SPATIAL PLANNING – THE OPEN FIELD FOR DATA DESCRIPTION AND WEB SERVICES

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ABSTRACT:

Spatial planning is important not only from the view of development of settlements and urbanised territories. It is necessary to integrate spatial planning activities in the total process of sustainable growth and landscape management. Spatial planning data represents an example of a part of SDI (Spatial Data Infrastructure). The current world and public need to share, combine, search, distribute and publish spatial data connected with spatial planning. Such data plays an important role in every time.
This paper describes the current results of four large European projects related to spatial planning – Humboldt, BRISEIDE (BRIdging SErvices, Information and Data for Europe), Plan4all (European Network of Best Practices for Interoperability of Spatial Planning Information) and SDI-EDU (SDI-EDU for Regional and Urban Planning). These projects are focused on the design of models of spatial data suitable for spatial planning, the transformation and mapping of models, application of web services, education and training of above-mentioned activities. The projects are centred around and compliant with INSPIRE (Infrastructure for Spatial Information in the European Community) and the European Spatial Data Infrastructure (ESDI).
This paper shows a summary of actual knowledge gained from these projects including relation of different types of spatial data description, spatial data harmonization and application of web services. Also the interconnections between these projects are mentioned.

1. INTRODUCTION

“That is to say, we can only arrive at a correct analysis by what might be called, the logical investigation of the phenomena themselves, i.e., in a certain sense a posteriori, and no: by conjecturing about a priori possibilities.” (Wittgenstein, 1929). Eighty years ago the famous philosopher Ludwig Wittgenstein emphasized the importance of a posteriori (not a priori) research work (study of existing structures and processes) to identify new approaches (including technologies, data models and harmonization rules) useful in practice. Therefore it is necessary to support cooperation, communication and information sharing.
This paper tries to apply the idea mentioned in the previous paragraph to spatial planning, because it is one of the human activities intervening in everyday life. Current spatial planning relates to many participants and stakeholders, methods, outputs, tools, technologies etc. Therefore the detailed research (originating from description of state-of-the-art) connected with cooperation, communication and standardisation is the necessary requirement of future development of spatial planning. The interoperable data and services (including all benefits mentioned in this paper and other source documents) will be the result of such approach.
First part of this paper (Introduction and Chapter 2) describes its crucial terms – spatial planning, spatial data and web services, their interconnection and current questions. The second part (Chapter 3) introduces examples of European projects focused on spatial planning, spatial data, web services and their description through standardised tools. The third part (Chapter 4 and Conclusion) tries to conclude results of the above mentioned projects and to show the design of a spatial planning system based on web services and its benefits.

2. SPATIAL PLANNING, SPATIAL DATA & WEB SERVICES – THEORY

There are many definitions of the term “spatial planning”. One of them is mentioned in the European Regional/Spatial Planning Charter (1983): "Regional/spatial planning gives geographical expression to the economic, social, cultural and ecological policies of society. It is at the same time a scientific discipline, an administrative technique and a policy developed as an interdisciplinary and comprehensive approach directed towards a balanced regional development and the physical organisation of space according to an overall strategy."
Spatial planning represents the methods used mainly by public sector to influence the development and use of land. But contemporary spatial planning goes beyond traditional land use planning to bring together and integrate policies for the development and use of land with other policies and programmes which influence the nature of places and how they function. Spatial planning includes all levels of land use planning including urban planning, regional planning, environmental planning and national spatial plans. Spatial planning is important not only from the view of development and stabilisation of settlement and urbanised territories. There is necessary to integrate spatial planning activities in the overall process of sustainable growth and landscape management.
Spatial planning has connections with a large number of human activities (e.g. nature protection, housing, public sector, tourism, utilities, risk management or economical activities such as agriculture, industry, transport etc.) and branches of science (e.g. geoinformatics, geomatics, geography, geology, hydrology, engineering, architecture). We have made certain of a broad scope of spatial planning during the cooperation in several projects. The scope includes hydrology, security and forestry; parts of the spatial planning issue.. (Cerba et al. 2009a)

