Session 1 (PS5): General ideas of SISE

Architectural Viewpoints and Trends for the Implementation of the Environmental Information Space

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Outline

• Implementation of an environmental information space (here: SISE) needs an Architecture

• An architecture of such a complexity is typically specified from several Viewpoints.
  – Selection of architectural concepts and structuring rules
  – Focus on particular concerns within a system

• SISE Architecture needs to be specified in iterations
  – Architectural Trends to be considered for each iteration
IS Research Framework

[Hevner et al, 2004]

Organisational Infrastructure

Information System Infrastructure

Business Strategy

Information Technology Strategy

strategy alignment

organisational design activities

information system design activities

infrastructure alignment

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TOWARDS eENVIRONMENT
Challenges of SEIS and SISE: Integrating Environmental Knowledge in Europe
Prague, 25 March 2009
SISE: Business Strategy

**Business Strategy**
- policy directives
- open access

**Directives**
- SEIS – Shared Environmental Information System (announced for 2009)

**Business Context**
- GMES – Global Monitoring for Environment and Security
- GEOSS - Global Earth Observation System of Systems
SISE: IT Strategy

- Make environmental data available in a controlled and dependable fashion
  - collected in environmental monitoring and earth observation programs
  - at several organisational levels
  - for processing, information fusion, visualisation, reporting and decision support
- Consider also associated thematic domains such as health, security, commerce and transport
SISE: Organisational Design

Business Strategy
policy directives
open access

Organisational Infrastructure
• networks of stakeholders
  • e-Government

organisational
design
activities

Government to
Employee (G2E)
Citizen (G2C)
Business (G2B)

G2G
G2E
G2C
G2B

G2G
G2E
G2C
G2B

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SISE: Information System Design (1)

Information Technology Strategy
- SISE

Information System Infrastructure
- open architecture
- standards compliance

EIS

technical IIF

human IIF

sensors

environmental phenomena

observations

procedures
models

information system design activities
SISE: System of Systems Engineering Design Challenge (2)

Information Technology Strategy
• SISE

Information System Infrastructure
• open architecture
• standards compliance

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## ISO Reference Model for Open Distributed Processing

<table>
<thead>
<tr>
<th>Viewpoints applied to “services”</th>
<th>Enterprise</th>
<th>Information</th>
<th>Service</th>
<th>Technology</th>
<th>Engineering</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>documentation of the business strategy → functional, informational and qualitative requirements</td>
<td>modelling approach of categories of information including their thematic, spatial, temporal characteristics as well as their meta-data.</td>
<td>modelling approach of Interface and Service Types including their syntax (signature) and semantics (functional effects)</td>
<td>architectural choices of the service platform, its characteristics and operational issues</td>
<td>mapping to the chosen platform and operational policies</td>
</tr>
</tbody>
</table>

**Architectural Constraints → Requirements**

**ISO RM-ODP**

**Open Distributed Processing (ODP)**

**Object-oriented Middleware**

**ISO RM-ODP**
Evolution of Reference Models

OGC RM
- Geospatial Computing
- Geospatial Services

OGC RM-OA
- Environmental Risk Management
- Geospatial SOA

OGC SWE
- Sensor Web
  - Sensor SOA

Open Distributed Processing (ODP)
- Object-oriented Middleware

ISO RM-ODP

Service-Oriented Architecture (SOA)
- Web Services

OASIS RM-SOA

Semantic SOA
- Semantics

OASIS Reference Ontology
Architectural Trends (personal non-exhaustive selection)

• Design of Open Geospatial SOAs
  – mapping of requirements to the service platform
  – multi-platform architecture including “lightweight” Web services (RESTful services)
Two-level Architectural Approach (1)

Conceptual Architecture

Abstract
(= platform-neutral)

Abstract specs

Concrete
(= platform-specific)

Implementation specs

Implementation components

Implementation Architecture
Two-level Architectural Approach (2)

**Abstract**

(= platform-neutral)

**Concrete**

(= platform-specific)

**Conceptual Architecture**

**Implementation Architecture**

feature

service

interface

W3C Web services

OGC Web services
“Toolbox” for Thematic Services

Risk-neutral/
Risk-specific
Service/
Interface
Specs

e.g. Differential Risk
Map Calculation
Service

e.g. Translating
Feature Access
Service

parameter refinement

Interface
re-usage

The “interface” is the unit of reusability!

Service/
Interface
Specs

e.g. Schema
Mapping I/F

e.g. Feature
Access I/F

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Two-level Architectural Approach (3)

Abstract
(= platform-neutral)

Concrete
(= platform-specific)

Conceptual Architecture

Implementation Architecture

feature
service
resource
interface

W3C Web Services
OGC Web services
RESTful Web services
Resource-oriented Architectural Style: possible integration

Service

Interface

Operation

RESTful service as alternate service interface

resource-oriented description of service capabilities

Resource-oriented description of service capabilities

Service provides 1..* Interface

Interface has 1..* Operation

Operation accesses 0..* data

data

resource type

representation

representation

representation

resource type

representation
Architectural Trends (personal non-exhaustive selection)

- **Design of Open Geospatial SOAs**
  - mapping of requirements to the service platform
  - multi-platform architecture including “lightweight” Web services (RESTful services)

- **Governance of Open Service Platforms**
  - IT level: policy support for access control, discovery and service management
  - Organisational level: service level agreements
Security: Abstract Access Control Pattern [OASIS]
Security: Abstract Access Control Pattern [OASIS]

Policy Enforcement Point

Service

Policy Decision Point

Authorization Provider

Authentication Provider

Policy Information Point
Architectural Trends (personal non-exhaustive selection)

• Design of Open Geospatial SOAs
  – mapping of requirements to the service platform
  – multi-platform architecture including “lightweight” Web services (RESTful services)

• Governance of Open Service Platforms
  – IT level: policy support for access control, discovery and service management
  – Organisational level: service level agreements

• Semantic Interoperability
  – Exploitation of Semantic Web technologies
  – Role of complex Semantic Web Service frameworks (OWL-S, WSMO)?
  – W3C recommendation for Semantic Annotation of Web service descriptions (WSDL) and XML schemas (SAWSDL)
Semantic Interoperability Challenge (1)

Syntactical Interoperability

→ information access and exchange

→ discovery, analysis and fusion of information by humans
Semantic Interoperability Challenge (2)

→ Semantic Interoperability
→ information access and exchange
→ discovery, analysis and fusion of information by machines
Semantic Annotation based upon SAWSDL
Use of SAWSDL in Resource Discovery

Requested Service Type

Semantic Model

Advertised Service Type

SAWSDL doc

OWL doc

concept mapping

service matchmaking = reasoning in semantic model(s)
Conclusion of the Architectural Tour

• Implementation of the SISE needs an Architecture
• Typically to be specified from several viewpoints
• RM-ODP good candidate as a basis for a Reference Model of an SISE Architecture as used in
  – Open Geospatial Consortium (OGC) Reference Model
  – Environmental risk management (ORCHESTRA → RM-OA, SANY → SensorSA)
  – Earth observation (GEOSS, ESA Heterogeneous Mission Accessability - HMA)
  – Support action GIGAS (about harmonisation of initiatives)
• Co-development of SISE Architecture and Requirements required
  – Architectural trends to be considered when designing an SISE architecture
• Design of an SISE Architecture needs an iterative System of Systems Engineering approach
Thank you for your attention!

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