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Executive Summary

The overall aim of RISE is to facilitate the production of data product specifications on the conceptual and implementation level consistent with the relevant international and industrial standards. A key outcome from RISE is, therefore, the definition of a process – a repeatable methodology – for developing, adopting and maintaining data products specifications.

This document complements the methodologies and guidelines deliverable (RISE 15 [2]) and outlines the methodology of a viewpoint analysis for a system, as defined in the OpenGIS Reference Model [1]. The higher level Viewpoints (Enterprise and Information) are presented from the perspective of the RISE Use Cases; the lower level Viewpoints (Computational, Engineering and Technology) address the specific case of the RISE Test Environment which provides a facility to test the Application Schema generated by RISE. It thus provides the framework to document the service requirements from use cases and bring the data model aspect in relation to respective system services needed to address the user's information requirements.

Terms and Abbreviations

application schema

Conceptual schema for data required by one or more applications [ISO 19101]

client

A software component that can invoke an operation from a server

conceptual schema

formal description of a conceptual model [ISO 19101]

conceptual model

model that defines concepts of a universe of discourse [ISO 19101]

coordinate reference system

coordinate system that has a reference to the Earth.

coverage

is a feature that associates positions within a bounded space (its spatiotemporal domain) to feature attribute values (its range)

data harmonisation

providing access to data through network services in a representation that allows for combining it with other harmonised data in a coherent way by using within the ESDI a common set of data product specifications

NOTE This includes agreements about coordinate reference systems, classification systems, application schemas, etc.

data product specification

detailed description of a dataset or dataset series together with additional information that will enable it to be created, supplied to and used by another party [ISO/DIS 19131]

data specification

data product specification that describes INSPIRE or GMES datasets of a specific theme from different data providers in a harmonised way

dataset

identifiable collection of data [ISO 19115]

dataset series

collection of datasets sharing the same product specification [ISO 19115]

DCP

Distributed Computing Platform

ESDI

European spatial data infrastructure as built based on the INSPIRE framework directive

feature catalogue

catalogue containing definitions and descriptions of the feature types, feature attributes, and feature associations occurring in one or more sets of geographic data, together with any feature operations that may be applied [ISO 19110]

feature

abstraction of a real world phenomenon.

feature data dictionary

dictionary containing definitions and descriptions of feature concepts and feature-related concepts [ISO/TC 211/N2005 – modified]

general feature model

metamodel of feature types

geographic feature

feature associated with a location relative to the Earth.

GML

Geographic Markup Language

GMES

GMES is the abbreviation of "Global Monitoring for Environment and Security" a concerted effort to bring data and information providers together with users, so they can better understand each other and make environmental and security-related information available to the people who need it through enhanced or new services [www.gmes.info]

INSPIRE

Framework directive for building an infrastructure for spatial information in the Community [inspire.jrc.it]

interface

named set of operations that characterize the behavior of an entity [6]

interoperability

capability to communicate, execute programs, or transfer data among various functional units in a manner that requires the user to have little or no knowledge of the unique characteristics of those units [ISO 2382-1]

ability of two or more systems or components to exchange information and to use the information that has been exchanged [IEEE]

NOTE It is worth to note that strictly speaking there is no "interoperability" between data sets. The only things that can interoperate are services and systems. In the case of several heterogeneous data sources, interoperability requires "wrapping" data sources into services that conform to standards. The output of these services is what is to be harmonised, not their inputs (database schemas). Thus the legacy is maintained and can evolve to support the specified service interfaces. As a result, data producers will not have to change the structure of their data.

NOTE Interoperability in the ESDI context means that each country maintains their own infrastructure, but adopts a framework that enables existing datasets to be linked up from one country to another (e.g. via transformation or translation).

map projection

coordinate conversion from a geodetic coordinate system to a planar surface.

metadata

Data about data.

OGC

Open Geospatial Consortium

operation

Specification of an interaction that can be requested from an object to effect behavior. [ISO 19119]

property

A facet or attribute or an object referenced by a name

ORM

OGC Reference Model

service request

An request by a client of an operation from a service.

service

A collection of operations, accessible through an interface, that allows a user to evoke a behavior of value to the user. [ISO – 19119]

service chain

sequence of services where, for each adjacent pair of services, occurrence of the first action is necessary for the occurrence of the second action [ISO 19119]

References

The following referenced documents are indispensable for the application of this document.