Spatial data is data with a direct or indirect reference to a specific location or geographic area (INSPIRE Registry, 2009). Spatial data represents an integral part of all spatial planning activities. Spatial data is used as source and reference data for design and building of spatial planning. And spatial plans as the final outputs of spatial planning are composed of spatial data sets. The main problem of spatial data (not only in the case of spatial planning) is their heterogeneity. Data has different characteristics including metadata records, data models, formats, levels of detail, dimensions, scales, etc.

The volume of spatial data sets is constantly growing (it is not a problem of spatial planning). Within the context of this rapid growth, the costs of data capture, management, updating, processing and distribution are increasing too. Spatial data sharing, re-use and possibilities of interconnection of existing spatial data sources pose a solution. Therefore, the spatial data interoperability (possibility for spatial data sets to be combined, and for services to interact, without repetitive manual intervention, in such a way that the result is coherent and the added value of the data sets and services is enhanced – INSPIRE Registry, 2009) assurance (e.g. by private spatial data providers or state administration) is required. The spatial data interoperability enables more efficient management and use of spatial data sets and achieving of desired savings.

Web services are software applications available from web servers. Users can make use them through clients supporting a concrete standard of web service. Exploitation of web services have many benefits (e.g. users need not to own complete software solution with many redundant functionalities, but they can choose only necessary services). In geomatics, the most used web services are standardized by Open Geospatial Consortium (OGC) – Web Map Service (WMS), Web Feature Service (WFS), Web Processing Service (WPS), Web Coverage Service (WCS) and Catalogue Service for the Web (CSW). The implementation of web services is limited due to problems connected with

- description of services (including metadata),
- chaining, combination and interconnection of web services,
- adherence, support and level of implementation of standards.

3. COOPERATION IN SPATIAL PLANNING

Spatial planning represents ideal example of necessity of cooperation, sharing and interconnection – there are many different data sources, approaches, methods, software products, hardware platforms, data producers and data users. And such heterogeneity needs an implementation of uniform and automatized communication and processes as much as possible.

The following projects (in alphabetical order) show examples of solutions oriented to above mentioned need of cooperation, sharing and interconnection of spatial data and related web services.

3.1 BRISEIDE

The information on the international project BRISEIDE was mainly taken from the BRISEIDE web page (http://www.briseide.eu). The BRISEIDE project – BRIdging SErvices, Information and Data for Europe aims at delivering:

- time-aware extension of data models developed in the context of previous/ongoing EU INSPIRE related projects (e.g. in the context of GMES, eContentPlus),
- application (e.g. Civil Protection) based on the integration of existing, user operational information and
- value added services for spatio-temporal data management, authoring, processing, analysis and interactive visualisation.

BRISEIDE will be applied, tested and validated within a Civil Protection application context, using the INSPIRE relevant themes, via a chain of stakeholders, data providers, technology partners, and downstream users. Project services converge with Free & Open Source Software (FOSS) initiatives from the Open Source Geospatial Foundation (www.osgeo.org). This ensures further development and processing functionalities built on top of the BRISEIDE framework, to be extended by public administrations or private industries according to their specific needs. The BRISEIDE platform will be available on lease, thus ensuring economic sustainability and partners' investment recovery.

BRISEIDE is also focused on technology of web services. It develops spatial analysis WPSs and integrates them within existing open source frameworks (e.g. WPS extension of Sextante by 52°North). Spatio-temporal processing services are exposed via the web and are made available through compatible WebGIS applications. Newly developed or protype web services already made available by relevant INSPIRE-related EU projects and exposing standard services such as WMS, WCS and WFS, will be used to provide access to relevant geodatabases, enriched, when needed, with information extracted from heterogeneous and distributed user operational databases. BRISEIDE services are accessible through a multi-platform 3D client, developed by Fondazione GraphiTech, invoked from a web page as a JavaWebStart application. The 3D client allows interactive orchestration of spatio-temporal WPSs providing support to chaining of required processing units. This ensures interactive access to datasets and a synchronous processing at the server side.

