

7 Framework Concept Environmental Information- the Example of Baden-Württemberg

This chapter describes technical and organisational elements for the formation of comprehensive environmental information systems, based on experiences from the cross-departmental Environmental Information System of Baden-Württemberg (Umweltinformationssystem Baden-Württemberg UISBW, hereafter abbreviated as EIS). ICT strategies depicted in the EIS framework conception [Mayer-Föll, Kaufhold 2006] are discussed. The concept of a service oriented and task related EIS may be adopted in a wider context, such as the establishment of a Single Information Space in Europe for the Environment (SISE). The Ministry of the Environment, Nature Conservation and Transport (UVM) coordinates the EIS development in an inter-department approach by a periodically updated framework conception, which gets together current ICT trends and the legal and organisational conditions in Baden-Württemberg, such as the e-Government Concept, the Environmental Information Act and INSPIRE (chapter 2).

A major characteristic of the EIS concept is the formation of strategic co-operations and development partnerships with state and federal institutions and enterprises. An administrative cooperation between the state, the districts and the municipalities of Baden-Württemberg regulates the data interchange between the administrative partners (chapter 3). A big challenge is the organisation of a secure data management in a system employed by about 3.000 professional users and a broad public via internet. Real-time measured data have to be directly provided on the internet. A special feature of the EIS is the operation of one single reference database [Keitel et al. 2009], which can be accessed by a comprehensive reporting system delivering data and services for customised environmental reports (chapter 4). The reporting services are available according to individual user rights. Additional spatial data services (WMS) enable the integration of thematic maps into any EIS application. The Spatial Information and Planning System with its central data pool delivers the required spatial data and contributes to the formation of the emerging spatial data infrastructures on the state, federal and EU level.

The web based service concept includes options for a flexible creation of user views according to individual requirements. An increasing number of standard web services are available at the EIS, which can be flexibly integrated into information portals and applications (chapter 6). A UDDI service register, combining the services, clears the way for the establishment of a service-oriented architecture (SOA). Corresponding to modern CMS based internet portals the information management and data retrieval is increasingly accomplished by intelligent linking and semantic search techniques, while complex metadata management has to be reduced (chapter 7). As the state stipulates a reduction of costs, the public administration has to apply the most efficient techniques possible, including standard software components such as the Google Search Appliance, which is in use since 2008 at the EIS. The multiple use of service components significantly improves the economical efficiency of the EIS (chapter 8) and causes a consolidation of the ICT infrastructure and an optimisation of administrative processes.

7.1 The holistic Approach of the Environmental Information System of Baden-Württemberg

The Environmental Information System of Baden-Württemberg (EIS) provides the organisational und technical infrastructure for the processing of environmental information in the federal state of Baden-Württemberg in Southwest Germany with approx. 10.7 millions of inhabitants. The great amount of environmental data gathered by the state on different topics such as water, soil, air, noise or nature and landscape requires modern ICT technologies. Many data are automatically measured and provided on the Internet.

The Ministry of the Environment, Nature Conservation and Transport (UVM) is in charge of the EIS. Most of the EIS components are developed and operated at the State Institute for Environment, Measurements and Nature Conservation (LUBW). From its outset in 1983 the EIS development has been accompanied by a framework conception, which describes the organisational, legal and political factors concerning the operation of the EIS as well as the potentials of modern information technology. Like the preceding editions the framework conception [Mayer-Föll, Kaufhold 2006] has been approved by the government of the federal state of Baden-Württemberg. Among the main guidelines determining the EIS development there are:

- the e-Government Concept of Baden-Württemberg as the superior legal framework for the EIS,
- the law for the reform of the administrative structures, causing a transfer of responsibilities from the state level to regional and district authorities,
- the ICT cooperative between the state and the municipalities,
- the Spatial Data Information Infrastructure of Baden-Württemberg, Germany and INSPIRE (Infrastructure for Spatial Information in the European Community),
- the Environmental Information Act of Baden-Württemberg, based on the EU Directive 2003/4/EC on Public Access to Environmental Information with its reporting obligations.

The federal structure of the German government causes special challenges for system developers. Environmental tasks occur in many federal, state and local authorities as well as in many different domains. By means of the EIS framework conception the idea of a multidisciplinary and interdepartmental EIS has been established early and is being pursued further. Thus the state-wide processing and distribution of environmental information in Baden-Württemberg and beyond can be effectively coordinated by the UVM.

An important factor for the ongoing success of the EIS concept is its independence from changing political conditions and administrative divisions. The EIS components entirely apply to the execution of environmental tasks, even in case of distributed responsibilities. Thus the major reform of the administrative structures in Baden-Württemberg in 2005 did hardly affect the system architecture and the EIS services could be rapidly integrated in the new workplaces. This concept of a holistic and task-related EIS may be well transferred to a multinational level, particularly with regard to the pan-European environmental legislation. The following chapters expose some organisational and technical key aspects of the framework conception of relevance for SISE.

7.2 ICT Co-operations for Environmental Information Sharing

The interdepartmental scope of the EIS requires special concepts for the cooperative usage of environmental data and services. Due to the reform of administration in 2005 many environmental tasks have been displaced to a regional and municipal level. This caused the demand for an intensified data cooperative between the state of Baden-Württemberg and its municipalities.

