ORCHESTRA - An Information Infrastructure to Support Cross-Boundary Risk Management

R. Denzer and R. Güttler

Environmental Informatics Group, Germany, E-Mail: Ralf.Denzer@enviromatics.org

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EXTENDED ABSTRACT

Many practical environmental assessment and management tasks are tasks which need to cross boundaries, in particular thematic, spatial, political and organisational boundaries. Typical examples are cross-border management of emergencies in Europe, eg flood management, where an IT system in practice would have to integrate data and information processess across at least 4 countries and at 6 to 8 provinces. Thus the information management as such becomes a very complex and costly issue.

This paper presents an overview of the ORCHESTRA project. ORCHESTRA responds to European needs to develop a standardised, general purpose and generic information infrastructure for the management of environmental and risk management information and related cross-boundary business processes.

ORCHESTRA was started in September 2004 and is funded under the 6th framework program of the EU (FP6), under the priority "Improving Risk Management" of the Information Society Technologies (IST) program. ORCHESTRA is a 14 million Euro project with 14 partners across Europe.

ORCHESTRA is currently developing a general purpose concept for the integration of risk management information systems in Europe.

With this, ORCHESTRA contributes to both the INSPIRE and GMES activities in Europe.

The paper presents an overview of the project, introduces general problems in integrating cross-boundary systems and gives an overview of the appraoch taken by ORCHESTRA.

Part of this is the ORCHESTRA Reference Model, which will be the basis for all specification and implementation work undertaken.

Note that this paper presents early results. Due to the ORCHESTRA project schedule, official versions of the ORCHESTRA are not yet published (they will be published in fall 2005) and it is thus not yet possible to give a complete picture in this paper.

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1. INTRODUCTION

Environmental Information Systems (EIS) and Environmental Decision Support Systems (EDSS) are usually complex information systems containing complex information and performing complex workflows, which may not even be pre-defined (ad-hoc workflows). In general, these so-called EIDSS Systems (Environmental Information and Decision Support Systems) – or short ENVIROMATICS SYSTEMS – are composed of a number of heterogeneous components and tools solving a complex monitoring, analysis or decision support task.

The component structure of Enviromatics Systems can not really be generalised or defined, because real world applications vary a lot depending on the concrete use of a concrete system. However, certain common elements are present in many systems (Swayne (2000), Denzer (2002), see figure 1): data management and data network components, geomatics components (GIS), decision support components (DSS) and numerical simulation models.

Even at the level of a single, stand-alone system for one single purpose, integration of data, models, visualisation, analysis and decision support tools is already a very difficult and costly undertaking.

Examples of such complex Enviromatics Systems are air pollution monitoring networks (Schimak(2003)), public water information systems (Usländer(2003)) and decision support systems in water quality and climate (Quinn(2003), Swayne(2003)).

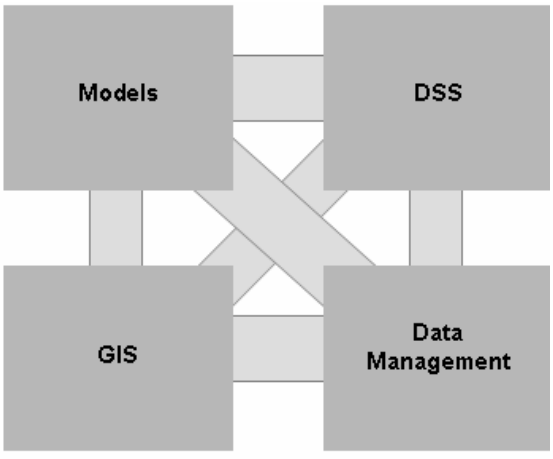

Figure 1. Typical Enviromatics Systems components

The complexity of Enviromatics Systems is increased considerably when it comes to integrating information and business processes *across* different existing systems for the purpose of cross-boundary information management and use of services. It has been recognised in the meantime that the issue of cross-boundary integration is an important topic, in particular in the European Union, with 25 member states and a number of associated neighbours.