1. OGC Reference Model: http://orm.opengeospatial.org/ .
2. RISE 15 Methodologies & Guidelines on Use Case and Schema Development.
3. RISE 18 Use Case Document: Diffuse nutrient leakage reporting to the Water Framework Directive.
4. RISE 23 Conceptual Schema in UML.
5. RISE 25 Data Product Specification.
6. RISE26/35 Draft/Final GML Application Schema.
7. RISE Testing System Design Document
8. RISE 36 Final Report on Testing System.
9. RM-OA: Reference Model for the ORCHESTRA Architecture: http://www.eu-orchestra.org/documents.shtml

The RISE documents above can be obtained from the downloads section of the RISE public website:

http://www.eu-rise.org/

Table of Contents

1. Scope

The overall aim of RISE is to facilitate the production of data product specifications on the conceptual and implementation level consistent with the relevant international and industrial standards. A key outcome from RISE is, therefore, the definition of a process – a repeatable methodology – for developing, adopting and maintaining data products specifications. The definition of the repeatable methodology in particular addresses issues concerning the harmonisation of heterogeneous data sources.

This document outlines the methodology of a viewpoint analysis for a system, as defined in the OpenGIS Reference Model [1]. The higher level Viewpoints (Enterprise and Information) are presented from the perspective of the RISE Use Cases; the lower level Viewpoints (Computational, Engineering and Technology) address the specific case of the RISE Test Environment which provides a facility to test the Application Schema generated by RISE. It thus provides the framework to document the service requirements from use cases and bring the data model aspect in relation to respective system services needed to address the user's information requirements.

2. RISE Architecture Outline

2.1. Architecture Approach

This document outlines the approach of a viewpoint analysis. It provides the methodology to document the service requirements from use cases and puts the data model aspect in relation to respective system services, which are needed to address the user's information requirements.

The viewpoint analysis follows the ISO Reference Model for Open Distributed Processing (RM-ODP) ISO/IEC 10746, which is an international standard for architecting open, distributed processing systems. It provides an overall conceptual framework for building distributed systems in an incremental manner. The application of RM-ODP is two-fold:

- A way of thinking about architectural issues in terms of fundamental patterns or organising principles, and
- A set of guiding concepts and terminology.

RM-ODP defines standard concepts and terminology for open, distributed processing. In a generic way, the model identifies the top priorities for architectural specifications and provides a minimal set of requirements — plus an object model — to ensure system integrity.

Five standard viewpoints are defined; the viewpoints address different aspects of the system and enable the 'separation of concerns':

Viewpoint Name	Definition of RM-ODP Viewpoint
Enterprise	Focuses on the purpose, scope and policies for that system.
Information	Focuses on the semantics of information and information processing.
Computational	Captures component and interface details without regard to distribution
Engineering	Focuses on the mechanisms and functions required to support distributed interaction between objects in the system.
Technology	Focuses on the choice of technology.

The OGC Reference Model (ORM) is an abstraction of the RM-ODP, which provides the framework for a Spiral Development process which is predictable and repeatable. It serves several important facets of standards-based development: It is used to guide multi-stakeholder concurrent engineering of software-intensive systems and it has two main distinguishing features:

One is a cyclic approach for incrementally growing a system's degree of definition and implementation based on requirements that are expressed as capabilities.

The other is a set of anchor point milestones for ensuring stakeholder commitment to feasible and mutually satisfactory system solutions.

The ORM has the following purposes:

- It provides a foundation for coordination and understanding (both internal and external to OGC) of ongoing OGC activities and the Technical Baseline;
- It describes the OGC requirements baseline for geospatial interoperability;
- It describes the OGC architecture framework through a series of non-overlapping viewpoints: including existing and future elements;
- It regularizes the development of domain-specific interoperability architectures by providing examples.

