

Establishing of fundamentals in building projects using web services

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Summary

During the establishing of fundamentals in a building project 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 workflows and interfaces which provide an efficient access to the necessary information related to a specific construction site.

Within the fundamental investigation human and natural circumstances have to be taken into account. Thus, in this project two examples have been chosen in order to demonstrate the holistic approach for an integration and provision of georeferenced information.

The developed internet-site <http://www.grundlagenermittlung.de> has been designed to support architects and civil engineers in early planning phases of a building project efficiently. It offers web-based services based on dynamic interfaces for a flexible search and collection of information concerning the building site. Therefore, a central Metadatabase-Server for Description, Discovery and Integration has been established which enables a registration of geo-referenced services and the redirection of incoming requests to other, distributed data pools. Using this Yellow-Page concept in combination with the underlying meta-data based on the ISO 19115 standard an efficient investigation of geographical and environmental information becomes possible.

1 Introduction

In the planning and construction phase of buildings a variety of information has to be collected, modelled, distributed and processed. The period of 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 validity 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 side 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.

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 Geoinformationswesen“, 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.

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

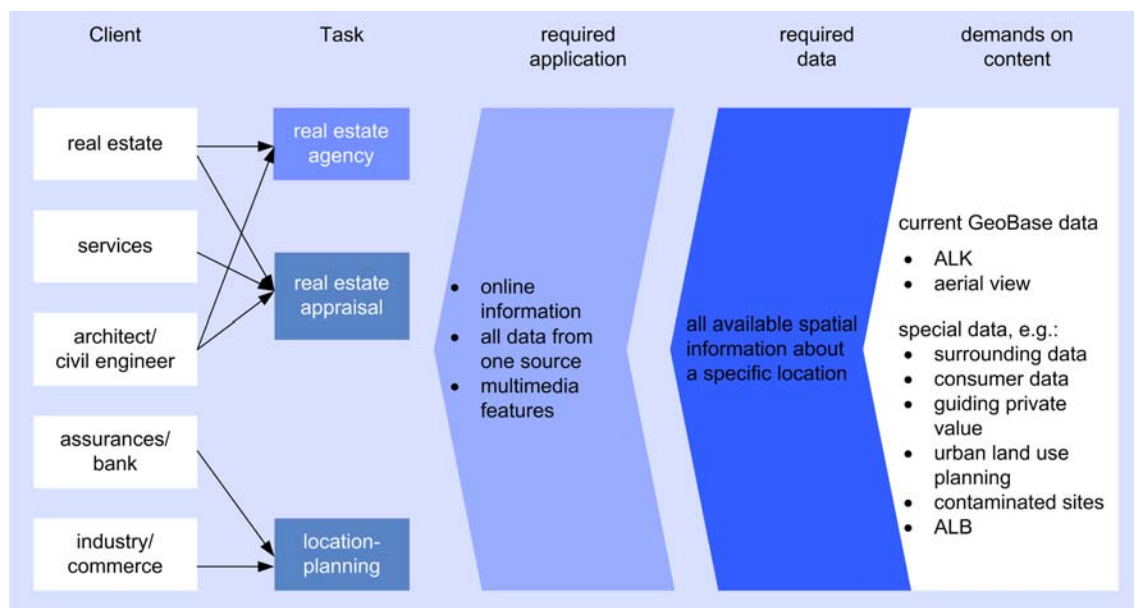


Fig. 1: Requirements in the spatial planning (Fornefeld et al. 2003)

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 Data exchange formats for geoinformation

The file-based exchange formats can be divided into the pixel-based formats for the graphical data and the vector-based formats. In addition to the graphical data the vector-based exchange formats (i.e. SHP¹, MIF²) can contain semantic information (Bill et al 1991).

The vector-based formats which have achieved a broad acceptance and a similar status to the DWG/DXF³-Formats in the area of computer aided design (CAD) allow a direct exchange of spatial data. But this exchange has the disadvantage that the depth of semantic information is restricted seriously. Major disadvantage is the layer concept which forces a specific flat structure to the complex semantic information. Furthermore, the vector file formats are proprietary from commercial companies (ESRI Inc. and MapInfo) and thus not standardized, so that they can be changed easily when a new software version has been developed.

2.1.1 Existing specifications of the OGC

In order to develop and specify processing and interoperability standards in 1994 the Open GIS consortium (OGC) has been founded. It contains more than 230 partners from the 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*: Internet-based generation of maps within a distributed GIS. (GetCapabilities, GetMap, GetFeatureInfo)
2. *Web Feature Service*: 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*: 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 modeling, 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.

2.1.2 Modeling 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

¹ ESRI Shape-Format

² MapInfo Data Interchange Format

³ Autocad Digital Exchange Format

of semantic information in addition to the graphical data. This holistic concept increases the complexity the 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 subject to changes, 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 *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).

