Layered Information System Architecture for the Implementation of the European Water Framework Directive

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The implementation of the European Water Framework Directive requires the support of a layered information system architecture. On the thematic layer, the existing legacy systems for groundwater and surface water must be extended or integrated into a common thematic information system with a unique conceptual approach for master and measurement data, spatial data and meta-data to allow integrated and correlated retrieval, exploitation, visualisation and reporting. On the co-operation layer, there is a need to present and store the results of the thematic layer and efficiently organise the collaborative work between the various players involved, such as environmental agencies, laboratories and the public. The present article shows how flexible and open information systems based on Internet and Web-portal technology can be used to support and integrate both layers.

1. Motivation

1.1. The European Water Framework Directive

The Water Framework Directive (WFD) is widely recognised as one of the most ambitious and comprehensive pieces of European environmental legislation to date. Its aim is to ensure that all European waters are protected according to a common standard. The Directive has two key components:

- a system of management of the natural water environment based around natural river basin districts (instead of administrative and political borders); and
- the introduction of co-ordinated "programmes of measures" to achieve at least "good status" for most of the European rivers, coastal waters and underground waters by specified deadlines.

Within each river basin district the ecological condition of rivers and lakes will have to be assessed; for groundwaters the key factors are

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chemical contamination and quantity. Objectives will then be set for each water body and measures to achieve that objective put in place. The condition of the water body will then be re-assessed to determine whether the specified objective has been met. This process will be repeated on a continuing basis.

1.2. Resulting IT Requirements

No single IT system may realise all the requirements that derive from the implementation of the Directive. There are consequences for IT systems on two functional layers (see figure 1):

1. the thematic layer
2. the co-operation layer

On the thematic layer, the most challenging subject is the integration or at least the coupling of the existing IT systems and data both for the surface water and the groundwater domain, possibly with additional information on water protection areas, soil and waste and land use. Here, a multitude of legacy systems must be migrated into a integrated thematic information system with a common approach for the meta-data, the master and measurement data as well as the spatial data. As a result, it is possible to carry out integrated exploitation both on groundwater and surface water data based on (partial) river basin districts, visualise them together in thematic maps and generate common reports according to the requirements of the Directive.

IT systems in the co-operation layer have two main objectives:

Firstly, they should efficiently support the co-ordination of WFD projects and the management of the community that is involved in the implementation of the Directive. Usually, this community is very heterogeneous. Its members are thematic experts, located in different sites and mostly belong to different agencies and companies. Thus, the respective IT system must support the co-operation in a way that is well-known from office environments without requiring programming knowledge.

Secondly, IT systems in the co-operation layer must be able to import, receive, visualise and store the results coming from the thematic layers in form of maps, documents or reports in tabular or textual formats. Furthermore, this information has to be mixed or aggregated to a higher degree and again put into a report format.

2. IT Solutions

The integrated information system WAABIS (Mayer-Föll 2001) for water, waste, contamination and soil that is commissioned and operated by the Ministerium für Umwelt und Verkehr[2] (UVM) and the Landesanstalt für Umweltschutz[3] (LfU) in Baden-Württemberg, Germany, is one example of an open and flexible IT system on the thematic layer. The overall technical aim of WAABIS has been a service concept on top of a relational database that allows multiple use of components across different application domains, such as

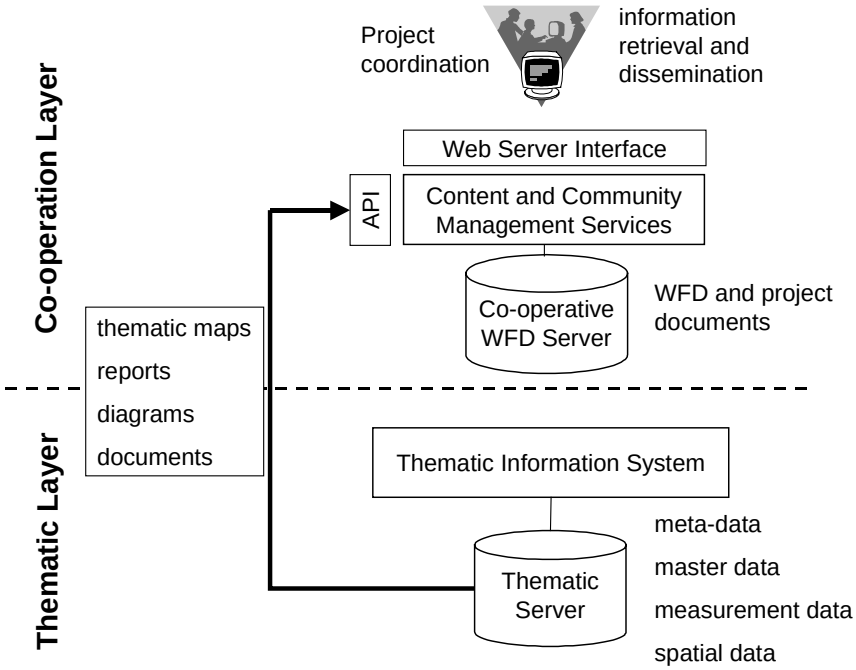

Figure 1 : Layered Information System Architecture

- a Java framework that provides software support for possibly persistent environmental objects and enables a defined correlate of thematic objects across application domains, or
- a GIS component “GISterm” of the German company “disy Informationssysteme GmbH” that allows generation and visualisation of thematic maps and diagrams with a Java programming interface.

[2] Ministry for Environment and Transport
[3] Regional Agency for the Environment

The WAABIS module Groundwater developed by Fraunhofer IITB ensures the quality of the master and measurement data by plausibility checks depending on space and time as well as chart-based measurement data correction and completion. So-called user-defined objects allow a personalised view of the system in order to support the individual workflow of the user in an environmental agency.

The system has been in use since 1999 by environmental agencies, water control bodies as well as urban and rural districts of Baden-Württemberg. In an extended collaboration with the Freistaat Thüringen, the system is now being extended to include the data and functions for surface water in order to satisfy the integrated view on surface and underground water of the Directive.

In order to master the information flow to the co-operation layer, an upload mechanism has been developed to the Java programming interface of WebGenesis. WebGenesis, developed by Fraunhofer IITB, provides all typical features of a content management system with additional focus on

- modelling of meta-data with flexible extensions
- complex (full text) search mechanisms on meta-data and content,
- automatic generation of navigation facilities
- authoring Support (e.g. different levels of functionality by using forms for interactive information acquisition and creation),
- Community Tools (e.g. forums, addresses, calendar, shops)
- supplemented by a variety of functions to administrate user groups, users, access rights and system configuration.

In Germany, WebGenesis is already used to co-ordinate various WFD-related projects (e.g. see http://wasserblick.net/start.html) on national and regional level.

Thus, by directly coupling the WAABIS and the WebGenesis information systems, an efficient layered information system architecture required for the implementation of the Directive on national or even international level can be deployed.

3. Bibliography

Mayer-Föll (et al) (2002): Project AJA - Anwendung Java-basierter Lösungen in den Bereichen Umwelt, Verkehr und Verwaltung, Phase II 2001. FZKA 6700