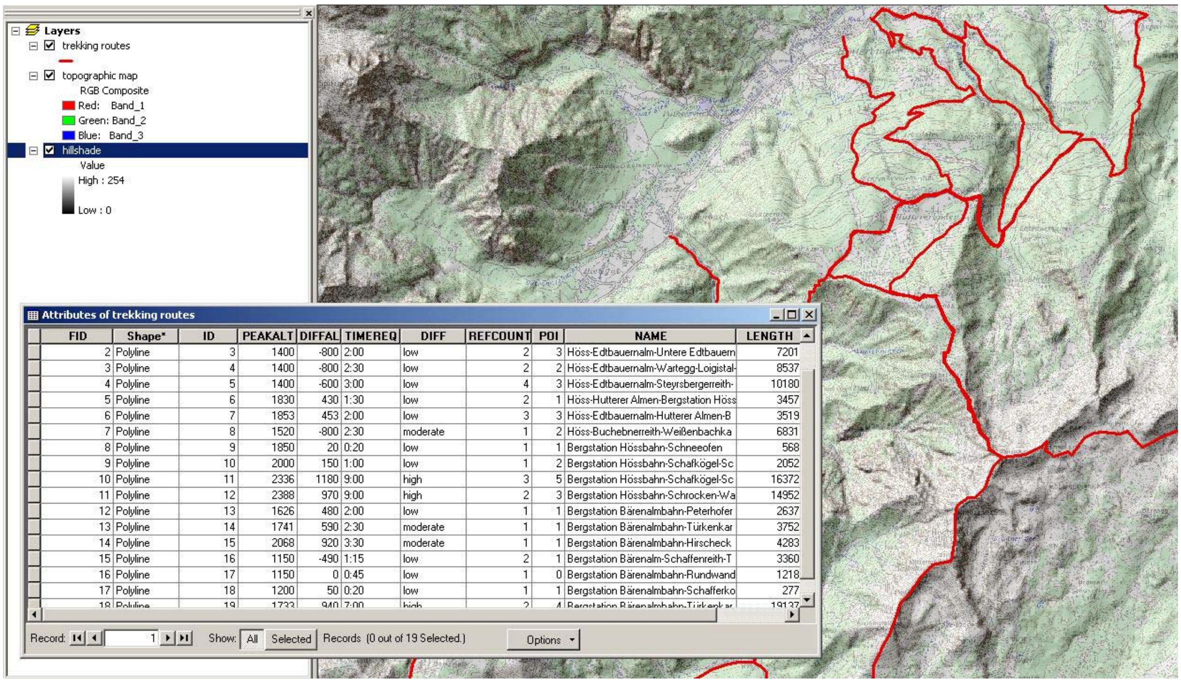

Figure 1: Valuable geo-data requires adequate attribute information

2.1.2 Data update and maintenance

The collected data from participating project countries represent a heterogeneous cross-section of principal data availability in European countries with varying information content, accuracy, and also refreshing periods.

Data maintenance and updating of both types, content and geographic data, should be managed preferably locally within the corresponding project countries. Since especially content data underlie permanent changes, the direct involvement of local e.g., countryside communities or outdoor sport companies etc. facilitates the task of updating. A general solution for the question of updating is to encourage data providers to take the responsibility for updating and maintaining of their own data, regulated by special contracts. From the economic point of view regularly updated datasets create win-win situations for all involved parties.

2.1.3 Data formats

Possible input data for the web mapping service can be all from GI Systems supported vector data formats (*shapefile, coverage, dxf,* data base formats *like mdb, Oracle*, etc.) and raster data formats (e.g., TIFF, JPEG). A Web Map Service produces maps of geo-referenced data while “map” is defined as visual representation of geo-data - a map is not the data itself. These maps are generally rendered in a pictorial format such as PNG, GIF, or JPEG or occasionally as vector-based graphical elements in Scalable Vector Graphics (SVG) or Web Computer Graphics Metafile (WebCGM) formats (OGC 2001b).