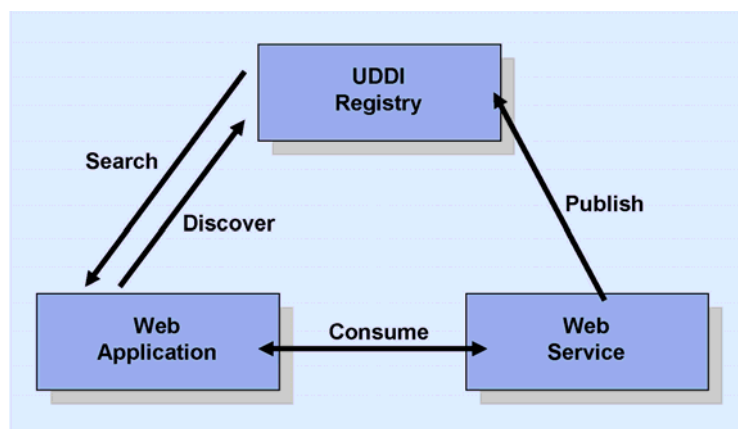


Fig. 2: UDDI-based Web Service Framework

In the described field of application the contents of two existing environmental information systems has been integrated within the GDDI server system which represent 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 platform GWO has been selected which controls the critical hydro geological information in the south of Hesse.

Both systems offer spatial information which are 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 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 systems allows a prompt reaction of the water supply companies to changes in the groundwater level based on complex spatial evaluations (Fig. 3) (Rüppel et al 2002).

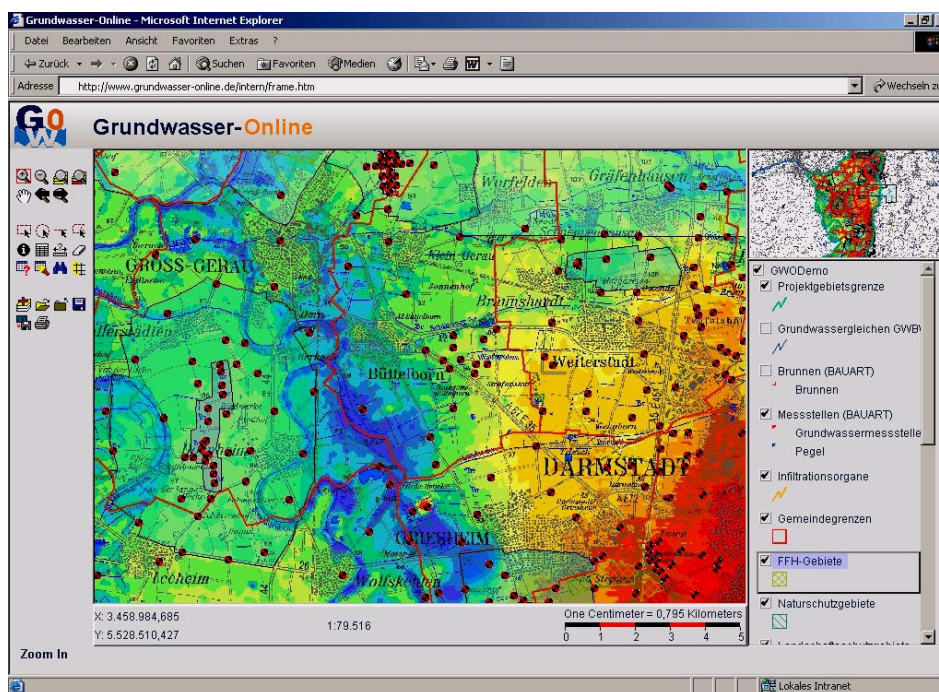


Fig. 3: Evaluation of the groundwater level in the Grundwasser-Online information system

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 sematic information for the global use.

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 service for the management and clearance of DUDS in the state of Hesse, a framework of different specific applications has been designed by CIP Engineering which support all processes during the management and processing of information in this field holistically. 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 centralized in a database. This database system supports an effective processing of incoming inquiries with regard 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. 4). Furthermore, it provides an integrated shop system for the market exploitation of the underlying information.