ICT cooperation between the state and the municipalities

The uniform gathering and management of environmental data on the EIS is regulated within two major ICT projects, in which the responsible ministry (UVM), the urban and rural districts and the governmental districts take part. The Information System for Water, Immission Control, Soil, Waste, and Occupational Safety and Health (WIBAS) [Braun von Stumm et al. 2006] and the Nature Conservation Information System (NAIS) have a joint software architecture and data organisation. They comprise about 45 different applications and services and include approx. 3.000 workplaces. The applications and services are developed and operated by the LUBW and the Datenzentrale Baden-Württemberg (Data Centre of Baden-Württemberg, a public software house) in a coordinated approach. Software upgrades are delivered once a year to all institutions in a unique setup together with the specialised

data and the spatial data from the central database of the LUBW. Local support is delivered by a special group of institutes providing ICT services.

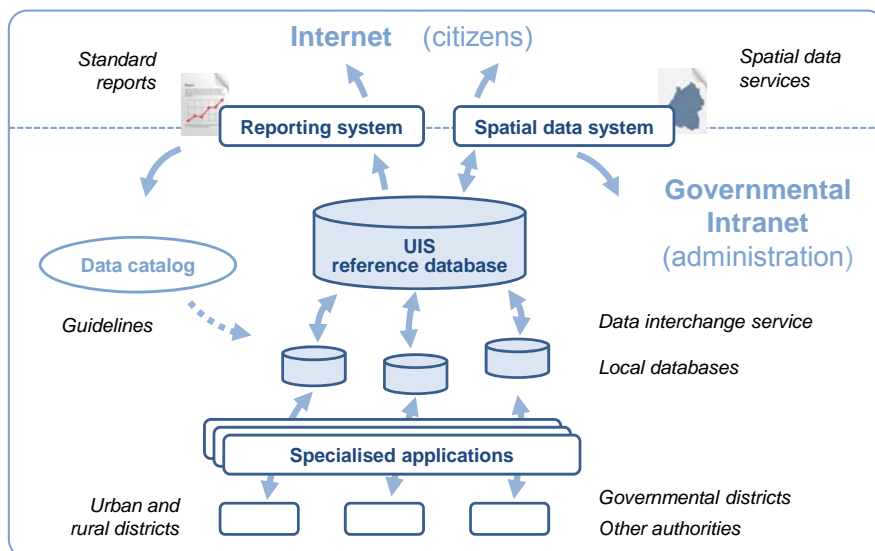


Fig. 7.1: Management of the data cooperative at the Information System for Water, Immission Control, Soil, Waste, and Occupational Safety and Health

Data collection and data management primarily take place in the local databases of the authorities by using their specialised applications (Fig. 7.1). Once a month the data destined for the data cooperative is transferred to the central EIS reference database, located in the LUBW. The technical and organisational aspects of the data exchange are stipulated at a special data catalogue, which also provides the policy for the standard gathering and management of environmental data, paying particular consideration to data privacy protection.

Cooperative ICT development

To improve the efficiency of software development for the EIS, a long-term development cooperation between the UVM, the LUBW, several research institutes and other development partners has been set up in 1994. Thus recent ICT developments and technological innovations can be rapidly integrated into the EIS infrastructure. The technical know-how and the common software components are open to all members of the cooperation. By now the third stage is in progress and several new partners from other federal states joined the cooperation.

In Germany the main responsibility for environmental protection is located at the federal states. The federal government however is in charge of the EU reporting obligations. To unify and coordinate the management of environmental data on a national level, the German Conference of Environment Ministers set up a task force for environmental information systems (StA UIS). Common federal ICT projects are coordinated by the StA UIS and an administrative coordination group (KoopUIS), which acts as a broker for ICT services and common software components such as the reporting framework *Cadenza*®.

Common access to environmental information from the state

An important federal ICT project was the development of a common environmental data catalogue (UDK), containing standard metadata on environmental objects in Germany. This cooperation also prepared the establishment of a first national environmental portal called "German Environmental Information Network" (gein). In 2006 gein was replaced by the PortalU (German Environmental Informa-

tion Portal), which aims at establishing a fast and reliable survey of all relevant environmental information from public organisations in Germany.

In addition to PortalU the federal structure in Germany also requires environmental information portals on the level of the federal states. In Baden-Württemberg it was decided to build up the environmental portal "Umwelt-BW" on available standard software components such as the web content management system Web Genesis®, well established at all state environmental authorities, and the Google Search Appliance, which is in use since 2008 (chapter 7). All environmental data provided by the state administrations, however, should be found at PortalU as well and a flexible linkage of PortalU and the state portal "Umwelt-BW" has been implemented, mainly based on web services. Thus PortalU also provides options for regional data searches, such as geographical selectors and a structured search on the UDK catalogues of the federal states. On the other hand the Semantic Network Service (SNS) of PortalU, based on an environmental thesaurus, is available at any environmental portal.

The sharing of environmental information on a national and multinational level requires unique standards for data exchange, such as the SOAP protocol for the interaction of web services, the UDDI standard (Universal Description, Discovery and Integration) for service registers (chapter 6) and the OSCI standards (Online Services Computer Interface) for secure data interchange within the public administration in Germany. Public web services from the EIS must be integrated in the portal "service-bw", the public administrations' service network of Baden-Württemberg. Special attention is required for the interchange of geographical data in the context of INSPIRE (chapter 5).

The public information demands of the Environmental Information Act however collide with the interests of data security and data privacy protection in many cases. Especially environmental data gathered by the state frequently contain personal information, which cannot be published on an internet platform. By now the legislation process concerning ICT networks and data privacy is still on the way.

7.3 Comprehensive Data Management

The routine operation of the EIS requires modern database and web technologies to merge highly distributed environmental data and to optimise data processing and data presentation for public decision-makers as well as for the citizens.

