

Internet-Based Provision of Regional Geographical Information Using Webservice Technologies

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Abstract

Geoscientific space-time-related information (geoinformation) becomes a more and more important resource for every economic sector and especially in the sector of regional planning. Many communities discover the huge value of the currently available geoinformation which has been aggregated in their fields of responsibilities.

For every planning process with spatial and regional reference a huge amount of influence factors and boundary conditions have to be investigated in order to provide the prerequisites for further planning processes. These investigative tasks are often related with a great effort concerning time and money, because there are no standardized interfaces which provide an efficient access to the necessary geoinformation related to a specific question. Furthermore, information regarding the location and regional particularities has to be gathered from various heterogeneous sources. These sources for regional geoinformation can be both public and private providers which offer a huge variety of geospatial data, different formats, of maps, digital ortho images in combination with special data like population data and environmental data.

Thus, in this paper two examples have been chosen in order to demonstrate the holistic approach for an integration and provision of regional geo-referenced information. The demands for regional and urban planning processes are represented in the field of groundwater information and regional groundwater management; the needs of private inquiries are demonstrated with the management of DUDS and ordnances as an adequate example for geoinformation needed by publicity and citizens.

1. Introduction

In the planning and construction phase of buildings a variety of information has to be collected, modelled, distributed and processed. The validity of this information depends on the use case: Normally the planner has to scope with the explicit planning information, especially of data concerning the hull of a building in combination with the financial and time-dependant data. This information is characterized by va-

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lidity of only a few years because in most cases after the completion the available data of a building is not changed any more.

The planning information which describes the building site and the spatial environment has an extended life span. Due to the global spatial reference this geoinformation is independent from a specific building project and can be used globally. With regard to a usage period of 25 up to 70 years on the one hand and the expensive process of collection and aggregation on the other an integrative management and provision of geoinformation becomes more and more important so that an efficient reuse of geoinformation becomes possible.

In this paper a concept for the network-based provision of geoinformation in the state of Hesse in Germany is introduced. In order to enable a holistic management, geoinformation from governmental and private organisations has been integrated. With regard to the global impact of spatial data aspects for the protection of secret information and for the commercial use had to be taken into account.

1.1 Governmental and private planning phases

The relevant planning steps concerning the establishing of fundamentals can be divided into two main branches:

1. Public spatial and environmental planning
2. Private/commercial planning with regard to a construction project

The governmental spatial and governmental planning consists of a variety of legal requirements and planning guidelines which reach from the “Bundesraumordnung”, the governmental base for the environmental planning in Germany, up to the specific urban plans for the use for future constructions sites.

The information of the private planning are characterized by the planning phases which are defined in the Germany by the HOAI, which regulates the cooperation between architects and engineers during all planning phases of a building. Those planning phases are divided into nine separate parts which cover the complete life-cycle of a building. Especially in the first planning phase - “establishing of fundamentals” - which claims only 3 percent of the total costs, lots of geographical information is needed for tasks like building site analysis, risk estimation or governmental inquiries.

1.2 Management of geoinformation

The requirement for a global management of the available geodata which is an interdisciplinary issue between regional planning, surveying, engineering and geography lead to the foundation of the German IMAGI („Interministeriellen Ausschusses für

Geoinformationssysteme“, IMAGI 2000) consortium in 1998, an initiative from various German ministries. Main task of this consortium is to provide an efficient management of geodata in the governmental scope. Due to the federal organisation structures in Germany which result in a responsibility of the states in Germany for the geodata management on the one hand side and the lack of an international standard for the exchange of geobase information on the other, various developments of concepts for the management of geographical information took place in parallel.