2.2. The overall process model of RISE

In order to produce sustainable results and provide best support for GMES, INSPIRE and related operational scenarios, RISE is following a standardised and well-documented spiral engineering approach described in the OpenGIS Reference Model (ORM) [1].

A respective process model answers two main questions:

- what should the project do next?
- how long should the project continue doing it?

The spiral engineering model holds that the answers to these questions vary from project to project, and that the variation is driven by risk considerations. It emphasizes the importance of having all of the project's success-critical stakeholders participate concurrently in defining and executing the project's processes as explained in detail in the RISE 15 *Methodologies & Guidelines on Use Case and Schema Development [2]*. It can be used to integrate software, hardware, and systems considerations, but is most important to use for software-intensive systems.

In RISE, each stage in the Spiral Development process is defined by the following steps:

Requirements expressed as capabilities are described in use case scenarios. These use cases will be described according to a template for use case descriptions and a checklist for data harmonisation aspects to be addressed in the description.

These use cases describe the relevant universe of discourse which is then documented as an application schema which is a model based on feature types and their properties resulting in a common terminology and described in a conceptual schema language. The Unified Modelling Language (UML) as profiled by the ISO 19100 series of International Standards will be used as the conceptual schema language. This application schema constitutes a core component of a Data Specification.

The Data Specification will be documented according to ISO 19131, the (draft) International Standard specifying the contents of Data Product Specifications in the field of geographic information. A Data Product Specification includes at least the following sections: specification scopes, data product identification, data content and structure, reference systems, data quality, data product delivery, and metadata.

Based upon the application schema, a GML application schema (GML = Geography Markup Language = ISO 19136) can be generated following the normative rules for such conversions.

These results will be tested within a Test Environment under real world conditions and brought forward to INSPIRE, OGC and industry for appropriate consideration and feedback.

Inherent costs and benefits of the harmonisation efforts carried out for applying this process within RISE have been tracked and documented in the RISE Cost Benefit Analysis, so that each organisation can determine for itself the likely costs for following the RISE Methodology based on its internal processes, policies and cost structures.

2.3. RISE Use Cases

The use case scenario analysed within RISE is the 'Diffuse Nutrient Leakage' reporting to the Water Framework Directive (WFD). Reporting on that and other issues had to be carried out by all EU Member States for the first time in 2005 under a limited set of requirements; guidelines for the next reporting in 2010 are under revision.

RISE developed use scenarios in the context of reporting carried out in Sweden and Norway.

The entire processing of selected input data, i.e. 'Hydrography', 'Landcover' and 'Elevation' [3], for the modelling of Diffuse Nutrient Leakage has been analysed towards harmonised data products. These data themes in turn were derived from the INSPIRE 'priority common basic data' list and GMES applications.

In both countries the cross-sectoral aspects as well as cross-border issues between the two countries are reviewed and reflected in the scenario descriptions.

2.4. Identification of Architectural Requirements

The results from the use case development constitute requirements. The requirements that relate to the input data are transformed to a first-cut of data product specifications (typically one per data theme), according to ISO 19131 Data Product Specification. If a data product specification for the relevant input data already exists, an initial analysis will be carried out to determine if the existing specification should be amended or if the requirements are different enough to warrant the creation of a separate data product specification.

Based upon the requirements, feature types and associated attributes, constraints and association as well as other relevant information like coordinate reference systems, metadata, etc. are defined and are the basis for the further analysis.

3. Viewpoint Analysis

3.1. Enterprise Viewpoint

3.1.1. Use Case Enterprise Viewpoint

The enterprise viewpoint defines the Objectives to be achieved by the architecture and identifies the organizations, relevant policies and scenarios. The relevant information is detailed in the RISE 18 – *Use Case Document: Diffuse nutrient leakage reporting to the Water Framework Directive [3].*

The Water Framework Directive (WFD) 2000/60/EC of the European Parliament and of the Council of 23 October 2003 establishes a framework for Community action in the Field of water policy. The main objectives of the legislative piece are to achieve a good status of water bodies, the protection of these water bodies and the impediment of their deterioration.

For the implementation, a Common Implementation Strategy (CIS) was developed by the member states and Norway to provide a common understanding and awareness of the Directive. The key tools of the CIS are the Guidance Documents, among them also a GIS Guidance Document for the required spatial data, which has been used in the RISE use case analysis.

