

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

G. Martirano¹, M. Bonazountas², S. Formosa³, M. Nolle⁴, E. Sciberras⁴, F. Vinci¹

¹Epsilon Italia

²Epsilon International

³University of Malta

⁴Malta Environment & Planning Authority



Overview

- Introduction
- User requirements
- Air geodatabase design
 - Conceptual design
 - Matching tables
 - Physical geodatabase
- Next steps and open points
- Conclusions

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

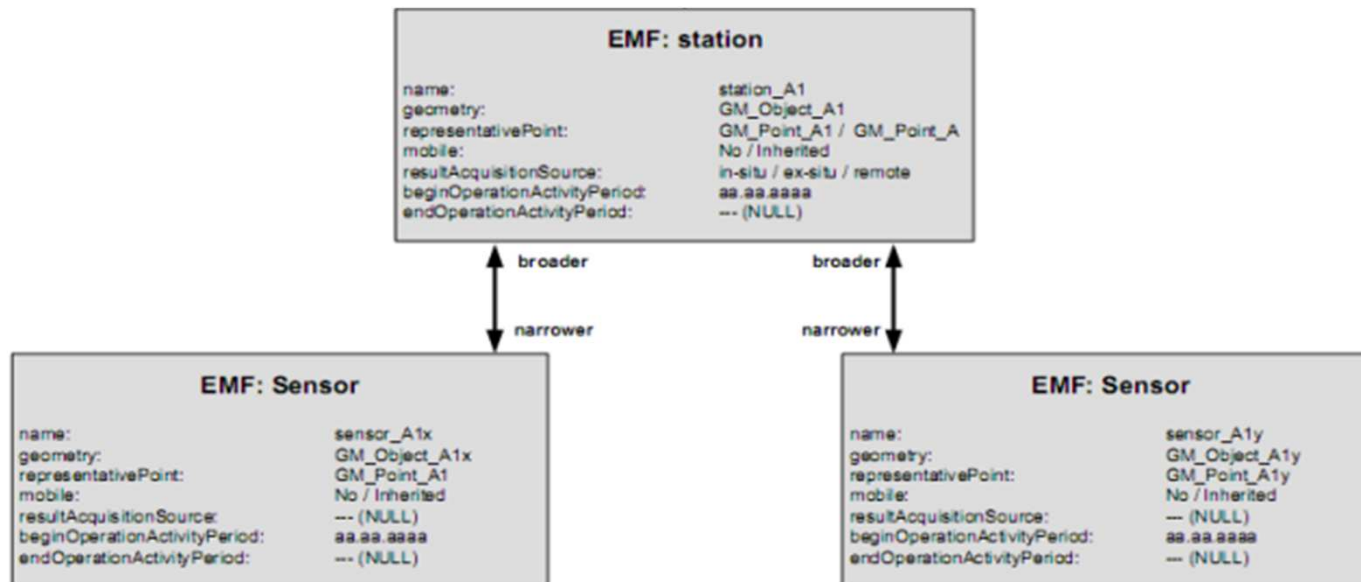
The INSPIRE Environmental Monitoring Facilities data model has been structured in order to be adapted to the modelling of different typologies of data.