2.1.4 Cartographic requirements

In web mapping services there is a strict separation between data and data visualization (SOGI 2003). This separation leads to difficulties in the preparation of a valuable respectively legible map. As data is the most important source for the creation of a map, it has to contain useful information. This means for example that it has to provide additional information about objects, if the map objects are clickable (see 2.1.1.). Even when data is well prepared the created map might not meet the users' expectations, because cartographic design rules for their visualization are not considered. Design rules have to be considered during the registration of the data sources on web mapping servers. When the data sources are well prepared and these design rules are considered, a valuable map can be created. The cartographic design rules imply that:

- the amount of data displayed has to correspond to the current zoom level,
- the size of symbols changes when the zoom level is altered,
- the colors of the data layers are well chosen,
- a legend, which allows the map reader to decode the map objects is provided,
- an adequate generalization of elements according to the map scale is applied.

2.1.5 Multi-lingual aspect

The names of data layers in a web mapping application, a legend and all attributes of the geographic data have to be available as multilingual datasets. This includes the languages of all participating nations. English has been chosen as system language. Challenging issues are the translation of specific terms that might not exist in any language and the handling of special characters.

2.1.6 Data characteristics

Experiences from the project show that geographic data have to offer certain properties. Without claiming completeness, Table 1 provides a compilation of basic requirements concerning specific datasets for a tourism related project like GEORAMA. The recommendations can serve as guidelines for similar web mapping projects.

	Layer	Illustration / scale	Additional attributes	Data type
Basic data	Topographic map	1: 25000 – 1: 50000	-	Raster
	Digital terrain model *	Hill shade	-	Raster
	Aerial image *	-	-	Raster
	Streets, railway, rivers, etc.	Line symbols according to categories	Infrastructure number and code, river names, etc.	Vector (lines)
	Administrative boundaries	Local or regional level	Name, ID-code, etc.	Vector (polygons)
	Contour lines	100 – 500 m intervals	Height information, e.g., 100 – 500 m contour intervals	Vector (lines)
	Cities, villages, etc.	Symbols	Names, coordinates, etc.	Vector (points)
Specific data / activities	Protected areas (e.g., national park), bird or flora watching area, geologically interesting areas, etc.	-	Kinds of species, season from – to, restrictions, etc.	Vector (polygons)
	Skiing resort, diving zones, airport, etc.	-	Area, perimeter, season from – to, other specific parameters	Vector (polygons)
	Routes, trails, pistes, etc.	Line symbols according to categories	Name or code of route, description, length, duration, difficulty, other specific parameters	Vector (lines)
	Points of view/interest, historic sites, accommodation facilities, gastronomy, refuges etc.	Appropriate symbols according to types	Name, description, opening hours or months, prices, other specific parameters	Vector (points)

* Reasonable only for certain zooming levels

Table 1: Basic requirements on geographic data for a web mapping application

2.2 Methodology of data acquisition

Within the preparatory work of data acquisition the question of metadata documentation ("data about data") was discussed as well. A number of main standard metadata elements adopted from the publication ISO 19115 (ISO 2003), by the International Organization for Standardization were stored for each collected dataset.

The general methodological approach of the data acquisition phase was organized in several steps that were partially overlapping and related to each other.

- Data investigation: Conducting researches in order to figure out data availability in the participating project regions at public national mapping authorities or local authorities as well as private GIS companies, tourism agencies, natural reserve administrations, etc.
- Cooperation with local authorities, institutions, tourism associations providing content data for the project regions;

- Design of data acquisition including general considerations (metadata documentation, data types, conceptual database design for content data storage etc.);
- Pre-processing, preparation and visualization of collected geo-datasets within a Geographic Information System;
- Pilot phase: Collection and processing of selected data for two pilot regions *Hinterstoder* (Austria) and *Kerkini Lake* (Greece) and presentation within an early web mapping prototype;
- Final data collection and arranging legal issues for data (including license agreements, royalties, usage contracts);
- Valorization of data: Aggregation of data from other project areas in order to increase information density (see 2.1.1.) combined with a valorization of existing dataset regarding quality enhancement;
- Post-pilot and commercial phase: Implementation of further project regions in a future step into web mapping application and finally transition of project into commercial exploitation stage.

2.3 Problems encountered

The data acquisition phase was characterized by several difficulties regarding data-related, seasonal, and areal restrictions. The corporation of the different cost models and updating issues have also been a challenge. Some of the following listed problems were individually depending on the participating countries and some were faced as general problems in every country.