Central management of environmental data in Baden-Württemberg

The LUBW not only runs the EIS reference database, serving applications such as WIBAS (chapter 3) but also a central data pool for spatial data (RIPS-Pool, chapter 5). In addition MEROS, a central database for measuring series, provides a uniform modelling for all measured data of the state-wide monitoring networks, covering various domains such as water, soil, air and radioactivity. These major databases have been combined in a unique approach by entity-relationship modelling to one logical database, the Database for the Comprehensive EIS Components. All application and spatial data of this encompassing database can be accessed by the central EIS Reporting System (Fig. 7.2).

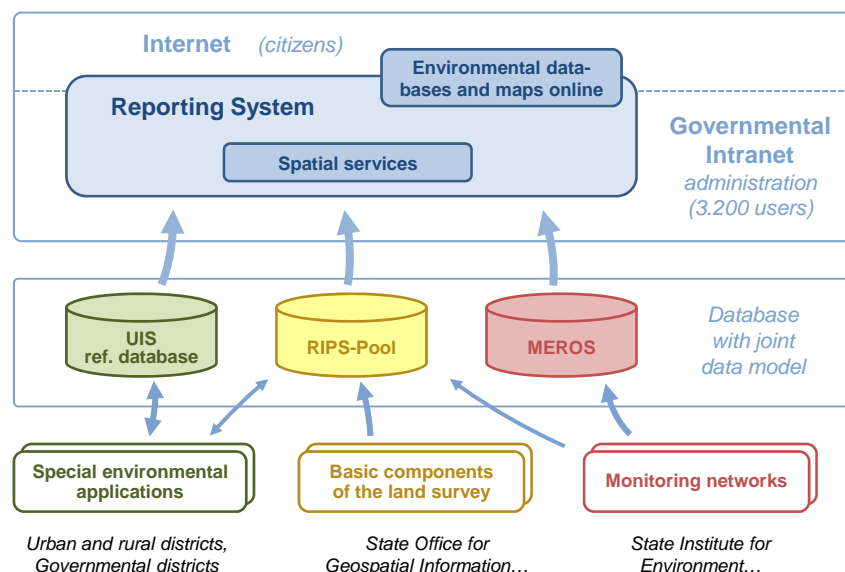


Fig. 7.2: Central data management and data access by the EIS Reporting System

Data services provided by the EIS Reporting System

Currently 3.200 users at the public administration can access the EIS reference database read-only via the EIS Reporting System by use of the administrative networks of the state and the municipalities. Data access is regulated according to the users' rights appointed in special data catalogues (chapter 3). The Reporting System is based on the Software CADENZA®, which is developed in cooperation with the disy GmbH in Germany. By now CADENZA® is in use at seven federal states, three larger administrations of the federal government and partly at the municipalities.

The EIS Reporting System allows the semi-automatic release of standard environmental reports, which includes several service categories such as reporting services for the selection and processing of data, chart services for the graphic visualisation of data series and spatial data services for the release of thematic maps. According to the status and the special needs of the users, three different versions of the system have been deployed: A full version for specific data analysis and a less complex web version for occasional users on the state intranet and a particular web version, offering public access to a limited amount of data on the Internet.

Management of Spatial Data within the Spatial Information and Planning System

The Spatial Information and Planning System (RIPS) was established for the central management of spatial data within the EIS. Its main task (in terms of a data warehouse) is to collect, store and provide geo-referenced data for different user groups via the governmental intranet and the internet. RIPS is developed and operated by the Centre for Information Technology of the LUBW. The UVM coordinates the interdepartmental use and processing of spatial data via RIPS. As a long-time development RIPS embraces technical infrastructure components as well as guidelines and standards. A network of task forces and committees represents more than 10.000 users within the state and municipal administration in Baden-Württemberg.

The processing of spatial data at the EIS includes central and local components. In particular RIPS comprises a central data pool combined with a geodata server, geographical information systems (GIS) with interfaces for geographical data recording, analyses and visualisation as well as information retrieval functionalities based on metadata. RIPS is designed not only as a service platform for the environmental administration, but also for public information purposes. The RIPS Conception [Mayer-Föll, Schulz 2006] corresponding to the EIS framework conception describes two principal purposes:

The consolidation of GIS applications at the local authorities and the implementation of a spatial data catalogue according to the INSPIRE Directive (Infrastructure for Spatial Information in the European Community).