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

Matching table

Application Schema 'Environmental Monitoring Facilities' (version 2.0)												Source location of information					Database mapping						
Feature Type	Document ation	Attribute / Association role / Constraint	Attribute / Association role / Constraint documentation	Data Type / Values / Code List - Enumerations	Multiplicity	Voidable / Non-Voidable	Data Type Attribute	Data Type Attribute documentation	Data Type / Values / Code List - Enumerations	Multiplicity	Voidable / Non-Voidable	"File name" or URL	Name of attribute	Example of one data source	Remarks	Action	Table	Attribute	Example of one data target value	Remarks	Action		
Environmental Monitoring Network <small>Supertypes: AbstractMonitoringFeature, AbstractMonitoringObject</small>	An Environmental Monitoring Network is an administrative/organisational grouping of Environmental Monitoring Facilities managed the same way for a specific purpose, targeting 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.	inspireId	External object identifier	Identifier	1		localId	A local identifier.	CharacterString	1		"Attard station"	Measuring networkable	Malta		Providing a unique value.	EMNetwork	inspireID_localId		Used the same value for the attribute "ID_net"			
		namespace		Namespace	1		namespace		CharacterString	1						Providing a unique value.	EMNetwork	inspireID_namespace					
		versionId		The identifier of the version	CharacterString	0..1	voidable	versionId		CharacterString	0..1	voidable						EMNetwork	inspireID_versionId				
		versionId_void		Reasons for void values.	VoidReasonValue * "Unknown n"			versionId_void		VoidReasonValue * "Unknown n"								EMNetwork	inspireID_versionId_void				
		name	Plain text denotation of the environmental monitoring	CharacterString	0..*			name		CharacterString	0..*							EMNetwork	name	Measuring networkable	Join between EMNetwork and Name tables by		
		additionalDescription	Plain text description of additional information not	CharacterString	0..1			additionalDescription		CharacterString	0..1			"Attard station"	Territorial coverage of	316 km2			EMNetwork	additionalDescription			
		legalBackground	The legal act, in which the management and regulation of the environmental monitoring	LegislationReference	0..*	voidable		legalBackground		LegislationReference	0..*	voidable	See Data Type sheet for references on LegislationReference	See Data Type sheet for references on LegislationReference	See Data Type sheet for references on LegislationReference	See Data Type sheet for references on LegislationReference	Join between EMNetwork and LegislationReference	EMNetwork	legalBackground_void				
		responsibleParty	Responsible party for the environmental monitoring object	CI_ResponsibleParty	0..*	voidable		responsibleParty		CI_ResponsibleParty	0..*	voidable		"Attard station"	Person in charge +	Michael Nolle + Unit D.			EMNetwork	respParty_*			
		responsibleParty_void		Reasons for void values.	VoidReasonValue * "Unknown n"			responsibleParty_void		VoidReasonValue * "Unknown n"									EMNetwork	respParty_void			
		beginLifespan	Begin of the lifespan of the digital object	DateTime	1	voidable		beginLifespan		DateTime	1	voidable							EMNetwork	beginLifespan			
		beginLifespan_void		Reasons for void values.	VoidReasonValue * "Unknown n"			beginLifespan_void		VoidReasonValue * "Unknown n"									EMNetwork	beginLifespan_void			
		endLifespan	End of the lifespan of the digital object	DateTime	0..1	voidable		endLifespan		DateTime	0..1	voidable							EMNetwork	endLifespan			
		endLifespan_void		Reasons for void values.	VoidReasonValue * "Unknown n"			endLifespan_void		VoidReasonValue * "Unknown n"									EMNetwork	endLifespan_void			
		geometry	Geometry associated to the environmental monitoring	GM_Object	0..1	voidable		geometry		GM_Object	0..1	voidable							EMNetwork	SHAPE			
		reportedTo	The Legal Act in which the Abstract Monitoring Feature is reported to	ReportToLegalAct	0..*	voidable		reportedTo		ReportToLegalAct	0..*	voidable	See Data Type sheet for references on ReportToLegalAct	See Data Type sheet for references on ReportToLegalAct	See Data Type sheet for references on ReportToLegalAct	See Data Type sheet for references on ReportToLegalAct	Join between EMNetwork and ReportToLegalAct	EMNetwork	reportedTo_void				
		reportedTo_void		Reasons for void values.	VoidReasonValue * "Unknown n"			reportedTo_void		VoidReasonValue * "Unknown n"									EMNetwork	reportedTo_void			
		hasObservation	The Observation(s) attached to the Abstract Monitoring Feature used	OM_Observation	0..*			hasObservation		OM_Observation	0..*								EMNetwork	broader			
		setUpFor	A link pointing to a broader definition of an AbstractMonitoringFeature	AbstractMonitoringFeature	0..1			setUpFor		AbstractMonitoringFeature	0..1								Hierarchy	narrower		Join between EMNetwork and Hierarchy tables by	
		observingCapability	A link pointing to a more detailed definition of an AbstractMonitoringFeature	AbstractMonitoringFeature	0..*			observingCapability		AbstractMonitoringFeature	0..*								OnlineResource	onlineResource		Join between EMNetwork and OnlineResource	
		broader	A link pointing to a more detailed definition of an AbstractMonitoringFeature	AbstractMonitoringFeature	0..*			broader		AbstractMonitoringFeature	0..*								EMNetwork	onlineResource_void			
narrower	A link pointing to a more detailed definition of an AbstractMonitoringFeature	AbstractMonitoringFeature	0..*			narrower		AbstractMonitoringFeature	0..*								EMNetwork	organisationalLevel					
onlineResource	A link to an external document providing further information on the Environmental Monitoring Facility	URI	0..*	voidable		onlineResource		URI	0..*	voidable							EMNetwork	organisationalLevel_void					
organisationalLevel	Level of organisation	LegislationLevelValue * "international" * "european" * "national" * "sub-national"	1	voidable		organisationalLevel		LegislationLevelValue * "international" * "european" * "national" * "sub-national"	1	voidable							Netw orkFacility	netw orkFacility_ID_sta		Join between EMNetwork and Netw orkFacility tables			
organisationalLevel_void		Reasons for void values.	VoidReasonValue * "Unknown n"			organisationalLevel_void		VoidReasonValue * "Unknown n"									Netw orkFacility	linkingTime_begin + linkingTime_end		Join between EMNetwork and Netw orkFacility tables			
contains	A link pointing to all Environmental Monitoring Facilities	EnvironmentalMonitoringFacility	0..*			contains		EnvironmentalMonitoringFacility	0..*								Netw orkFacility	linkingTime_void		Join between EMNetwork and Netw orkFacility tables			
linkingTime	Lifespan of the link between Environmental Monitoring	TM_Object	1	voidable		linkingTime		TM_Object	1	voidable							Hierarchy	linkingTime_begin + linkingTime_end		Join between EMNetwork and Hierarchy tables by			
linkingTime_void		Reasons for void values.	VoidReasonValue * "Unknown n"			linkingTime_void		VoidReasonValue * "Unknown n"									Hierarchy	linkingTime_void		Join between EMNetwork and Hierarchy tables by			
linkingTime	Lifespan of the hierarchical link between Environmental	TM_Object	1	voidable		linkingTime		TM_Object	1	voidable							Hierarchy	linkingTime_void		Join between EMNetwork and Hierarchy tables by			
linkingTime_void		Reasons for void values.	VoidReasonValue * "Unknown n"			linkingTime_void		VoidReasonValue * "Unknown n"									Hierarchy	linkingTime_void		Join between EMNetwork and Hierarchy tables by			