- General data usage restrictions: copyright regulations, constraints and rights of use (similar in all project regions for public and private data). These restrictions are discussed in section 3.
- Military restrictions: publishing of maps or data showing military bases in border areas is prohibited (e.g., in Greece at the borderline to Bulgaria).
- Seasonal or areal restrictions: there are several restrictions regarding the acquisition of primary data affecting for this reason also leisure activities inside the area. Especially in nature protection areas and national parks seasonal or areal restrictions are often imposed on visitors due to specific breeding times of birds for example (project area of Portugal). Other areal restrictions can be declared hunting grounds that are limited to open season or restricted forest zones due to woodworks (e.g., Austria).
- Costs: examples are web page links to thematic information liable with costs (e.g., web cameras or commercial tourist information services), costs for commercial and permanent use of data contrary to special usage agreements for project's purposes and finally royalties for basic data.
- Data maintenance: Though geographic data are considered to be more expensive than content data, the update rate of content data is supposed to be higher. A high update rate is considered for data provided by private companies with commercial interests. Content data have the characteristics to be subjected to a high fluctuation regarding up-to-dateness and maintenance. Mainly private companies are considered to be responsible for the project's content data (e.g., gastronomy, accommodation facilities, outdoor companies, etc.).

3 DATA POLICY AND LEGAL FRAMEWORK

In European countries exist various concepts for geo-data policy combined with different strategies for access to public spatial and non-spatial information. An explicit and coherent data policy for the European Commission (EC) is urgently needed, particularly at a time when the EC is promoting several European Union (EU) policies aiming at an efficient and wide-spread use of digital technologies and information (*eEurope*, *eContent*, *eGovernment* Information Strategies) (COGI 2000). Andrew Frank states that the selling of topographic data at low costs fosters the use of geographic data and therefore would be the preferable policy (Frank 2003). The position paper from the Joint Research Centre "Towards a Geographic Information Policy for the European Commission" states in that context:

"The object of an EC geographic information policy should include the terms and conditions for the acquisition, use, maintenance, and dissemination within the Commission and to third parties of all the geographically referenced data that is necessary to formulate, implement, and monitor EU policies" (COGI 2000).

3.1 Copyright regulations and licence agreements

Negotiations resulted that in each project country the property rights of acquired data remain at the data owner and only the right of use can be acquired. Generally, data can be purchased either by single licence contract (unlimited duration, one-time data delivery by paying 100% of licence fee), subscription contract (including regular updates of provided data) or limited contract (thematic and temporal limitation of data usage) (ARK 2001). In case of GEORAMA special licences agreements have to be arranged individually with local private and public data providers to be authorized in re-using and publishing data on the Internet.

Functionalities like printing of maps or downloading of data is on principle possible in the presented application (see section 4). In practice though, only printing of maps will be enabled. Downloading of acquired data cannot be offered due to copyright restrictions and restricted license agreements from the participating project countries.

3.2 Pricing policy strategies

From the perspective of economics, geo-data are merit goods and the use of such goods is of national interest. Geo-data are characterized typically by high fixed costs (due to acquisition and maintenance) and very low marginal costs (dissemination) but their optimal price is not determined by a market price (Krek and Frank 1999). The spectrum of possible strategies for pricing policy ranges from no-cost dissemination (public domain) to full cost recovery. In between are situated the Low Cost Strategy (LC) and the Partial Return on Investment Strategy (PRI). Since there are a number of pros and cons there is no optimal strategy among the mentioned variants for pricing of geo-data (Keller 2001).

Within a future commercial phase of GEORAMA revenues will be raised partially either from advertising or from offering specified services. It is intended to provide digital maps from the web mapping service completely for free while information for mobile phones (future scenario) will be offered for marginal costs as paid service.

4 PUBLISHING GEOGRAPHIC DATA WITH A WEB MAPPING SERVICE

A web mapping service is a service that publishes geographic data in the Internet. In the service the data sources and their representation are defined. The viewing of the geographic data is done with a map viewer. The first map viewer was developed by the Xerox Palo Alto Research Centre (PARC) ten years ago (Xerox 2003). The PARC map viewer's zoom and pan operations could be performed, which means that the size of the objects in the map could be changed and the map could be moved. In addition to that it was possible to search for predefined geographic locations (Putz 1994). Today many web applications like for example route planners; company finders, and tourist information sites, etc. make use of map viewers.

The web mapping service of the GEORAMA project has to meet specific demands, because of the

- spatial distribution of the data,
- the different Geographic Information Systems employed,
- the required extensibility of the service.