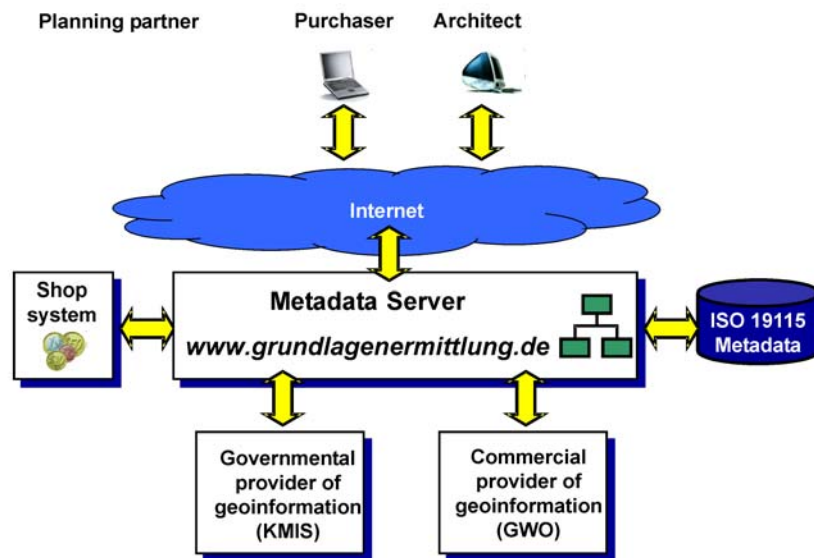


Fig. 4: System architecture of the Framework *Grundlagenermittlung.de*

4.1 Modeling 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

have been completed by necessary optional items from the standard. Fig. 5 shows the main groups in the metadatabase model of *Grundlagenermittlung.de*. 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.

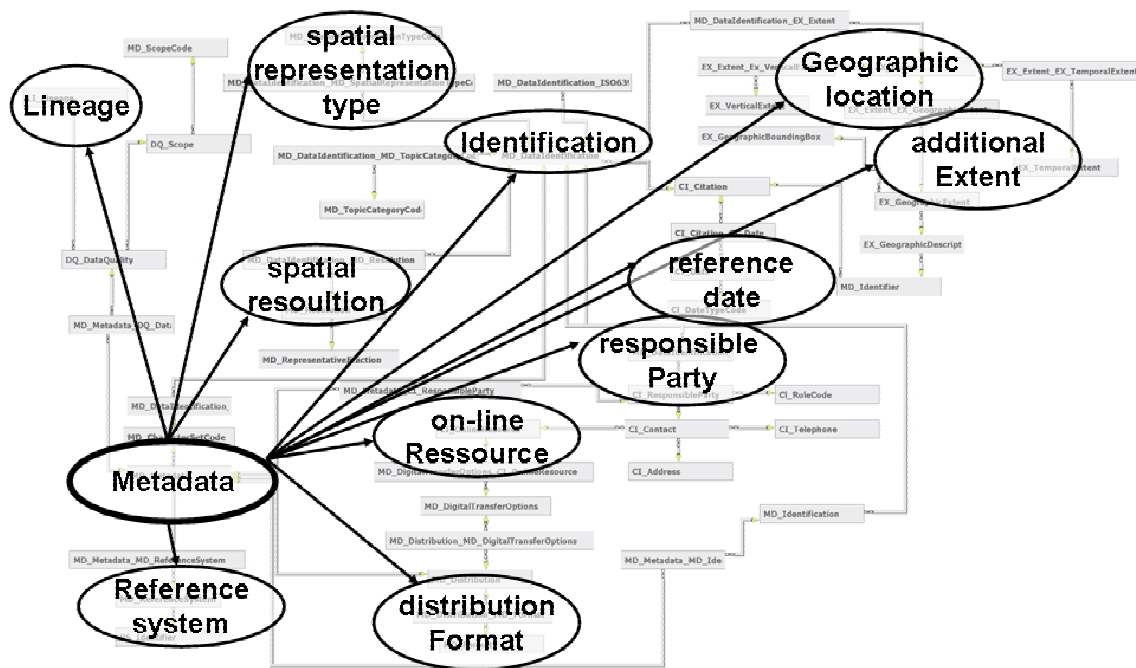


Fig. 5: Main topics of the database model based on ISO 19 115

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. 6 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.