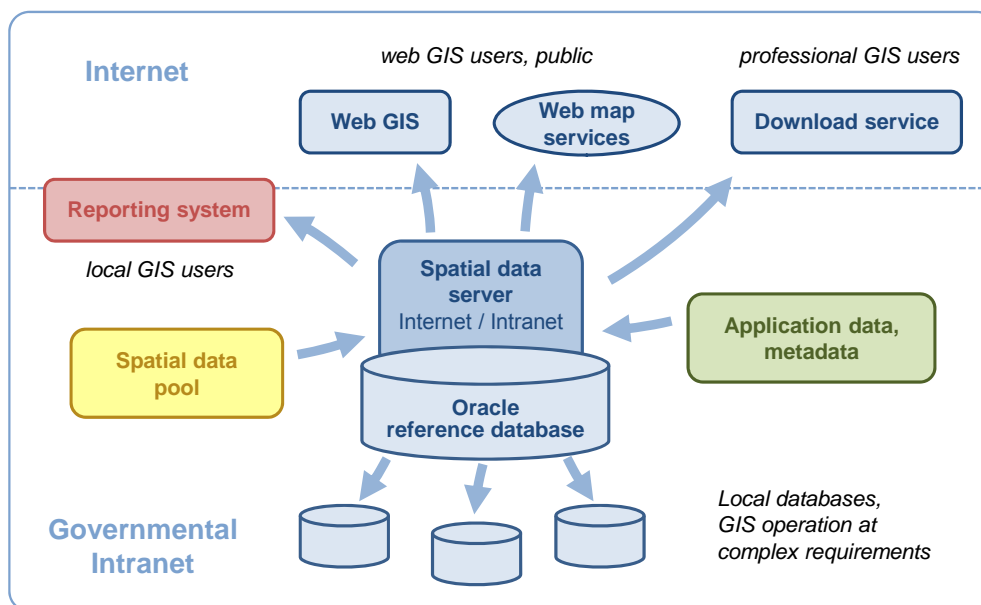


Fig. 7.3: Management and distribution of spatial data

A pool of spatial data merges spatial base data from the land survey and spatial application data concerning environmental topics (Fig. 7.3). Oracle Locator is used for standard data storage and management (also at local authorities), ArcGIS/ArcSDE (ESRI) for the central organisation of spatial data and the provision of appropriate services. The environmental spatial data of the RIPS-Pool are provided by the LUBW and other authorities with a state-wide responsibility as well as from a monthly data exchange with the concerned authorities. The data is disseminated from the central spatial data server to different user groups [Keitel et al. 2009]:

to users of GIS at local authorities via the EIS Reporting System or its integrated service GIS-term, both based on the CADENZA® software,

to professional GIS users (i.e. engineering offices) by means of web services (WMS, WFS, WPS) or a spatial data download service,

to the citizens by the web portal Environmental Databases and Maps online, also based on the CADENZA® software.

Spatial data services

The LUBW provides spatial information in order to fulfil national and European law, such as the Water Framework Directive and Natura 2000, via the RIPS-Portal (<http://www.lubw.baden-wuerttemberg.de/?16134>). A set of mapping services is directly supplied by the EIS reference database. These mapping services refer to the standards of the Open Geospatial Consortium (OGC), especially WMS (Web Map Service) and WFS (Web Feature Service). On the other hand a number of spatial application data services have been implemented within the RIPS framework in order to support specific tasks, called via intranet or internet. The main advantages of the RIPS mapping services are [Müller et al. 2009a]:

Spatial functionalities are available uniquely from a central server without local client installations. Updates or enhancements are carried out without dependencies from fixed data exchange scheduling.

Current access to large sources of spatial data is ensured, e.g. a high-precision digital elevation model with a resolution of 1 m, or a stream network containing approx. 17.000 objects.

The pilot project "Flood Hazard Maps" is an innovative RIPS service, as proven by the GIS Best Practice Award 2009, awarded by the "Deutscher Verein für Vermessungswesen" [Müller et al. 2009b]. The high-resolution risk maps are built on complex surveying data and hydraulic models. Quality assurance is supplied by a web based communication platform, using the AJAX technology and XML. Assisted by this platform the concerned districts and municipalities may report not only failures but also digitize missing of geo-referenced objects directly via a map (points, lines and polygons).

Current web mapping technologies have limitations regarding the dynamic production of large-sized and high-resolution maps. Therefore the LUBW implemented an automated printing service according to the technology and business process "Print on Demand". Local users can individually select map sections, size, print quality and scale. The resulting map is delivered as an up-to-date PDF document. The Print on Demand service is available at many other RIPS services, such as flood hazard maps and noise maps.

The service Environmental Databases and Maps online enables citizens to select, visualise and query a large number of different map layers, for example protected areas, water bodies or administrative boundaries. Professional GIS users can also download geographical data directly from the central database (e.g. in ESRI shape format). Additional services, such as a map service depicting the suitability of roofs for the production of photovoltaic energy, may be integrated into third party websites.

An increasing number of Web Map Services (WMS) is provided by the RIPS Portal not only for the use at client side GIS, but also as additional layers in combination with Google Maps and Google Earth. RIPS also takes advantage of the newer OGC standard WPS (Web Processing Service) and provides functionalities such as the generation of height profiles from the state-wide digital elevation model.

All spatial data and mapping services within RIPS are well documented conform to specifications from OGC and to the international ISO 19115/19119 standard, which defines the schema required for describing geographic information and service specifications. Meta data catalogues have been developed and enhanced in order to ensure data descriptions and the further use by other parties, e.g. the superior metadata catalogue of the PortalU, considering the OGC-defined interface "Web Catalogue Service" (CSW). So the Spatial Information and Planning System with its comprised know-how and technical infrastructure is an important basis for the implementation of the European INSPIRE strategy, as described in the following section.

Establishment of Spatial Data Infrastructures

The INSPIRE Directive (Infrastructure for Spatial Information in the European Community) plays a major role at the establishment of Spatial Data Infrastructures on different levels. INSPIRE intends the development of supranational Spatial Data Infrastructures mandatory in several steps until 2019 to allow an interdisciplinary, comprehensive use of spatial data. A federal law from 2009 puts the legal base for the implementation of INSPIRE in Germany and a corresponding German Spatial Data Infrastructure (GDI-DE).

Due to the common interests of the Spatial Data Infrastructures and the EIS a cross-linked structure of committees has been set up to prevent contradictory or double developments. The implementation of the Spatial Data Infrastructure on the state level demands not only standardised technical interfaces but also the coordination of data contents between different suppliers of spatial data and the construction of organisational frameworks. Baden-Württemberg established a competence centre for the Spatial Data Infrastructure as a contact point, residing at the responsible state institute. The state-wide Spatial Data Infrastructure currently pursues 3 fundamental tasks:

the development of a master plan and definition of a service oriented architecture (SOA), regarding the demands of GDI-DE and INSPIRE.

the setup of a geo-portal for Baden-Württemberg as a central access point providing all geographic information on a comprehensive platform for all user groups.

the construction of a metadata catalogue as a central control instrument including all partners and considering international standards.