Different system architectures for web services were evaluated in respect to their technical, legal and economic constraints. The implementation of a centralized architecture, which implies the set-up of one European database for geographic data, seems impossible, because of the legal aspects for data and the difficulties in standardising and maintaining the available data. To solve the problems of copyrights for and maintenance of data, a distributed architecture was aimed at. The data reside in their country of origin and the responsibility for data revision remains at the side of the data providers. The GEORAMA service has to reach independency from employed geo-information products, because the data providers already use GIS and the unification of products is a challenging and expensive task. The demand for software independency and extensibility of the service can be met by the use of *interoperable web mapping services*.

The Open GIS Consortium (OGC), which is a non-profit organization having members from government, private industry and academia, took the initiative for the development of computing standards supporting interoperability in the geo-information community. Interoperability refers to the collaboration of software components provided by different companies where barriers of communication (e.g. import/export problems) are overcome. The OGC provides implementation specifications, which define the interfaces – sets of methods – conforming web services have to implement. The interfaces of the web services are therefore standardized and known. This is the basis of interoperability, because the functionality of any conforming service can be accessed from a client machine. The vision of this approach is to "geo-enable" the web and move away from monolithic systems. The flexibility, functionality, and productivity of geographic information systems are augmented when web services for the geo-information community are available in the Internet (SOGI 2003).

There are different kinds of OGC web services: services for coordinate transformations (OGC 2001), the search of metadata of data collections and services (OGC 2002), the display of maps (OGC 2001b) and others. The service mentioned at last, which is developed for publishing of geo-data on the web, is called *web mapping service* (WMS). The GEORAMA project employs this kind of service, which is based on the WMS implementation specification (OGC 2001b)of the Open GIS Consortium. As usual in web applications, a client and a server communicate. This approach is also valid for web mapping services. The client of the GEORAMA project is represented by the prototype of the map viewer and the servers are the WMS servers. The map viewer is responsible for sending requests to a server and processing respectively displaying the server's replies. At the side of the web map server the data sources, which are available for web publishing, are registered and administered.

Different web map service versions exist and the specification is steadily extended. The GEORAMA map viewer is developed for WMS in the version 1.1.0, which was the current version at the beginning of the project. At the time this paper was written, WMS in the version 1.1.1 has been available. The steady improvements are a problem for applications using OGC WMS, because the downwards compatibility can not be guaranteed. A web map server basically implements three interfaces: GetCapabilities (required), GetMap (required), and GetFeatureInfo (optional). The GetCapabilities interface provides the client with a description of the data available at the server. The returned capabilities document contains metadata specifying the owner of the data/service, the costs of the service, the version of the WMS server, the geographic extent of the data, the spatial reference system etc. The GetMap request returns a map as a raster image that is created on the server based on the requested data. The request for a map requires, among other things, information about the data layers to be included, the spatial reference system and the geographic extent of the data, and the styles defined for the layers. These pieces of information are retrieved from the capabilities document. The optional interface GetFeatureInfo makes map images queryable, if it is activated. Features that are provided attribute information can be clicked and the additional information is presented. Figure 2 is a schematic representation of the concept of open interfaces described above: There are different data sources respectively web mapping services available providing data layers for maps when addressed through the interfaces. The service registry contains a listing of the available services.

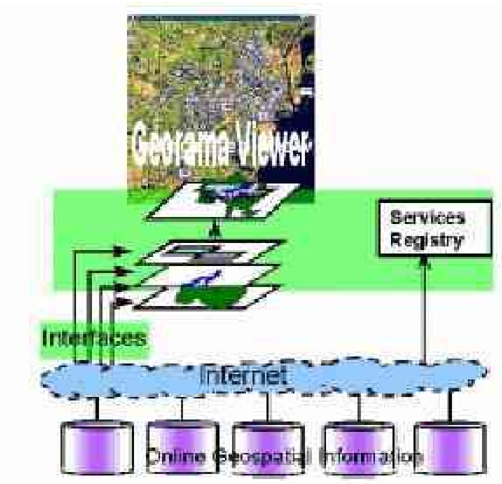

Figure 2: Concept of open interfaces

Within the GEORAMA project data providers join the GIS framework by publishing their data via the OGC WMS interface. Any compatible GIS can be used for data collection, processing, and maintenance, because OGC WMS can deal with all common geographic data formats. There are OGC WMS servers offered in different price classes and from different software companies. In general the expenses for setting up a web mapping server are acceptable, because usually documentation is available (Gietler, Hofer et al. 2003), (Kolodziej 2003). Open source and low cost solutions are available on the market like for example WMS of the German company lat/lon (www.deegree.org) and the University of Minnesota (http://mapserver.gis.umn.edu/). The GEORAMA map viewer, the client of this application, requests and displays the maps of the different web mapping servers and provides functions that allow the users to interact with the map.