The GIS Guidance Document details the specifications of hydrology data required for analysis and reporting in the WFD. It has been issued in 2002 as a recommendation document that is under revision. Considered are those requirements and steps which provide the hydrological features to which the diffuse nutrient leakage as part of the ecological status reporting of surface water bodies to the WFD is referred to.

The WFD in 2005 primarily required information on and categorisation of water bodies, to which for the actual modelling of diffuse nutrient leakage potential land cover information is added:

The provision of River Basin District overview information
Requested by the WFD are data on River Basin Districts and their catchments, the River Basins and primary catchments (the smallest units in a catchment hierarchy). These units have to be equipped with a European code as indicated in the GIS Guidance Document of the WFD, as well as with their name. The catchments furthermore have to hold a unique national code expandable into the European code requested by the WFD.

The categorization of surface water bodies
This categorization comprises of the assignment of a unique national and European code for each surface water body feature, a name and the categorization of each surface water body. The structure of the national code is thereby up to each member state, the code itself is extended into a unique European feature code required by the WFD. Surface water bodies are to be categorized into Rivers, lakes, coastal waters and transitional waters.

Land cover information for diffuse nutrient leakage modelling
Within RISE the focus is set on input data for the diffuse nutrient leakage modelling. So in addition to the water body categorisation, land cover information needs to be provided as input to the actual modelling of the leakage potential for a given area. The landcover information is processed from earth observation data. As an example, the Swedish model for the N and P leakage calculation requires information on the following set of landcover classes:

- Urban areas,
- Forest,
- Glacier,
- Mountainous area above the treeline,

- Wetlands,
- Water (rivers and lakes),
- Forest clearcut areas,
- agricultural areas,
- National Sea,
- International Sea.

3.1.2. RISE Test Environment Enterprise Viewpoint

In order to test the Application Schema for the Data Product Specifications generated by RISE, a RISE Test Environments has been developed. This employs similar technology to a possible future real-life service and so is used as the basis of the engineering and technology viewpoints provided later.

The Enterprise Viewpoint of the RISE Test Environment (RTE) is different to a future real-life service as RISE is focussed on validating the RISE approach and demonstrating its practicability. However. since RISE addresses the harmonisation need for input data to the modelling of diffuse nutrient leakage, the RISE Test Environment enterprise viewpoint addresses a subset of the overall Enterprise Viewpoint:

3.2. Information Viewpoint

The Information Viewpoint of an architecture focuses on the semantics of information and information encoding. It describes the basic information building blocks and Application Schemas used following the requirements from the RISE Use cases and enumerates the relevant encodings, formats, and languages of relevance. The Information Viewpoint for the Use Cases and the RISE Test Environment is essentially the same.

With the harmonisation needs towards application-specific data products identified in the use case analyses, the conceptual and GML application schemas are developed consecutively and detailed in *RISE 23 Conceptual Schema in UML [3], RISE 25 Data Product Specification [4] and RISE26/35 GML Application Schema.* These deliverables describe the Application Schema, both in UML and GML, and these provide the machine-readable descriptions that are required to harmonize the heterogeneous data sources by means of the translating Web Feature Service and a multilingual feature catalogue specification.

The following OGC and ISO Documents are relevant for further development of the information viewpoint:

- ISO/TS 19103, Geographic Information – Conceptual Schema Language
- ISO 19109, Geographic Information – Rules for application schemas
- ISO 19131, Geographic Information – Data product specification
- Geography Markup Language, v 3.1.1, (= ISO 19136)
- “OGC GML Schema Maintenance and Tailoring Discussion Paper,” OGC Document 05-117, published 2006-05-02.
- UGAS Tool (OWS-3 GeoDSS IPR) (05-118)
- OWS-3 GML Performance Investigations (05-050 and 05-101)

3.3. Computational Viewpoint

The Computational Viewpoint of an architecture identifies services and service interaction patterns necessary to support the objectives of the Enterprise Viewpoint. We now concentrate on the Computational Viewpoint for the RISE Test Environment because describing the Computational Viewpoint of the other systems which may use the harmonised Data Product Specifications in the future is outside the scope of the RISE Project.