From the view of spatial planning, that is not explicitly mentioned in the project materials, all aims are very important – technological solution through web services, relation to Civil Protection and the INSPIRE Directive, re-using data sources and web services, temporal component, including its management, of spatial illustrating the changes of land use and land cover.

3.2 Humboldt

The Humboldt project (http://www.esdi-humboldt.eu/home) contributes to the implementation of an ESDI (European Spatial Data Infrastructure) that integrates all the diversity of spatial data available from the multitude of European organizations, it is the aim of this project to manage and advance the implementation process of this ESDI. To achieve this objective and to maximize the benefits gained from this integration, the requirements of INSPIRE, GMES (Global Monitoring for Environment and Security), environmental agencies and other related activities in the EU should be met.

As a cornerstone for future businesses, spatial planning, citizen security, risk management and many more opportunities, the ESDI has to be a lasting development, prepared for the steps that will inevitably follow with the continuing progression of globalization. To enable this, the Humboldt project suggests an optimized, community-centered implementation process. New knowledge will then be gained and new processes will be developed from the possible combination of data that already exist but are currently highly scattered and heterogeneous.

Besides a technological-focussed framework which will be developed in the Humboldt project, the project also will set up a number of scenarios (e.g. Urban Planning or Urban Atlas). The scenarios will use the developed framework components in real-world conditions and will be used as promoters for the target users of the project. (Cerba et al., 2009a)

The Humboldt Scenario Urban Planning is focused on using the Humboldt framework with CORINE land cover (CLC) data set and Spatial Analytic Backgrounds (SAB; reference data for spatial planning in the Czech Republic). To perform the harmonization, to re-use CLC data as an input for SAB, the following Humboldt tools will be used – HALE (Humboldt Alignment Editor) to establish harmonization rules (data models mapping) and CST to convert real data sets based on harmonization rules.

3.3 Plan4all

The objective of Plan4all is to build a network of local, regional and national public bodies, stakeholders, ICT industry, organisations dealing with planning issue and regional development, universities and international organisation to find consensus about harmonisation of Spatial Data Infrastructure for spatial planning according to the INSPIRE Directive and also to contribute to the standardisation of related data themes from INSPIRE Annexes. The Plan4all is focused on implementation of the INSPIRE Directive into spatial planning processes, with focus on built spatial planning data model for selected themes and implemented recommendations of drafting teams for metadata and networking. The project uses experiences from the previous projects including Armonia, Humboldt, eSDInet+ or EURADIN. The transfer of knowledge is ensured through the Plan4all partners involved in these projects. The Plan4all team uses also the experience of OGC (Open Geospatial Consortium) members working in the team for definition of technological standards.

Plan4all is focused on the harmonisation of spatial planning data and their metadata and on building a networking infrastructure for sharing the data and metadata based on the existing best practices in regions and municipalities of the EU, but also on the base of results of current standardisation activities defined by OGC and W3C (World Wide Web Consortium). This involves description, summarising, optimisation, multilingualism and harmonisation of metadata, data models and networking standards (e.g. building European cluster for SDI in spatial planning under umbrella of ISOCARP /International Society of City and Regional Planners/ and EUROGI /European Umbrella Organisation for Geographic Information/) of data for spatial planning, based on previously collected and analysed experiences and then seeking to define common procedures and methodologies for spatial data sharing and utilisation cross Europe new spatial planning data standards.