7.4 The EIS Service Concept in the Course of Web Technologies

From its first edition in 1986 the EIS framework conception described the EIS in terms of a service concept, providing options for a flexible view on the EIS data depending on individual user requirements. At its early stage the EIS was composed by heterogeneous database applications operated by distinct authorities. The development first focused on the implementation of a common data infrastructure, combining the applications according to a bottom-up approach. The emerging network technologies enabled a closer interaction of ICT systems and required concepts for the information management. The framework conception and its service concept have thus been updated periodically according to recent technologies.

Currently the EIS supplies a large number of services according to the service concept. The available services enable navigation and data access as well as the integration of standard office applications and semantic searches. Instead of uniform applications for large user groups, the EIS provides options to set up customised user interfaces, matching the specific demands for information. Open data interfaces facilitate a comprehensive data exchange. A common data model, used in most environmental domains, allows a large number of users to work with these data. The multiple use of components considerably increases the efficiency of the system.

Web services and UDDI registers

The service concept has been enhanced by the recent implementation of an EIS service register connecting EIS web services and supporting the composition of individual user interfaces. An increasing number of EIS components, especially in the field of reporting and geospatial services conforms to the W3C web service standards respectively to the OGC web map services (WMS). About 60 standardised EIS web map services are currently available to all users, delivering up-to-date maps corresponding to their special tasks. These services e.g. enable regional authorities running their own websites, to integrate reports and thematic maps, which are dynamically generated from the central EIS reference database.

The LUBW operates the service register, which has been developed conform to the UDDI standard (Universal Description, Discovery and Integration). It guarantees consistent access to environmental services not only for EIS users and services but also for a wider target group (like the SISE community), aiming at a flexible chaining of environmental services. The UDDI register specifies web services under a merely technical point of view. Human users without special ICT knowledge are not able to apply this register for search purposes. Thus a central EIS service platform was established by coupling the UDDI register with an easily operable Wiki system (based on MediaWiki), which contains plain text descriptions of the services (Fig. 7.4). Employees at the environmental administration may register their web services by filling in the Wiki form. The associated UDDI specification is automatically generated by the system.

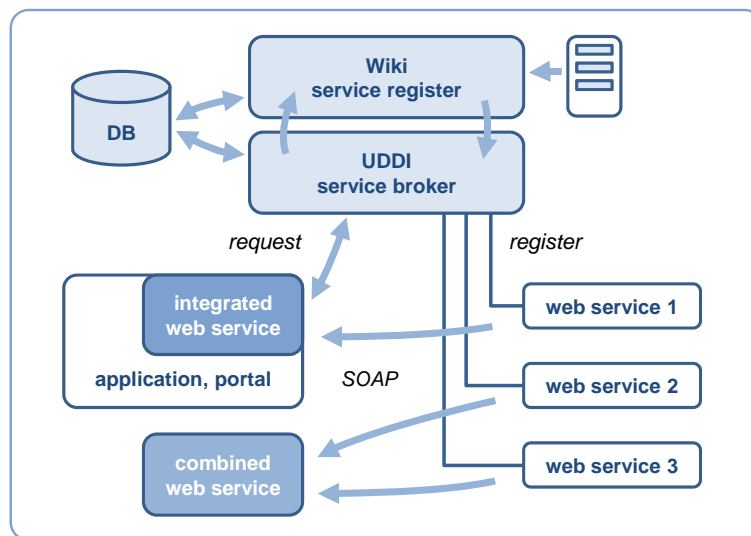


Fig. 7.4: Principle and functionality of the EIS service platform

Towards a SOA architecture

The EIS service platform enables users to search for appropriate services according to their demands. The registry is indexed on the database level by the common search engine of the LUBW (GSA). Web services thus are represented in environmental portals as well. The service platform also provides the basis for public online services according to the e-Government Concept of Baden-Württemberg and for the compliance of standardised reporting obligations to the EU Commission.

The existence of an EIS service platform is an approach to a service-oriented architecture (SOA) for the EIS. Characteristics of a SOA are user oriented options to create special interfaces for special tasks and the ability to customise web services. Mostly a specific combination of services and applications is needed to execute cross-department environmental tasks. To conform to this requirement the SOA should be able to provide superior services combined of a multiple selection of web services (Fig. 7.4). The AJAX technology allows the implementation of such highly flexible user interfaces by using a web browser only.

Collaborative Web 2.0 technologies

Due to the emerging usage of the Social Web and public information sharing platforms new concepts have to be created for the coming generations of the EIS including collaborative working processes. Collaborative information sharing is a necessity for modern administrations, which are increasingly organised in cross-organisational working groups. Currently a notable number of Wikis and similar software tools are in use in many working groups at the environmental authorities. Especially Wikis are to be easily integrated in communication networks and provide options for a flexible organisational communication. Also the demand for a closer collaboration of citizens in the public sector requires the integration of Web 2.0 techniques. Private data providers and citizens are willing to deliver large data input, as the example of the OpenStreetMap project shows. The conditions of collaborative information sharing at public authorities however are not comparable to the private usage of the Social Web. The demands of reliability, quality and integrity of public environmental data have to be considered and data privacy or property rights limit the data distribution in many cases. At this point the idea of a "Creative Commons" licence model concerning public information should be reflected.