The computational viewpoint is concerned with the functional decomposition of the system into a set of services that interact at interfaces. This viewpoint captures the details of these components and interfaces.

The RISE 15 Methodology and Guidelines document [2] covers the information viewpoint, but does not address the computational viewpoint. It is highlighted in the document that the data product specification model of ISO 19131 could in principle be extended to cover both data and services, which in general are both required to fulfil all user requirements. However, this is beyond the scope of the RISE project, since the project focus is on data specification aspects.

The identified service requirements from the analysed Use Cases included the Web Mapping Service for general presentation and navigational purposes.

The main service used by RISE is the Web Feature Service (WFS); this is the key service interface for access to vector data. The challenge for these services is that they need to support translation capabilities to map between the harmonised application schema and the database schema of the existing datasets to be served through the WFS interface. This capability is often called “translating WFS”.

RISE also requires the use of a Web Coverage Service in order to be able to handle gridded DEM data.

The services utilised in the RISE Test Environment also includes a portrayal services (i.e. making use of a WMS). Transform services are also used internally within the test environments to provide the on-line generation of harmonised data products, but these are not offered as additional external services

The services provided will be outlined in more detail in Section 3.5 Technology.

In the context of architectures for GMES or INSPIRE a number of additional services may be required for a working infrastructure including registry and processing services.

The following OGC Documents may be of further relevance to the computational viewpoint:

- OGC Topic 12 – Services Architecture
- OWS Common
- Web Feature Service v1.1
- CIPI-TP WFS-X; Translating WFS.
- Data Aggregation Service
- Topology Service (to be developed in OWS-4)

3.4. Engineering Viewpoint

The Engineering viewpoint focuses on the mechanisms and functions required to support distributed interaction between objects in the system. It identifies specific components, services, datasets, tests, expected outcomes, etc. of the subsequent implementation. For RISE, these issues are addressed in the in the RISE Test Environment and will be documented in the *RISE 36 Final Report on capability of the Testing System* [8].

The following Figure illustrates the Engineering Viewpoint for the RISE Test Environment and this will be fully documented in the Testing System Document referred to above.

