Use of the INSPIRE EF Data Specifications to develop the SEIS-Malta Geodatabase for the Air Quality data management

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Overview

• Introduction
• User requirements
• Air geodatabase design
  – Conceptual design
  – Matching tables
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Introduction

• SEIS-Malta system (Shared Environmental Information System (SEIS) and web-based GIS interface) forms part of a global project on environmental monitoring funded under the 2007-2013 Structural Funds Programme for Malta.

• The project “Developing national environmental infrastructure and capacity”, is co-financed by the European Regional Development Fund (ERDF) which provides 85% of the project’s funding and the Government of Malta, which finances the rest under Malta’s Operational Programme I - Cohesion Policy 2007-2013 “Investing in Competitiveness for a Better Quality of Life”.

Introduction

• The project is “aimed to radically improving the national environmental monitoring capacity in five environmental themes – air, water, radiation, noise and soil. It will result in the procurement of equipment, information management systems, environmental baseline surveys, training of staff, and the enhancement of the national monitoring programmes in these five environmental themes”.

• This presentation describes the activities accomplished for the design and development of the data model and associated Geodatabase for the AIR-theme of the SEIS-Malta system.
Introduction

Putting SEIS in action through putting INSPIRE in action?
User requirements

- The MEPA (Malta Environment & Planning Authority) overall system architecture to be used for the development of the SEIS-Malta is based on an ArcGIS Server platform and ArcSDE must be employed to manage the underlying geospatial data that will be stored in Microsoft SQL Server RDBMS.
AIR Geodatabase design

The AIR geodatabase has been designed according to the following steps, most of them carried out in parallel:

1. Analysis of the target Data Model (INSPIRE Environmental Monitoring Facilities Data Specifications v2.0)
2. Analysis of the Source Data (MEPA website + sample data provided by MEPA)
3. Conceptual design of the geodatabase according to INSPIRE EF Data Specification
4. Preparation and filling-in of the matching table
5. Creation of the geodatabase structure with ArcGIS Diagrammer
6. Import of the geodatabase in ArcGIS and SQLServer
Conceptual design of the geodatabase

Based on the results of the first two steps, the geodatabase structure has been designed considering the following aspects:

• to include all the INSPIRE EF elements for which a correspondence with the source data has been found
• to include all the additional element not existing in the INSPIRE EF data model but present in the source data
• to include the INSPIRE EF elements not existing in the source data
Conceptual design of the geodatabase

The INSPIRE Environmental Monitoring Facilities data model has been structured in order to be adapted to the modelling of different typologies of data.

In the AIR data modelling the following structure has been used:

- EnvironmentalMonitoringNetwork Feature Type, for the modelling of the measuring networks
- EnvironmentalMonitoringFacility Feature Type, for the data modelling of the Air Monitoring Stations
- EnvironmentalMonitoringFacility Feature Type, for the data modelling of the sensors installed on the stations
Conceptual design of the geodatabase

The data model provides the possibility to use the same feature type to model objects at different levels with the possibility to take into account the hierarchy, as in the case of stations and sensors.
Conceptual design of the geodatabase

- For the storage of the information of the measures, one table for each monitored pollutant has been created.
- All attributes and/or items with a multiplicity greater than one have been treated in separate tables, linkable to the feature type by means of joins using the unique ID.
Matching table

• After the design of the geodatabase conceptual schema, a matching table has been created, in order to map all the correspondences between the elements of the INSPIRE data model, of the source data and of the final geodatabase.
Matching table

- The matching table has been structured in the following three groups of columns:
  - Application Schema 'Environmental Monitoring Facilities', a group of columns containing the elements of the INSPIRE data model
  - Source location of information, a group of columns containing references to the location of the related information in the source data
  - Database mapping, a group of columns containing the mapping of the various elements in the final geodatabase
### Application Schema 'Environmental Monitoring Facilities' (version 2.0)

**Table:** Matching table

<table>
<thead>
<tr>
<th>Feature Type</th>
<th>Document Type</th>
<th>Attribute / Association role / Constraint</th>
<th>Data Type / Values / Code - List - Enumerations</th>
<th>Data Type / Attribute documentation</th>
<th>Data Type / Attribute Values / Code - List - Enumerations</th>
<th>Multiplicity</th>
<th>Validity</th>
<th>Non-Validity</th>
<th>Remarks</th>
<th>Action</th>
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</tr>
</tbody>
</table>

### Source location of information

**Table:**

<table>
<thead>
<tr>
<th>Name of attribute</th>
<th>Example of one data source</th>
<th>Remarks</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>

### Database mapping

**Table:**

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Example of one data target value</th>
<th>Remarks</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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*Note: The table above contains information on the attributes and data types related to the 'Environmental Monitoring Facilities' Application Schema.*

**Explanation:**

- **Environment Monitoring Network:** An administrative/organizational arrangement of environmental monitoring facilities managed the same way for a specific area. Each network respects common rules aiming at ensuring coherence of the observations, especially for purposes of Environmental Monitoring Facilities, mandatory parameters selection, measurement methods and sampling regime.