The Plan4all project consortium is composed of 24 partners from 15 European countries. The University of West Bohemia (Pilsen, Czech Republic) is the leader of the project. (Cerba et al., 2009b)

3.4 SDI-EDU

The SDI-EDU project (http://www.sdi-edu.zcu.cz) is a multilateral project – transfer of innovations. The project consortium consists of 10 partners from 6 European countries. Within the framework of the SDI-EDU project we intend to achieve a high level of cooperation between all partners involved in this project. The SDI-EDU project aims to transfer former and actual experience from EU research projects dealing with SDI and spatial planning like Humboldt, NaturNet Redime or Plan4all towards planners in European regions and municipalities.

The European regions, provinces and municipalities will use the results of SDI-EDU to promote their cultural and socio-economic heritage and to find the Spatial Data Infrastructure useful to the regional management of their territories. The SDI-EDU project consortium will test and evaluate the utilities in order to extend the dissemination and distribution of resulting deliverables to other Member States.

For two years, SDI-EDU is going to support training of responsible people to set up and use some of these services according to the specific problems of the EU regions on local and regional level. Thus the project will let the regions participate actively in the implementation of the INSPIRE Directive.

In our focus are both the national level stakeholders (ministeries, planning institutes, leading planning ateliers), and the regional administrations and urban planners. To describe the whole portfolio SDI-EDU uses illustrative use cases from European, national, regional, and even local scales. The targeted end users – specialized, but ordinary public active in planning processes – have to fully understand the meaning and consequences of INSPIRE, of complex and harmonised spatial information. The lectures are based on existing situation and open questions, therefore, learning by doing is one of the key teaching methods.

Using the former European projects outputs and knowledge the SDI-EDU team aims to a new kind of learning services. The end users will have much greater opportunity to influence the teaching content, the administrators will be able to modify the prepared templates, the applied Open Source licensing methods opens completely new approach to cheap, focused, and though distributed, yet enough centralised learning system.

INSPIRE caused changes in the amount of accessible geo-data, therefore, the end-users need to find and understand the geo-information better, the SDI-EDU serves to transfer the innovative technological tools and modern learning methods to assist them. (Janecka & Hiess, 2010)

4. SPATIAL PLANNING, SPATIAL DATA & WEB SERVICES – ARCHITECTURE

All the mentioned projects work with common architecture in spatial planning (Figure 1). This schema describes spatial data flows and processes in the framework of spatial planning activities.

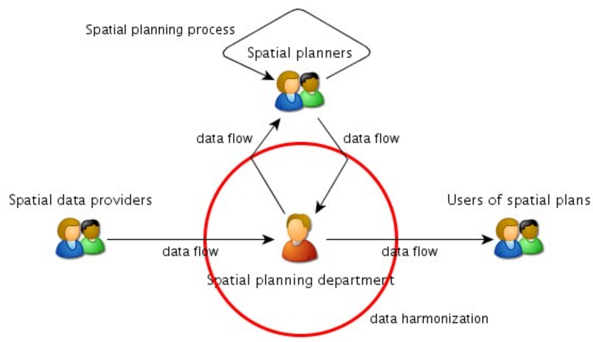

Figure 1. Common architecture of spatial planning.

To enable automated processes as much as possible it is necessary to connect data flows and processes with concrete tools and technologies. The main requirement it is to ensure the interoperability. Therefore we choose web services standardised by Open Geospatial Consortium (OGC) as mentioned in Chapter 2. In the ideal world (from a view of technologies) all the above mentioned spatial planning activities could be processed by web services. In the real world the involvement of human experts is and will be necessary.

The OGC web services could be divided into three groups – services for data and services searching, services supporting data flow and services processing data sets. The INSPIRE Directive (INSPIRE, 2007) uses similar, more detailed classification, but for the purposes of spatial planning data produced by WMS (raster images) represents reference and source data such as vector data provided by WFS. Many spatial data themes and data sets important for spatial planning exist only or mainly in raster form (e.g. land cover data or satellite images). But another services WCS and above all WFS offer spatial data more comfortable.