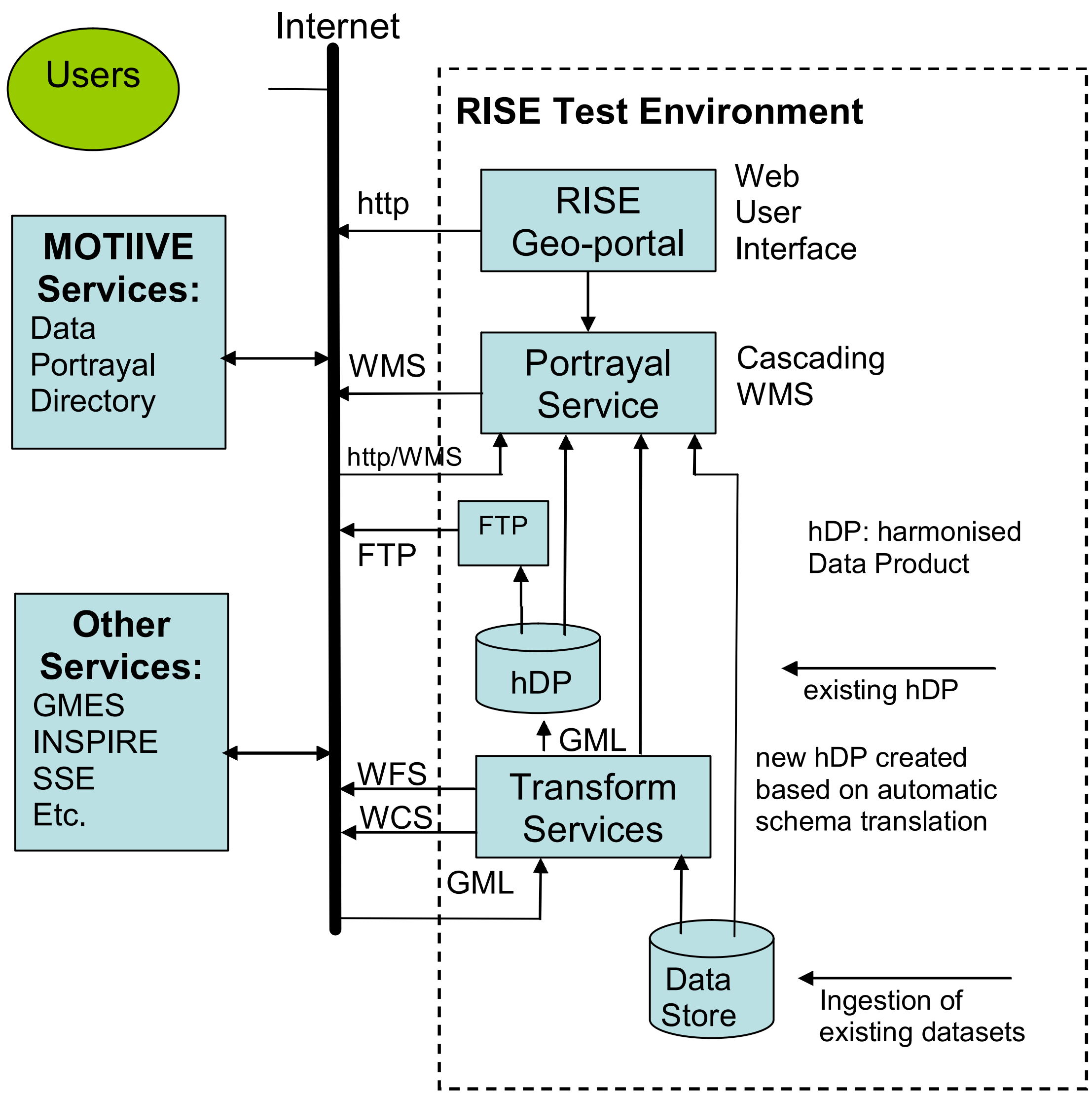

Figure 3.1. RISE Test Environment Engineering Viewpoint.

One of the main goals of the RTE is to demonstrate the "on-the-fly" creation of data products which conform to a harmonised data product specification. However, it is recognised that there may be an advantage in providing access to a pre-generated data product. An ftp service may therefore be included in the RTE to facilitate this aspect.

The *RISE 15 – Methodologies & Guidelines on Use Case and Schema Development* [2] describes components that will be required to support an operational ESDI. This ranges from identifier management, object classification, terminology dictionaries, multi-language definitions to a test for conformance. This effectively could result in a registry of active operational components in the ESDI, including compliant datasets, objects and who holds them, schema translations, etc. However, this aspect will not be addressed by the RISE implementation.

3.5. Technology Viewpoint

The Technology Viewpoint focuses on the choice of technology of the system and describes the technologies chosen to provide the processing, functionality and presentation of information.
The implementation and development of an operational testing environment is required to test the application schema and will be carried out in WP5.2. This includes the implementation of databases for existing data models, translating Web Feature Services, and development of Client Software Tools to aid in the testing process.

The main software components employed in the RISE Test Environment are shown in the following Table, together with their mapping to the main engineering components shown in Figure 3.1.

Software component	Corresponding Engineering Component
Oracle Database 10g	Data Store
Go Publisher (with WFS functionality) V1.2.2	Transform Services
Minnesota Map Server (WMS) 4.6	Portrayal Service
Minnesota Map Server (WCS) 4.6	Transform Services
Apache/Tomcat V4.1.3	Underlying http server
FTP Server –Fedora & Redhat	FTP Server
Java Technologies V1.4 and JSP.	Client for Portrayal Services

4. Conclusion

Describing information systems in terms of the five viewpoints proposed by the OpenGIS Reference Model ensures that all aspects of system modelling are addressed in a consistent manner. The process also aids understanding and interoperability between systems.

This document has used the RISE Use Cases and RISE Test Environment as an example to show the process in operation and highlight the relevant process steps and documentation that should be considered to analyse and document which impact the application of the RISE Methodology in any other given scenario can have.