INSPIRE Catalogue Services for Environmental and Geographic Applications – Building Blocks for the Implementation

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Abstract
Over the last decade catalogue services for environmental and geographic information were set up almost independently by administrations of the Länder. In both areas organizational structures were also implemented on a federal level to improve interoperability and to coordinate the activities. Driven by the INSPIRE process, such catalogue services are becoming more and more important. This paper is to present the activities in Bavaria in the context of other national approaches.

The Umweltobjektkatalog (UOK) is the central database for metadata describing INSPIRE relevant objects. The UOK was designed and implemented by the environmental administration more than a decade ago and is now a well-established system in this field. It was built to catalogue the many different information sources in a systematic and uniform way. The Bavarian Geodateninfrastruktur (GDI-BY) decided to use this system as the central technology concerning metadata for retrieval of data and services. It was adapted to the demands of the INSPIRE regulations. In Bavaria the environmental administration and the geodetic administration have jointly set up both organizational structures and information systems for catalogue services. A working group on metadata was set up as part of the GDI-BY to coordinate organizational issues on an operational level. Relevant data sets are transferred to information systems on the German federal level. The agreement of the Länder and the federal administration concerning the German Environmental Information Portal (Umweltportal Deutschland – PortalU) offers both comprehensive knowledge on metadata and on information portals. The German Geoinformation Infrastructure (GDI-DE) is the counterpart on the side the geoinformation offices. Based on this infrastructure the Free State of Bavaria has set up the required organizational and technical means connected to the federal level to fulfil the INSPIRE-Demands concerning metadata and catalogue services.

Keywords: INSPIRE, Metadata, Catalogue Services

1. Introduction
The INSPIRE directive aims to provide high-quality geographic data of the European administrations in a uniform way. It focuses on technical and quality standards for the dissemination of such data over web services on the internet. Relevant information services have to comply with standards defined in implementing rules of the EU. One of these services is the catalogue service. It is essential for the retrieval of geographic data sets or web services. In December 2008, the European commission published the implementing directive on metadata. It defines the data structures to describe data sets and services to ensure interoperability of the information systems for data retrieval. We aimed to implement these rules on existing structures and technical systems. The implementation of the INSPIRE directive concerning metadata is based on several building blocks that cover both organizational and technical issues. Individual building blocks make use of existing technical or organizational structures to minimize the effort. They focus on specific issues. Their interconnection leads to the implementation of the INSPIRE demands.
2. The Umweltobjektkatalog (UOK)

More than ten years ago, the environmental administration of Bavaria started the construction of a comprehensive metadata information system. The aim was to catalogue the existing heterogeneous data sets in a systematic way and to improve their usability. It records references to the original data but is not a replacement for applications in general. Today more than 20 different areas (classes) with more than 70.000 entries are covered. The areas include protected sites, geology, geographic data, and research projects. The system is used by the environmental offices in Bavaria. Interfaces exist to various other data bases like the Germany Environmental Information Portal (PortalU). All elements are recorded using a uniform methodology based on the XML-technology with dynamic style sheets for presentation and entry of data. International Standards like ISO 19115 or ISO 19139 are taken into account. This technological approach gives the Umweltobjektkatalog the necessary flexibility to record different types of data corresponding to the broad area of environmental issues.

The Bavarian Geodateninfrastruktur (GDI-BY) decided to use this system as the central technology concerning metadata for retrieval of data and services that covers all INSPIRE-relevant metadata in Bavaria. The necessary steps to adapt the UOK to the requirements of the INSPIRE-directive and the local needs are coordinated by the GDI-BY. A working group on metadata was established as part of it. This working group is chaired by both a representative of the environmental administration and the geodetic office. All relevant decisions on the enhancements were taken by this group.

2.1 Implementing the data model

The INSPIRE regulation on metadata defines three data structures based on the ISO standards regarding data sets, data series and services. Although they cover similar fields of information, they refer to different parts of the ISO-definitions. Therefore a comprehensive XML-model had to be developed that covers all relevant ISO-structures. The XML-model is based on the long name format of the ISO 19115.