Data services are well-know and becoming more popular. But also the services processing spatial data would be very useful. There are some interesting services like PyWPS (providing the GRASS GIS system functionality) or spatial data harmonization services designed in Humboldt project, but their usage is not as wide as in the case of WMS. WPS could be used in spatial planning for two main purposes:

1. Building of spatial plans or some activities connected to building of spatial plans like spatial analysis.
2. Spatial data harmonization – preparation of heterogeneous spatial data to a form processable by automated tools.

Finally there are CSW services closely connected to metadata. These kinds of services enable efficient and simple search of available data sets and services.
In order to make the exploitation and combination of web services feasible, it is necessary to create a tool that enables to design a chain of services and its processing (links to services, forwarding of data and information) – Figure 2.

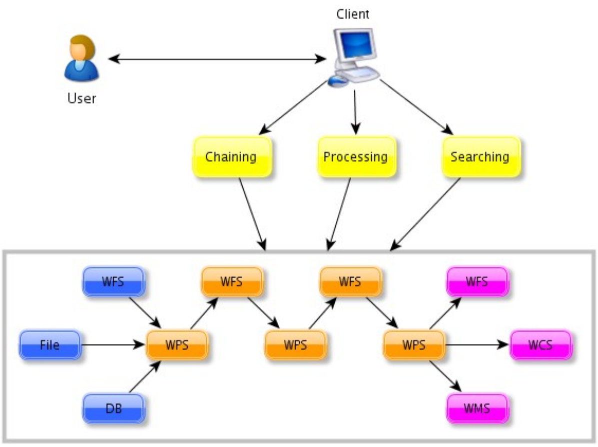

Figure 2. Combination of web services.

In order to be able to use automatized services for data uploading, processing and visualization it is necessary to have interoperable data and services. The most important premise of interoperability is a high-quality data description. Spatial data experts use many kinds of description of spatial data (more about spatial data description, its forms and importance in Cerba, 2009). All forms of data description must be formal (close set of used terms) and formalized (formal coding). It is necessary to mention the standardization, openness and connection to other standards. Current spatial data of European spatial planning are mostly described by metadata records. The metadata often support the proprietary (e.g. national or internal) standards and INSPIRE or/and ISO metadata profiles are missing. A worse situation is in the case of using other types of spatial data description – different levels of data models like ontologies, topic maps, UML models etc. Only database models and W3C XML Schemas are implemented in terms of database solutions or GML format.
The following table (Table 1) shows existing and potential outputs of the above mentioned projects. The outputs are or will be focused on spatial planning – description of spatial data, web services and all their aspects connected to data harmonization, building SDI and interoperability, including training and education.

Project	**Outputs**
BRISEIDE	Construction of new web services and data models (with temporal aspects).
Humboldt	Harmonization processes and tools (web services), training materials.
Plan4all	UML data models, implementation of web services and data harmonization.
SDI-EDU	Training and education activities (importance of SDI in spatial planning, including web services).

Table 1. Outputs of the projects focused on data description and web services.

5. CONCLUSION

Interoperability of spatial data and web services, as the main target of the above mentioned projects, does not mean only the support of national or European legislation. It provides many important benefits (based on Cerba et al. 2009b):

- No duplicities in data and no redundant data sets.
- Clear origin and assurance of spatial data and web services quality.
- Data structure and web services description standardization.
- Data and web services purity, security and structure uniformity.
- Better data and web services manipulation.
- Reciprocal data accessing via web services according to the standards of Open Geospatial Consortium – Web Map Service (WMS), Web Feature Service (WFS), Web Coverage Service (WCS) and Catalogue Service for the Web (CSW).
- Fall of data and web services updating and maintenance costs.
- Better software development.
- Better source exploitation.
- Improvement of chances in communication with other subjects.
- Better utilization and commercialization of spatial data and web services.
- Data and services more accessible and usable.

In order to build and improve spatial data and web services interoperability, it is necessary to coordinate existing activities that should be focused not only on building SDI components, standards, spatial data description, but also on education, including further education, professional and vocational education, tertiary education, retraining and professional re-qualification.

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