- **Title:** Matching table

- **Remarks:**
  - Voidable values are marked with an asterisk (*)
  - Unpopulated values are marked with an exclamation mark (!)

- **Action:**
  - *Add* (A)
  - *Delete* (D)
  - *Update* (U)
  - *Not applicable* (N/A)

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*Note: The table above contains information on the attributes and data types related to the 'Environmental Monitoring Facilities' Application Schema.*

**Explanation:**

- **Environment Monitoring Network:** An administrative/organizational arrangement of environmental monitoring facilities managed the same way for a specific area. Each network respects common rules aiming at ensuring coherence of the observations, especially for purposes of Environmental Monitoring Facilities, mandatory parameters selection, measurement methods and sampling regime.

- **Title:** Matching table

- **Remarks:**
  - Voidable values are marked with an asterisk (*)
  - Unpopulated values are marked with an exclamation mark (!)

- **Action:**
  - *Add* (A)
  - *Delete* (D)
  - *Update* (U)
  - *Not applicable* (N/A)
# Matching table

The cases indicated in the table below may occur:

<table>
<thead>
<tr>
<th>Groups of columns</th>
<th>Source location of information</th>
<th>Database mapping</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>Filled</td>
<td>Filled</td>
<td>Filled</td>
<td>INSPIRE EF elements for which a correspondence with the source data has been found and it has been mapped in the geodatabase</td>
</tr>
<tr>
<td>Filled</td>
<td>Empty</td>
<td>Filled</td>
<td>INSPIRE EF elements for which a correspondence with the source data has not been found but it has been mapped in the geodatabase</td>
</tr>
<tr>
<td>Empty</td>
<td>Filled</td>
<td>Filled</td>
<td>Additional element not existing in the INSPIRE EF data model but present in the source data and mapped in the geodatabase</td>
</tr>
<tr>
<td>Filled</td>
<td>Empty</td>
<td>Empty</td>
<td>INSPIRE EF elements not existing in the source data and not applicable</td>
</tr>
</tbody>
</table>
Physical geodatabase

- The physical geodatabase has been created using the visual editor ArcGIS Diagrammer, a tool allowing the creation of all the geodatabase elements (Feature Classes, Tables, Coded Value Domains, etc.).
- Once completed, the geodatabase structure has been exported as "XML Workspace Documents", an ESRI proprietary file format that allows to exchange and share geodatabase schemas. The "XML Workspace Document" file can be loaded in a SQL Server database, using an ArcSDE connection in ArcCatalog.
Next steps and open points

• To make a second loop as soon as the v3.0 of INSPIRE DS will be released …

• To wait for the finalisation of the “ingestion services”, under development by other members of the consortium, based on the actual structure of the geodatabase and making some process/transformation to ingest into the geodatabase the datasets, which are measurements coming from the field.

• To wait for the finalisation of the “reporting services”, under development by other members of the consortium, based on the actual structure of the geodatabase and making transformations to comply with the reporting obligations.
Next steps and open points

• To see if it is better to restructure the geodatabase in order to make it more close to the reporting obligations, but more distant from the INSPIRE DS (basically comparing the complexity of the transformations used by the reporting services vs. those used to match the INSPIRE DS).

• To start working on the other themes:
  – Water theme (bathing waters, inland surface waters, groundwaters)
  – Noise theme
  – Soil theme
  – Radiation theme
Conclusions

• Using a geodatabase to store environmental information is an operational need for the organizations aiming to effectively implement their data management workflows.

• On the other hand, a proper structure of the geodatabase will facilitate the INSPIRE compliance in terms of datasets interoperability.

• In order to have INSPIRE compliant datasets, it is convenient to replicate in the geodatabase the same structure contained in the INSPIRE gml application schema of the relevant data theme. In this way the subsequent transformation process from geodatabase to gml is an easy process.
Conclusions

Putting SEIS in action through putting INSPIRE in action?

It works!

Thank you

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