Figure 1 XML-Structure used by the UOK (Detail: GEMET-Keywords)
The UOK uses a native XML-Database (TAMINO, Software AG). Data structures according to ISO 19119 can directly be stored in the database without the need for normalization like in relational ER-Schemes. This simplifies the creation of the database. The example (Figure 1) shows repeated data segments for GEMET-keywords.

### 2.2 Entry and presentation of Data

Three entry forms were implemented for data sets, data series and services respectively. Presentation of data is performed through only one dynamic style sheet that shows the available data.

![Figure 2 Selection of metadata entry form according to the INSPIRE Metadata Regulation](image1)

The INSPIRE directive also defines the use of thesauruses to assign keywords to the individual metadata sets as well as value domains for certain elements. The most important one is the GEMET (General Multilingual Environmental Thesaurus) thesaurus of the EEA (European Environment Agency).

![Figure 3 Selection of keywords from the GEMET-Thesaurus for the use in the UOK](image2)
It was implemented in full to allow the user the selection of arbitrary keywords from the German version of the GEMET with automatic translation to other languages covered by the GEMET. An abridged version that contains only GEMET keywords corresponding to the areas defined in the annexes I to III of the INSPIRE directive is also available as well as the value domains defined in the regulation concerning metadata. The entry forms are structured according to the INSPIRE regulation on metadata with references to the ISO 19115, the chapters of the INSPIRE regulation and a short description of the entry field. A comprehensive user manual is also available.

2.3 Import of XML-Files

Metadata can also be recorded using other tools. Figure 5 shows the entry form of a commercial GIS tool. The application allows the export of the recorded data in ISO 19115 format using short names.

Figure 4 Data Entry Form of the UOK according to the INSPIRE regulation

Figure 5 Entry of Metadata using the ESRI Metadata assistant
The UOK provides a standard XML-import functionality. Since the implementation of the ISO 19115 differs between the commercial product and the UOK in respect of the use of long vs. short names, an additional style sheet had to be implemented that does the conversion.

2.4 Catalog Service Web 2.0.2 AP ISO 1.0

According to the INSPIRE regulations, the Catalog Service Web (CSW) standard has to be used for transferring metadata to the INSPIRE portal of the EU. This standard covers a wide range of functionality that may only in part be relevant for a metadata information system for Bavaria. This refers to the extent of the supported query language, the queryable elements, the shape of the area of interest (bounding box), the returnable properties, and the supported operations. The CSW implementation of the UOK has to support two major requirements: Return metadata to the metadata catalogues like geoportal.bund or the Umweltportal Deutschland and to record data from individual public agencies or offices. The requirements are defined by the working group “Geodatenspektrum” of the GDI-DE. This working group also provides a test suite to verify the compliance of individual implementations (GDI-DE, 2009). The CSW 2.0.0 implementation of the UOK passed all 57 steps of the test engine. Recording metadata elements from other sources is a more complex issue since specific implementations have to be taken into account. This refers to the catalogue systems themselves as well as to the IT-infrastructure in computer centres. Firewalls may prevent the exchange of data from the internet to protected areas.

2.5 iPlug Interface

The iPlug interface is the standard means to exchange data with PortalU – the German Environmental Information Portal. It connects different data sources to their central database. The Datasource Client (PortalU, 2009) allows the connection to different databases like MySQL, Oracle, MS-SQL-Server, PostgreSQL or Tamino. As part of the German Environmental Information Network (gein) the UOK uses this general interface to send catalogue information to PortalU.

![Figure 6 Mapping of INSPIRE elements of the UOK to PortalU using the iPlug-Interface](image-url)
The administration user interface allows to specify the mapping of the XML data model to the fields used by PortalU. Ever XML-field is connected to the corresponding entry of PortalU. Since PortalU uses an elaborate ranking method, a ranking factor can be added to influence the presentation at the German Environmental Information Portal. Metadata is subsequently transmitted to PortalU at regular time intervals.