2. CROSS-BOUNDARY INTEGRATION

ORCHESTRA addresses fundamental problems which arise with the need to integrate business processes which span *across* boundaries of various types, including: geographical, political, administrative/organisational and thematic boundaries. Therefore, in general, ORCHESTRA addresses everything which can be considered a ***cross-use*** of information and services. These fundamental issues, as described in the ORCHESTRA project proposal, can be summarised as follows:

- Given the multiple use of data and services for multiple purposes, any European infra-structure for risk management needs to be able to integrate systems as a whole.
- Systems which need to be integrated are heterogeneous and fragmented. Heterogeneity describes the mixture or combination of different information types. Fragmentation refers instead to the distribution of similar information types over multiple locations.
- This includes that: information resources and services are spread over many levels of administration (from local to EU level) and cross-boundary use of information is virtually not happening; information resources and services are extremely heterogeneous in terms of semantics, information models, internal architectures, technical implementation and so forth; it is not yet well understood how to cope with multi-linguality and multi-terminology in different information resources, although recent developments in ontologies and advanced metadata systems offer valuable approaches
- A variety of meta information systems (often catalogue systems) have been built in the past, with the goal to support the discovery of information. In addition to

this, existing systems often offer portals in order to help discover their information. The problem today is that access in catalogues and portals is often restricted to the meta information level.

- Navigation and search are not available in a seamless fashion today: there are no general purpose cross-system navigation, search and access methods which help end users to find and access data. Users often only have the option to search the World Wide Web or to search manually in different portals, combining information manually after retrieval; Spatial and non-spatial information resides in two different information worlds and technologies which are not integrated with each other. Seamlessly moving between spatial, temporal and factual search paradigms back and forth is not offered

A detailed description of these (and other) integration obstacles can be found in (Denzer2005b).

3. THE ORCHESTRA PROJECT

The cross-system issues developed in the previous section are present in many application domains of environmental and risk management. Risk management itself is a major strategic objective of the 6th framework program of the EU and general purpose infrastructures for supporting information management are a key necessity to solve risk management problems, which are complex and cross-boundary in nature.

ORCHESTRA intends to develop an open and generic information infrastructure for risk and environmental information management in Europe. ORCHESTRA particularly intends to improve the deployment of cross-boundary information management processes and thus to face the challenges described in the previous chapter.

ORCHESTRA has a total budget of over 14 million euros and is conducted by an international partnership. The project has started in september 2005 and will last 36 months. At the time of this writing, the first version of the ORCHESTRA architecture is available and the major specification work is undertaken. The first public version of this architecture is available since October 17 (www.eu-orchestra.org). Technical information in this article needs to be considered as early results.

Table 1	**ORCHESTRA PARTNERS**	
Short Name	Partner	Country
ATOS	ATOS ORIGIN	Spain
JRC-IES	Joint Research Centre, Institute for Environment and Sustainability	International
JRC-IPSC	Joint Research Centre, Institute for the Protection and the Security of the Citizen	International
EIG	Environmental Informatics Group	Germany
OGCE	Open Geospatial Consortium (Europe)	United Kingdom
BRGM	Bureau de Recherches Geologiques et Minieres	France
OS	Ordnance Survay	United Kingdom
IITB	Fraunhofer Institute IITB Karlsruhe	Germany
ARCS	ARC Seibersdorf Research	Austria
ETHZ	ETH Zurich	Switzerland
INTECS	INTECS S.P.A.	Italy
DATAMAT	DATAMAT S.p.A.	Italy
TYPSA	TYPSA	Spain
BMT	BMT Cordah Limited	United Kingdom
AMRIE	The Alliance of Maritime Regional Interests in Europe	Belgium

4. RELATED ACTIVITIES

ORCHESTRA needs to be ssen in the context of several activities:

- The INSPIRE initiative (see INSPIRE 2005), an initiative to a produce Europan-wide geographical and environmental digital baseline
- The GMES initiative (Global Monitoring for Environment and Security)
- The goal of the European Commission (DG INFSO) to support these initiatives through IT R&D in FP6.

ORCHESTRA considers itself as a project which produces architectural standards and specifications for wider use. It is probably the largest project of this sort in Europe.

ORCHESTRA will provide all its results to the initiatives mentioned above and will collaborate to provide the means to develop a European-wide information base. For this purpose standardisation is essential.