7.5 Information Management and Search Technologies

At the EIS the domain of information management changed within the last years from a scientific discipline into an ICT routine job, carried out mainly by EIS services related to search engine techniques. Due to the reporting obligations of the Environmental Information Act of Baden-Württemberg a wide range of environmental topics and highly distributed data have to be merged as well as different levels of information, such as measured data, reporting data, specialised documents or maps. The reporting tasks demand a high level of quality and transparency of information. Besides data quality and accessibility a clear structure and an intuitive data retrieval is of great significance for user acceptance. To meet these demands a number of environmental internet portals have been established in Baden-Württemberg, providing comprehensive access to a combination of reports, documents and heterogeneous information [Weidemann et al. 2008]. The focus of research and development is currently placed on the improvement of search technologies [Abecker et al. 2009].

For the implementation of the EIS portals the web content management system Web Genesis® (developed at the Fraunhofer IOSB Institute in Germany) is applied as a development framework. In addition to the websites of UVM, LUBW and many other environmental authorities several special portals have been set up, such as:

Environmental Databases and Maps Online, for public access to a selection of databases and the spatial data pool (<http://brsweb.lubw.baden-wuerttemberg.de>),

Fachdokumente Online, for the management and presentation of special environmental documents and reports (<http://www.fachdokumente.lubw.baden-wuerttemberg.de>),

Themenpark Umwelt, for public environmental education (<http://www.themenpark-umwelt.baden-wuerttemberg.de>).

The complete amount of EIS data converges in the superior environmental information portal "Umwelt-BW" (<http://www.umwelt-bw.de>), which provides thematic access to all domains of the environment at the state, district and municipal level in Baden-Württemberg and delivers relevant access information to the federal PortalU as well (chapter 3.3).

Change of metadata systems

Initially the Environmental Data Catalogue (UDK) was implemented as the central instrument for metadata management for the environmental domain. It describes environmental information objects by aspects of availability, accessibility, quality, and data character in a unique data model. The UDK not only represents environmental information from Baden-Württemberg, but also from all federal states and the federal government and accordingly implies a quasi-standard for the description of environmental information in the German language area. The core of the UDK topic structure was built by the UDK Thesaurus, a unique environmental taxonomy in German language, provided by the Umweltbundesamt (UBA, Germany) and delivering the basis for the multilingual GEMET Thesaurus of the European Environment Agency (EEA). As the functionality of the UDK software was partially adopted by the PortalU services, the original application was shut down in 2009. Currently the UDK database is used as a data source supporting the thematic search at PortalU. The central information bus of the InGrid® software transfers the search queries to the data sources and UDK matches are included in the search results at PortalU.

Long-term experiences in the operation of the UDK catalogue pointed out, that the manual gathering of complex meta-information on every information object is a demand, which cannot be achieved in practice. Automatic and semi-automatic techniques of metadata gathering have been reflected [Mayer-Föll, Kaufhold 2006]. As the complex UDK data model is not plainly compliant to modern web services and the amount of information is rapidly increasing, the importance of the UDK is declining in terms of information management. Currently the majority of data requests are handled by environmental portals supported by advanced search technologies.

Environmental portals powered by Google

The Google Search Appliance (GSA) as a commercial high end search engine for business applications is in use since 2008 in combination with the EIS information portals. The GSA is connected to the content management system (CMS) via a stand-alone application, which combines hardware and software components in a "black box", adding the well known search functionalities of the Google internet search [Weidemann et al. 2008]. By applying the GSA the search results at the environmental portals could be significantly improved. Instead of a complex set of search options the portal user gets a simple input field to place one or more search terms. The advanced functionality can be added by an online administration interface, which allows tagging techniques, ratings of certain key matches and options to include external information systems in the search. Thus the management of search-relevant "metadata" is reduced to a minimum. The GSA technology enables to index documents and websites as well as database contents [Schlachter et al. 2008].

The consistent usage of the GSA at the EIS web portals marks the first application of a commercial Google product at the public administration in Germany. It was designed originally for the purposes of data retrieval at big enterprises. The successful implementation and results of the new search engine are however revealing that the demands of data retrieval at public information systems do not differ much from commercial ones. In the meantime a number of federal states have adopted this integrated portal concept and a corresponding cooperation between the environmental ministries of Baden-Württemberg and three other states was established [Keitel et al. 2009].

Semantic Technologies

Currently the EIS research and development focuses on the improvement of search results by using semantic web technologies. Internet users without special knowledge in environmental topics should be enabled to find all available information for their special requirements by placing a request as simple as possible. Generally the user demands for information contain temporal and spatial relations according to their individual situation. As an example, citizens who plan to build a home need comprehensive information about aspects such as legal regulations, the local environment (air, water, noise, green areas, recreation sites etc.) and local infrastructure, which concerns many specific responsibilities and data sources. The search results should be presented in a "mashup" page composed by individual matches from all involved information systems and displayed adequately for the different information categories.

To coordinate research activities, a semantic working group was established at the EIS. Currently a prototype application is tested, which is based on a combination of ontologies and a standard OWL-API programming interface [Abecker et al. 2009]. An informational ontology is needed to define the responsibilities of information providers. A spatial ontology (gazetteer) allocates geographical keywords and spatial relations and an ontology of environmental topics helps to specify imprecise requests and define synonymous search terms. The topic ontology is delivered by the Semantic Network Service (SNS, provided by the UBA) which is in use at PortalU as well [Rüther, Bandholtz 2008]. The SNS is a standard web service containing the UMTHESES®-Thesaurus, provided by the federal environmental administration in Germany.