3. The German Environmental Information Portal - PortalU

The German Environmental Portal (Umweltportal Deutschland – PortalU) is a combined effort of the environmental administration in Germany. References to environmental data from public agencies or offices in Germany are collected and transmitted to the central portal. As PortalU plays a central role in the collection and dissemination of references to environmental data on the federal level, it is also an important building block in the INSPIRE process. Therefore, PortalU will be adapted to the requirements of the INSPIRE directive. The steering committee has made the necessary decisions to customize the data structure and to update the existing CSW interface to the current standard (2.0.2) using the application profile AP ISO 1.0 (PortalU, 2009).

PortalU was designed to exchange data with other information systems. A generic interface bus (the iBus) was implemented to provide a general means for data interchange. Individual interface components (the iPlugs) implement Standards like CSW or the communication interface to the UOK. This general approach allows the collection of INSPIRE metadata at environmental offices and their transmission via INSPIRE communication standards CSW 2.0.2 AP ISO 1.0 to geoportal.bund.

![Figure 7 INSPIRE-Metadata of the Bavarian administration available at PortalU](image)

INSPIRE relevant metadata recorded in the UOK is available at PortalU. This achievement is an important step in the technical implementation of the required catalogue services.
4. Geodatenkatalog

The Geodateninfrastruktur Deutschland (GDI-DE) is a joint project of the federal authorities, the Länder and the communal level. It is intended to create a networking structure that covers the Länder as well as different organizational levels to assure that geoinformation will play a more prominent role in the decision making process of the administration, economy and politics. Besides national developments the GDI-DE also focuses on European projects (INSPIRE) and international approaches. The pilot study Geodatenkatalog aims to define a network topology that allows non-redundant retrieval of geodata with good performance located in different areas or levels of the administration. The implementation of a central client that is able to interchange data with other OGC-compliant catalogue services is an important goal of this project. It will retrieve relevant data from other catalogue services and collect the data in a central repository. This is to implement a fast and reliable catalogue service for e.g. the INSPIRE Portal. Geodatenkatalog-DE will act as the central access point for INSPIRE catalogue services.

INSPIRE relevant metadata recorded in the UOK is available at geoportal.bund. In a first step, an open-source implementation of the CSW 2.0 AP 0.93 standard by the GeoNetwork was used. This implementation proved as a fully working system that was easily connected to the Geodatenkatalog. However, it was not possible to fully integrate this system to the XML-database of the UOK. Therefore, this prototype was replaced by a CSW 2.0.2 AP ISO 1.0 implementation at the UOK. This achievement is an important step in the technical implementation of the required catalogue services.
5. Results

Today the technical and organisational infrastructure is in place to fulfil the INSPIRE requirements concerning metadata within the given time frame. This achievement was possible because we did not try to set up a stand-alone system that covers all possible aspects of the INSPIRE directive. Instead we relied on a network where every group focuses on its specific domain of expertise and duties.

The Umweltobjektkatalog UOK is the central element for the implementation of the catalogue service in Bavaria. It acts as the central repository for metadata (Landesportal/Geodatenkatalog). It is able to capture metadata from different sources via different interfaces. The connections will be extended according to the needs of the users who want to provide data within the scope of the CSW 2.0.2 and ISO standards. Examples of manual entry of data are shown in figure 3 and 4. Figure 5 shown an example of the import of metadata from other sources.

The UOK will provide the necessary interfaces to deliver the metadata to the catalogue services of PortalU and geoportal.bund that are operated at the federal level. They will be responsible to offer the catalogue services according to the INSPIRE regulations. An example of the presentation of metadata at the Umweltportal Deutschland origination from the UOK is shown in figure 7. Figure 8 shows an example of the result list at geoportal.bund.

![Flow of metadata in the INSPIRE Process](image)

6. Conclusion and Outlook

The focus of the current work is on the INSPIRE process. The current projects were able to show how requirements concerning catalogue services can be met within the INSPIRE time frame. More effort will be necessary to guarantee the quality of the metadata on the long run. Having such networking information systems in place will give rise to new applications of such catalogue services. New demands will rise from the users as well as from the European administration. The current efforts to establish a shared environ-
mental information system (SEIS) will lead to new requirements and challenges. These new approaches should make use of the now established infrastructure.

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References