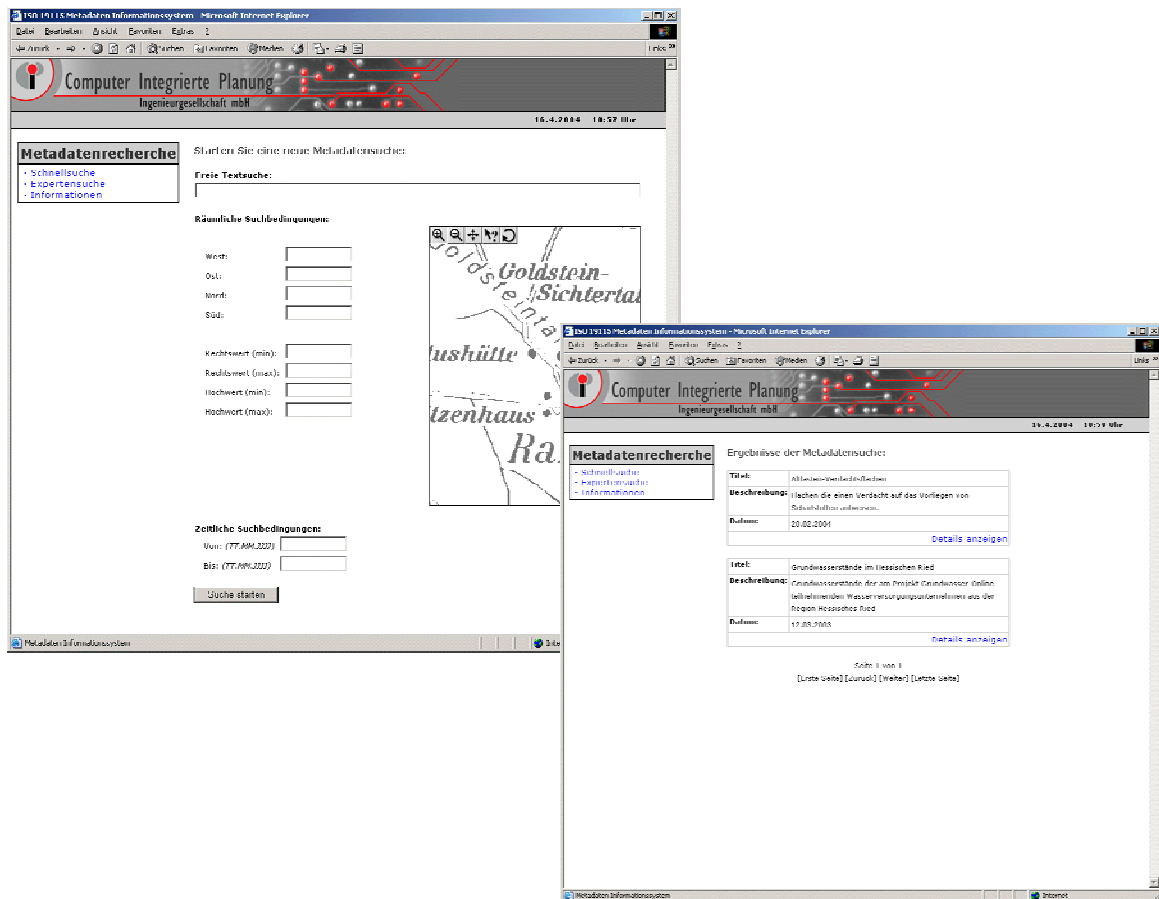


Fig. 6: Specification of search criteria and retrieval of information

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 gCommerce, is important for each provider of geoinformation. Within the framework *Grundlagenermittlung.de* a shop application has been integrated (Fig. 7) to offer commercial capabilities for the underlying data sources.

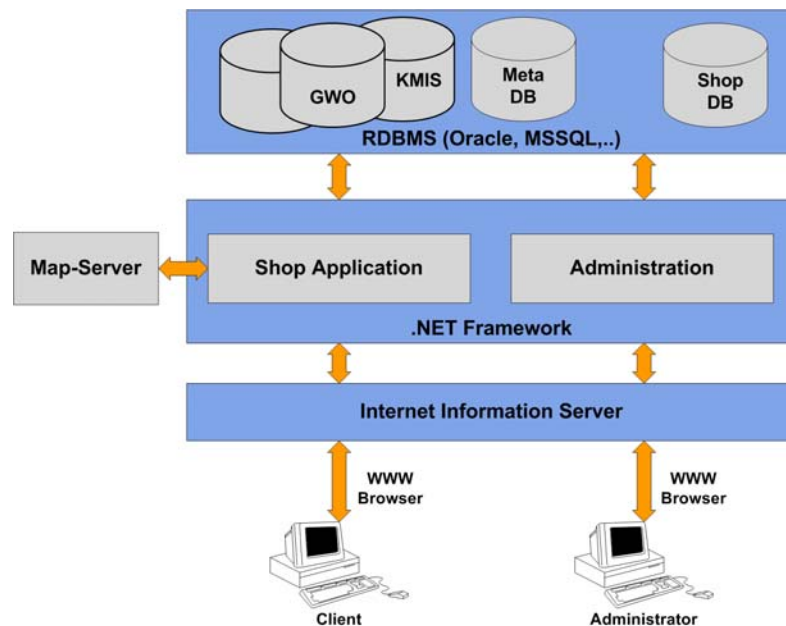


Fig. 7: Components of the gCommerce Shop

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. Fig. 8 illustrates the shopping-cart for geoinformation within the framework *Grundlagenermittlung.de*.

Grundwasser Rohdaten und Ganglinien

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

[In den Warenkorb legen](#)

Fig. 8: "Shopping-cart" in the integrated gCommerce System

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 modeling of metadata for geoinformation up to an internet-based prototype for the provision and marking 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.

6 References

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