7.6 Economical Factors

The consequent gathering and preparation of data and the public supply with environmental information is an obligation for public authorities, stipulated by state, federal and EU law. The guaranteed access to up-to-date information about the state of environment is an important common value for a modern information society, building awareness on political and technical questions on the environment. Long term effects of environmental awareness building cannot be observed within a few years. Thus the measurement of economic efficiency of a public environmental information system by only monetary aspects is impossible.

The efficiency of the EIS development was subject to an internal study concerning the framework conception. The study was carried out according to a standard evaluation method for public ICT develop-

ment, which opposes the development expenses to qualitative benefits such as usability, accessibility of data, reliability and many more. As only the expenses can be monetarily measured, the numeral result is necessarily negative. An economical profit cannot be expected from a public information system fulfilling legal demands. On the other hand certain factors turn the balance to a positive result of the efficiency calculation:

The EIS infrastructure causes a significant optimisation and automation of administrative processes.

A significant improvement of work efficiency reduces the costs of administrative routine jobs.

Numerous departments and authorities beyond the environmental domain benefit from the EIS services.

The system development brings a consolidation of individual applications formerly operated by the authorities themselves.

Due to techniques such as web services the majority of EIS components allow multiple use.

Many EIS projects enhance the general ICT research and development at the public sector.

Cooperations with other states and departments bring monetary benefits (return of invest).

The EIS ensures the public supply with environmental information according to federal and EU law.

EIS services closely comply with legal demands concerning EU legislation such as the Water Framework Directive or INSPIRE.

Within the last years the usage of commercial standard software components has been increased at the EIS. Especially the implementation of the Google Search Appliance (GSA) at the EIS portals appears to be an economical advantage, as it can be estimated by now. The vendor offers a simple licence model, which depends on the number of indexed objects and on the duration of usage. This opens possibilities of cooperative software sharing, as practiced in Baden-Württemberg. The high licence expenses are compensated by a fast implementation process and a significant decrease of maintenance costs. Thereby expenses of the system development are partially delegated to a commercial software seller. The influence on ICT concepts and strategies however is given off by using standard software.

References chapter 7

Abecker, A., Bock, J., Kleb, J., Wissmann, J., Bügel, U., Chaves, F., Henß, J., Döpmeiser, C., Schlachter, T., Weidemann, R., Ebel, T., Tauber, M. (2009): "SUI". In: Mayer-Föll, R., Keitel, A., Geiger, W. (eds.): "F+E-Vorhaben KEWA. Kooperative Entwicklung wirtschaftlicher Anwendungen für Umwelt, Verkehr und benachbarte Bereiche in neuen Verwaltungsstrukturen. Phase IV 2008/09". Forschungszentrum Karlsruhe, Wissenschaftliche Berichte, FZK 7500, pp. 157-166.

<http://www.fachdokumente.lubw.baden-wuerttemberg.de/servlet/is/93855/?COMMAND=DisplayBericht&FIS=90934&OBJECT=93855&MODE=METADATA>

Braun von Stumm, G., Schulz, K.-P., Kaufhold, G. (eds., 2006): Konzeption Informationssystem Wasser, Immissionsschutz, Boden, Abfall, Arbeitsschutz (WIBAS) als Teil des ressortübergreifenden Umweltinformationssystems Baden-Württemberg (UIS BW). Konzeption WIBAS 2006. Universitätsverlag Ulm.

<http://www.fachdokumente.lubw.baden-wuerttemberg.de/servlet/is/92427/?COMMAND=DisplayBericht&FIS=90934&OBJECT=92427&MODE=METADATA>

Keitel, A., Mayer-Föll, R., Schultze, A. (2008): "Die UIS-Rahmenkonzeption 2006 – Masterplan für die Verarbeitung von Umweltinformationen im IuK-Verbund Land/Kommunen Baden-Württemberg". Environmental Informatics and Industrial Ecology, Shaker Verlag, Aachen, pp. 232-240.

http://www.iai.fzk.de/Fachgruppe/GI/litArchive/EnviroInfo/2008Lueneburg/Volume1-Environmental_Informatics_and_Industrial_Ecology/Die UIS_Rahmenkonzeption_2006_Masterplan_fuer_die_--a936.html

Keitel, A., Mayer-Föll, R., Schultze, A. (2009): "Framework Conception for the Environmental Information System of Baden-Württemberg (Germany)", In: Hřebíček, J., Hradec, J., Pelikán, E., Mírovský, O., Pillmann, W., Holoubek, I., Bandholtz, T. (eds.): "Proceedings of the European conference TOWARDS eENVIRONMENT". Masaryk University, 2009, pp. 461-468.

<http://www.e-envi2009.org/?proceedings>

Mayer-Föll, R., Kaufhold, G. (eds., 2006): "Umweltinformationssystem Baden-Württemberg, RK UIS 06 - Rahmenkonzeption 2006". Universitätsverlag Ulm.

<http://www.fachdokumente.lubw.baden-wuerttemberg.de/servlet/is/90750/?COMMAND=DisplayBericht&FIS=90934&OBJECT=90750&MODE=METADATA>

Mayer-Föll, R., Schulz, K.-P. (eds., 2006): Konzeption Räumliches Informations- und Planungssystem (RIPS) im ressortübergreifenden Umweltinformationssystem Baden-Württemberg (UIS BW). KONZEPTION RIPS 2006. Universitätsverlag Ulm.