5. STANDARDISATION

An information infrastructure for environmental information management in Europe can not be built or bought as a turn-key system. Similar attempts have been made in the past and have failed.

The main difference compared to stand-alone systems (which you can build turn-key) is that an infrastructure as envisioned by ORCHESTRA can not be built in finite time. It needs to be able to grow and adapt. ORCHESTRA needs to be *designed for change*.

Design for change implies that the ORCHESTRA infrastructure will operate over a long period of time. As foundation for such long lifetime, standards are of utmost importance. For this reason ORCHESTRA has proposed to pursue what we call a "standardisation approach", in contrast to what we call a "standard engineering approach". The engineering approach would be the classical way to build the turn-key system. We are convinced that this approach will fail (again). The standardisation approach builds on existing standards wherever possible and aims to develop a software standard for risk management itself. ORCHESTRA is therefore actively contributing to standardisation both in Open Geospatial Consortium and INSPIRE.

The ORCHESTRA Archictural Specifications will be publicly available open specification.

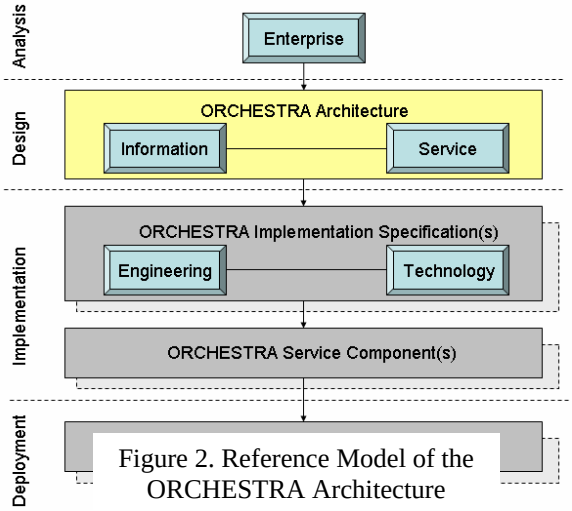

Figure 2. Reference Model of the ORCHESTRA Architecture

6. THE ORCHESTRA REFERENCE MODEL

An early decision during the project was to follow the overall methodology of RM-ODP (Reference Model for Open Distributed Processing, ISO/IEC 10746 RM-ODP). Although quite aged this model was helpful in the specification process of the ORCHESTRA architecture. The standard needs to be adapted where necessary but is a good guideline for the specifications.

RM-ODP separates a number of aspects of large systems (called viepoints, see table 2.). ORCHESTRA adapts this approach to today's needs.

Based on this approach, an architectural approach has been taken which allows a maximum of flexibility when building concrete service networks. The complete approach can not yet be presented in this paper but will be available through a document called RM-OA (Reference Model for the ORCHESTRA Architecture) around November 2005. It will be presented with the presentation at MODSIM.

Figure 2 shows how the ORCHESTRA Architecture (OA) makes use of RM-ODP. The important issue in our approach is that the OA is the ***combined platform-neutral specification of the information and service viewpoints***.

Table 2	ORCHESTRA Viewpoints	
Viewpoints	Mapping to Orchestra	Usage example
Enterprise	Reflects the analysis phase in terms of the system and the user requirements as well as the technology assessment	Use case description of a geoprocessing service
Information	Covers the conceptual model of all kinds of information with their thematic, spatial, temporal characteristics as well as their metadata.	UML class diagram defining the information elements that are used by the geoprocessing service
Computational (referred to as Service Viewpoint)	Covers the Orchestra services that enable syntactical and semantic interoperability and administration across system boundaries	UML specification of the geoprocessing service
Engineering	Covers the mapping of the Orchestra service specifications to the chosen service infrastructure	Mapping of the UML specification to WSDL
Technology	Covers the technological choices of the service infrastructure and the operational issues of the infrastructure.	Usage of W3C Web Services and UDDI

With this approach, the specifications are not linked to a concrete middleware infrastructure (like WebServices, CORBA or others), it will be possible to opreate networks even if there are new generations of middleware software.

7. ACKNOWLEDGMENTS

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