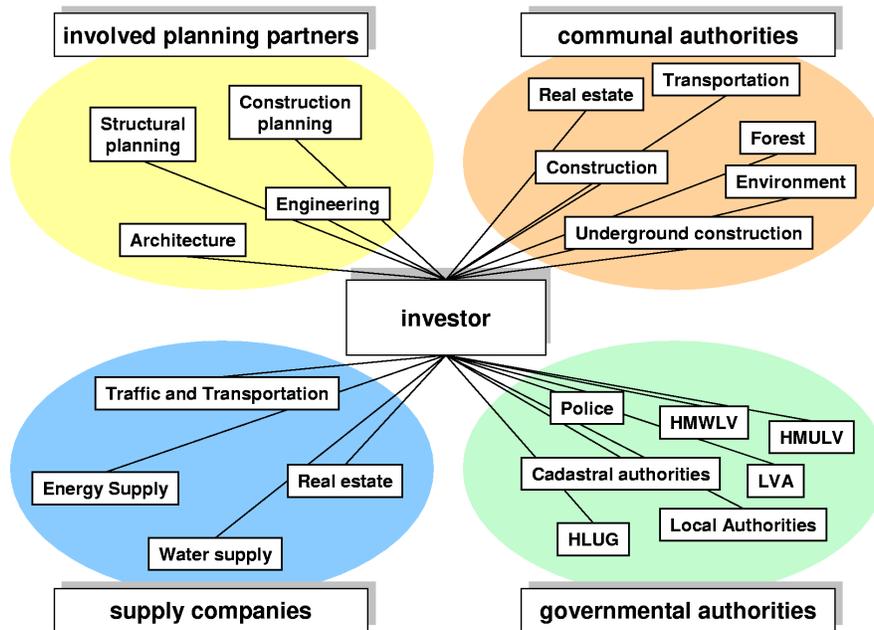


Figure 1: Participants in the information chain

Another problem concerning the development of geodata results from the high complexity and the individual requirements for geoinformation of the involved planners (Fig. 1).

2. Interfaces for geoinformation

With regard to an effective reuse of distributed geodata for the establishing of fundamentals the question of a suitable interface format had to be solved. In general, two different concepts have to be taken into account: Proprietary file formats and global standards.

2.1 Existing specifications of the OGC

In order to develop and specify processing and interoperability standards the Open GIS consortium (OGC) was founded in 1994. It contains more than 230 partners from commercial companies, governmental organisations and research institutes. In order to exchange spatial information in an independent format various specifications have been developed:

1. *Web Map Service (WMS)*: Internet-based generation of maps within a distributed GIS.
2. *Web Feature Service (WFS)*: Internet-based access to geodata within a distributed GIS. This service is restricted to vector data, which can be mapped to database systems easily.
3. *Web Coverage Service (WCS)*: Internet-based access to geodata within a distributed GIS. This service is restricted to pixel-based data.

The data exchange and the usage of the mentioned services can be performed using the GML (Geography Markup Language), an XML schema for the modelling, exchange and the storage of geoinformation.

Unfortunately the available specifications are restricted to graphical data so that there is a lack for the description of specific semantic information.

2.2 Modelling of geodata using the ISO standard

In parallel to the work of the OGC within the International Standardization Organisation (ISO) a Technical Committee (TC 211 - Geographic Information/Geomatics) aims at the development of a standard for all kind of data, methods and services in the field of georeferenced information. These standards are listed within the ISO 191xx.

Similar to the work of the OGC these ISO standards aim at the creation of a basis for a global interoperability, but the TC211 includes in its standardisation processes a complete description of semantic information in addition to the graphical data. This holistic concept increases the complexity of the models, so that five different work groups have been founded (WG1-5):

- WG 1 (Framework and Reference Model)
- WG 2 (Geospatial Data Models and Operators)
- WG 3 (Geospatial Data Administration)
- WG 4 (Geospatial Services)
- WG 5 (Profiles and Functional Standards)

Additional to the ISO 19119 standard (services and access methods), which is still in draft, the ISO 19115 standard (metadata) is of major importance for the interoperability of semantic information. This standard offers an efficient method for the unified description of metadata. Therefore, it is a basis for a global search and

retrieval of georeferenced information and allows an accumulation of spatial and environmental information from different providers. Within an agreement of cooperation the ISO 19115 standards has been accepted by the OGC lately.

3. Design of www.grundlagenermittlung.de – A GDDI framework for the retrieval of geoinformation

This paper describes a concept for the effective support of planning partners in the phase of establishing of fundamentals in a planning project. This concept bases on the described interfaces and standards of the ISO 19115 directly.

The developed information system encapsulates metadata of existing geodata sources and offers a framework for web services in the field of retrieval of spatial data. Based on a GDDI (Geographic Description, Discovery and Integration of Web Services) server system external provider can publish metadata about his available geoinformation using a UDDI registry, so that a web application of a consumer can discover the required information dynamically (Fig. 2).

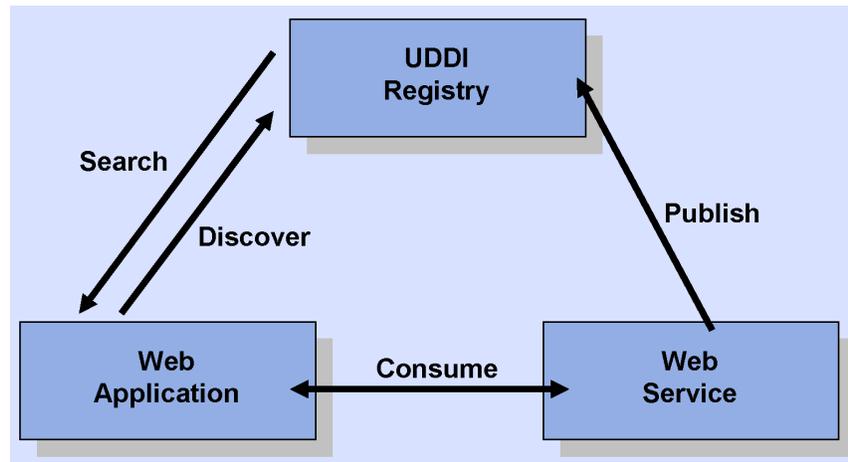


Figure 2: UDDI-based Webservice Framework

In the described field of application the contents of two existing environmental information systems has been integrated within the GDDI server system which manages the governmental and the commercial data sources.