<http://www.fachdokumente.lubw.baden-wuerttemberg.de/servlet/is/92464/?COMMAND=DisplayBericht&FIS=90934&OBJECT=92464&MODE=METADATA>

Müller, M., Ellmenreich, B., Schillinger, W., Schulz, K.-P., Hummel, R., Schleyer, A., Faust, T., Heß, D., Höhne, A., Frenzel, R., Martineck, S., Kazakos, W., Kettemann, R., Welker, F., Strittmatter, J. (2009a): "RIPS – GDI – DVV". In: see Abecker et al. (2009), pp. 7-31.

<http://www.fachdokumente.lubw.baden-wuerttemberg.de/servlet/is/93840/?COMMAND=DisplayBericht&FIS=90934&OBJECT=93840&MODE=METADATA>

Müller, M., Panczak-Geörg, M., Mattes, E., Ellmenreich, B., Schillinger, W., Moser, M., Seitz, T., Bar-nikel, G. (2009b): "GIS-Einsatz zur Web-basierten Darstellung von Hochwassergefahrenkarten in Baden-Württemberg". Zeitschrift für Geodäsie, Geoinformation und Landmanagement, 134. Jg., 6/2009, pp. 333-349.

<http://www.fachdokumente.lubw.baden-wuerttemberg.de/servlet/is/94637/?COMMAND=DisplayBericht&FIS=90934&OBJECT=94637&MODE=METADATA>

Paoli, H., Holtmann, C., Heißler, W., Tauber, M., Esslinger, K. (2008): "UIS-UDDI". In: Mayer-Föll, R., Keitel, A., Geiger, W. (eds.): "F+E-Vorhaben KEWA. Kooperative Entwicklung wirtschaftlicher Anwendungen für Umwelt, Verkehr und benachbarte Bereiche in neuen Verwaltungsstrukturen. Phase III 2007/08". Forschungszentrum Karlsruhe, Wissenschaftliche Berichte, FZK 7420, pp. 173-180.

<http://www.fachdokumente.lubw.baden-wuerttemberg.de/servlet/is/92060/?COMMAND=DisplayBericht&FIS=90934&OBJECT=92060&MODE=METADATA>

Paoli, H., Heißler, W., Ebel, R., Schild, M. (2009): "Enviro-SOA". In: see Abecker et al. (2009), pp. 141-148.

<http://www.fachdokumente.lubw.baden-wuerttemberg.de/servlet/is/93852/?COMMAND=DisplayBericht&FIS=90934&OBJECT=93852&MODE=METADATA>

Rüther, M., Bandholtz, T. (2008): "Semantic Network Service (SNS) Update and Future Vision". Environmental Informatics and Industrial Ecology, Shaker Verlag, Aachen, pp. 401-408.

http://www.iai.fzk.de/Fachgruppe/GI/litArchive/EnviroInfo/2008Lueneburg/Volume1-Environmental_Informatics_and_Industrial_Ecology/Semantic_Network_Service_SNS_Update_and_Future_Vis--a916.html

Schlachter, T., Geiger, W., Weidemann, R., Zilly, G., Ebel, R., Tauber, M., Zetzmann, K., Sawade, A., Mayer-Föll, R., Bachmann, V., Köther, B., Rott, W., Keil, D. (2008): "Landes-Umweltportale". In: see Paoli et al. (2008), pp. 63-76.

<http://www.fachdokumente.lubw.baden-wuerttemberg.de/servlet/is/91157/?COMMAND=DisplayBericht&FIS=90934&OBJECT=91157&MODE=METADATA>

Schlachter, T., Geiger, W., Weidemann, R., Zilly, G., Ebel, R., Tauber, M., Sawade, A., Mayer-Föll, R., Zetzmann, K., Bachmann, V., Köther, B., Keil, D., Sattler, T., Trumpler, M. (2009): "LUPO". In: see Abecker et al. (2009), pp. 149-156.

<http://www.fachdokumente.lubw.baden-wuerttemberg.de/servlet/is/93854/?COMMAND=DisplayBericht&FIS=90934&OBJECT=93854&MODE=METADATA>

Uhrich, S., Kruse, F., Klenke, M., Giffei, C., Peters, S. (2008): "The Information Technology of the German Environmental Information Portal PortalU as Tool for the European Level?". Environmental Informatics and Industrial Ecology, Shaker Verlag, Aachen, pp. 215-218.

http://www.iai.fzk.de/Fachgruppe/GI/litArchive/EnviroInfo/2008Lueneburg/Volume1-Environmental_Informatics_and_Industrial_Ecology/The_Information_Technology_of_the_German_Environme--a940.html

Weidemann, R., Geiger, W., Schlachter, T., Zilly, G., Ebel, R., Zetzmann, K. (2008): "Konzept für eine neue Generation von Landes-Umweltportalen". Environmental Informatics and Industrial Ecology, Shaker Verlag, Aachen, pp. 223-231.

http://www.iai.fzk.de/Fachgruppe/GI/litArchive/EnviroInfo/2008Lueneburg/Volume1-Environmental_Informatics_and_Industrial_Ecology/Konzept_fuer_eine_neue_Generation_von_Landes_Umwel--a938.html

Weidemann, R., Geiger, W., Greceanu, C., Schlachter, T., Zilly, G., Lautner, P., Türk, K., Ebel, R., Hahn, R., Lehle, M., Tauber, M., Theis, M., Weiß, W., Witt-Hock, J., Zimmermann, R. (2009): "FADO". In: see Abecker et al. (2009), pp. 175-190.

<http://www.fachdokumente.lubw.baden-wuerttemberg.de/servlet/is/93857/?COMMAND=DisplayBericht&FIS=90934&OBJECT=93857&MODE=METADATA>