5 RESULTS

In the course of the GEORAMA project a prototypic implementation of the presented framework has been carried out. We have been relying on available publishing software from prominent vendors as well as open source products (OGC WMS compatible). A map viewing software has been designed and developed using server sided programming technology. The prototype aims at reducing the expenses for the realization of the system architecture and makes the participation for many regions possible. These important requirements were achieved, because of the reliance on OGC web mapping services. Employed WMS allow the map viewer to present different data types and therefore data interoperability is reached.

The map viewer offers functionality, which is based on the interfaces of web mapping services. The functionality of the map viewer cannot compete with the one provided by proprietary services. Basic interaction operations like zooming, panning, and the re-centring of the map are implemented. Information about an object is provided when clicking on it and it is possible to influence the content of the map by adding or removing data layers. Any interaction with the map requires a new server request; because of that the performance of an OGC client suffers. The offered functionality allows people to get an overview over a region, which is the main intent of the maps presented in this project. In addition to that, little experienced map users are not swamped with features. The usability of the map viewer was an important aspect; this led for example to the implementation of multilingualism in the map viewer. Figure 3 shows the prototypic map viewer of GEORAMA.

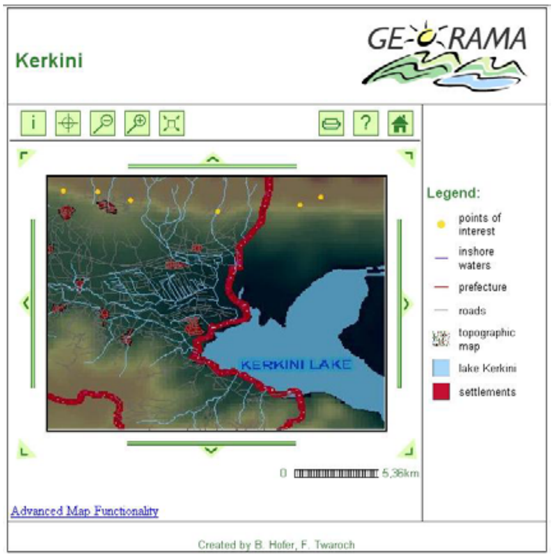

Figure 3: Screenshot of the map viewer prototype showing the WMS of *Kerkini* (Greece)

6 CONCLUSIONS AND OUTLOOK

The project showed that by using the specifications of the Open GIS Consortium an open and easily extensible web mapping application can be implemented. The application supports the interoperability of data, which means that various data formats can be integrated. There are still requirements geographic data have to meet: legal and economic issues have to be solved, the update rates negotiated, the information density assured, and cartographic guidelines applied.

Tourist information systems like GEORAMA would be a lot easier to accomplish when standards for the description of sport and recreation activities existed. The standards should be developed with regard to geo-information services. Tourism regions do not have the resources to provide several web sites with their content information regularly. The envisioned standard could support them in such a way that they produce one file only, which is used for different products like web pages, press released, and flyers. The file could be provided in a dialect of the eXtensible Markup Language (XML), which is a standard for describing information.

Several extensions of the OGC web services can be expected in future. The interfaces of OGC web mapping services will be extended and allow for example the use of 3D information and attributes in WMS. Further these services will support indoor and outdoor activities. Standards for "publishing, finding, and binding" of services are enhanced, which is another step towards the geo-enabled Internet the OGC has.

The future procedure of the GEORAMA project will focus on the integration of new project regions within the existing partner countries and beyond, by embracing further EU countries. In a future commercial phase the project aims at the continuous extension of the web mapping service in order to encourage the dissemination of public and private data for tourism purposes by providing relevant information through new media. These efforts will imply the integration of mobile services. The web portal will benefit from further developments in the area of mobile services. Investigations on the use of data and open web services with Personal Digital Assistants (PDAs) and cellular phones can enrich the functionality of the portal.

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