In the field of governmental providers an information system for contaminations, the KMIS system for the management of military waste, has been chosen. As a representative for commercial environmental information systems the management plat-

form GWO has been selected which controls the critical hydro geological information in the south of Hesse.

Both systems offer spatial information which is of major importance for planning and construction processes in this region. A short introduction in these systems is given in the following chapters.

3.1 The project Grundwasser-Online (GWO)

The project „Grundwasser-Online - GWO“ has been initiated by the local water supply companies in the south of the state of Hesse. They commissioned the companies CIP Engineering and BGS Environmental Planning (both located at Darmstadt, Germany) in cooperation with Darmstadt University of Technology to develop an internet-based software tool for the groundwater management in the specified region (Grundwasser-Online 2004).

This region which has a size of 1400 km² is located between the both congested urban areas Rhein-Main and Rhein-Neckar. It is characterized by the extensive usage as a groundwater catchment area. Due to the considerable climatical variation in the last years in combination with the human usage the level of the groundwater changed drastically within so that as a consequence damages in buildings and agricultural areas occurred.

Due to these events an information system has been developed which enables the integration of all processes in the field of groundwater management including the collection, aggregation and evaluation of all required and underlying data. This system allows a prompt reaction of the water supply companies to changes in the groundwater level based on complex spatial evaluations (Rüppel et al 2002).

The collected and evaluated groundwater information in the software system can be provided and distributed as time-dependant series of measurements for a given location and as spatial maps with semantic information for the global usage.

3.2 The geoinformation system KMIS

The KMIS-System is a geographical framework for the network-based management of DUDS in the state of Hesse. Even 60 years after the end of the Second World War this topic is of major importance in construction projects in German cities and industrial areas. The military waste comprises all kind of ammunition, especially from the attacks from the (allied) air forces of both world wars.

By order of the “Kampfmittelräumdienst”, a governmental agency for the management and clearance of DUDS in the state of Hesse, a framework consisting of different specific applications has been designed by CIP Engineering which supports holistically all processes during the management and processing of information in this field. Using modern information and communication technologies information

all steps from the discovery and evaluation of contaminated areas up to the clearance based on external services of specialized clearance companies have been integrated, so that all related information can be stored in a centralized database. This database system supports an effective processing of incoming inquiries concerning a construction project.

Using the described approach the KMIS information system is able to offer georeferenced information about contaminated and cleared areas for a given construction site within the context of this paper.

4. Implementation of the framework

The framework `grundlagenermittlung.de` integrates different sources for geoinformation with regard to the usage in early planning phases (Fig. 3). Furthermore, it provides an integrated shop system for the market exploitation of the underlying information.

4.1 Modelling and integration of metadata

With regard to the available and distributable geoinformation in the field of groundwater and military contaminations the core area of the ISO 19115 has been implemented within a relational database system. Therefore the mandatory elements from the MD_Metadata subset

- Dataset language
- Dataset topic category
- Abstract describing the dataset
- Metadata date stamp

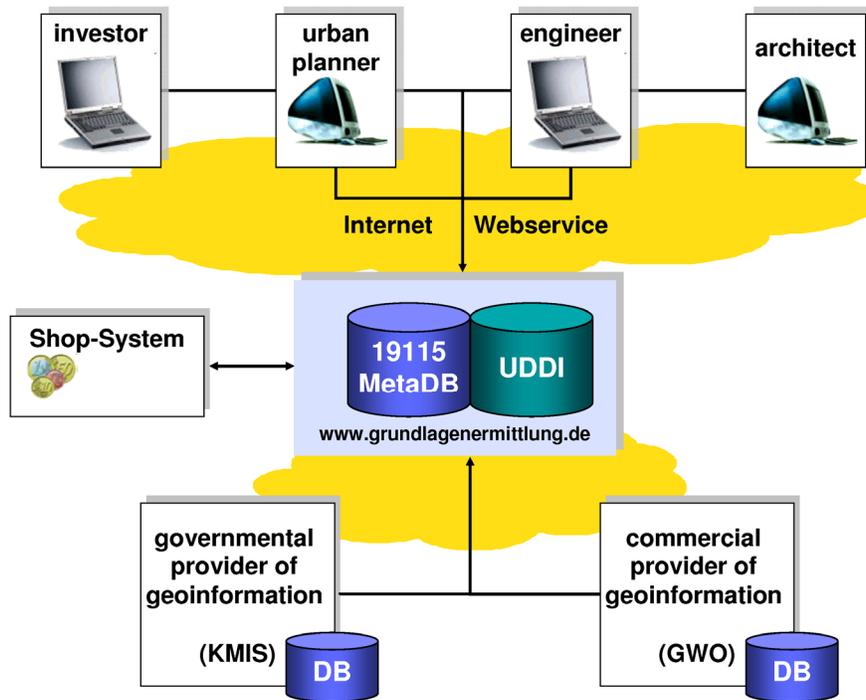


Figure 3: System architecture of the framework grundlagenermittlung.de

has been completed by necessary optional items from the standard. In order to instantiate the metadata model an import mechanism has been developed which enables the processing of XML-based input streams from any geoinformation provider in compatibility to the ISO standard.

4.2 Spatial retrieval of geoinformation

Using a web based frontend an effective internet-based search in the metadatabase and a retrieval of sources for the required geoinformation can be executed. Fig. 4 illustrates the spatial search based on the mapserver technology which enables the specification of search criteria for a purchaser, an architect or a planning partner within a construction project.

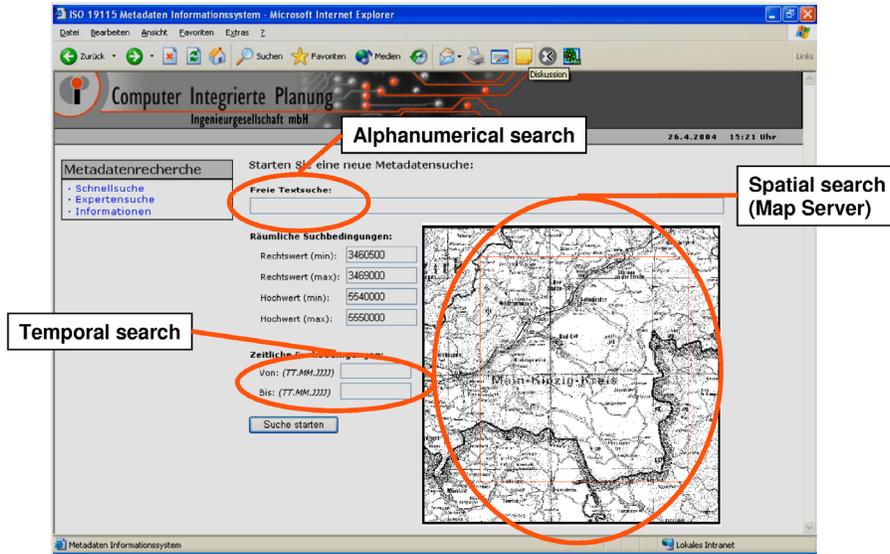


Figure 4: Specification of search criteria and retrieval of information

4.3 Marketing of geoinformation

Geoinformation is very cost-intensive due to its need for continuous actualisation. Therefore a commercial exploitation of geoinformation, the so-called g-commerce, is important for each provider of geoinformation. Within the framework grundlagenermittlung.de a shop application has been integrated to offer commercial capabilities for the underlying data sources.

Main topic of this shop system is the provision of an unified internet portal for the different providers and the various methods of distributing information which reach from the postal service to web based services.

GWO Nummer	Betreiber	Hochwert	Rechtswert	Von	Bis	Jahre	Preis	Entfernen
KDD-00-D Br 2	Kreis Darmstadt-Dieburg	5515660	3471520	1998	2002	5	1,25 Euro	löschen
GWO-IB-63	_Grundwasser-Online	5522360	3468700	1975	2002	28	7,00 Euro	löschen
GWO-IB-71	_Grundwasser-Online	5523450	3468530	1975	2002	28	7,00 Euro	löschen

Figure 5: shopping cart

5. Endnotes

In this paper a concept for an internet-based service to support processes in the early planning phases of buildings is introduced. It shows design and implementation aspects which reach from the analysis and modelling of metadata for geoinformation up to an internet-based prototype for the provision and marketing of available geoinformation.

With the developed system a new method for investigative processes in building and civil engineering, especially in the establishing of fundamentals, has been described. It offers advantages for all planning partners by means of an efficient information retrieval which improves all subsequent decisions in planning processes. Potential influences provoked by the groundwater situation and contamination at a construction site can be detected early so that expensive damages and delays during the construction phase can be avoided.

The developed system offers a flexible base for the integration and commercial exploitation of all kind of geoinformation which is related to processes in building and civil engineering. A direct integration of the described framework of in existing software tools e.g. in CAD-systems, using web services would support the planning partners adjacent to their design and engineering work which can lead to an improved quality in all subsequent planning and construction processes.

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