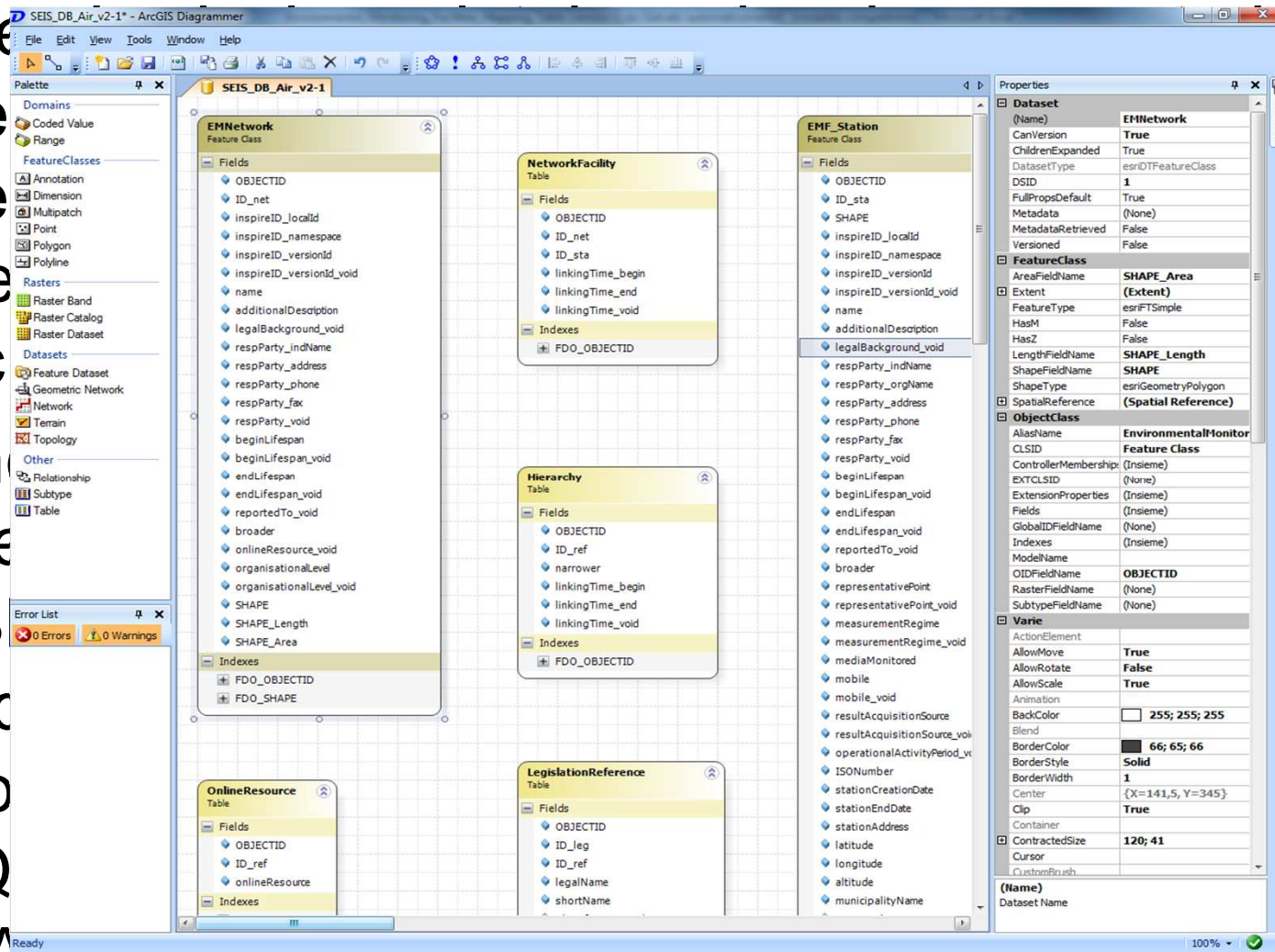
Matching table

The cases indicated in the table below may occur:

Groups of columns			Note
Application Schema 'Environmental Monitoring Facilities'	Source location of information	Database mapping	
Filled	Filled	Filled	INSPIRE EF elements for which a correspondence with the source data has been found and it has been mapped in the geodatabase
Filled	Empty	Filled	INSPIRE EF elements for which a correspondence with the source data has not been found but it has been mapped in the geodatabase
Empty	Filled	Filled	Additional element not existing in the INSPIRE EF data model but present in the source data and mapped in the geodatabase
Filled	Empty	Empty	INSPIRE EF elements not existing in the source data and not applicable

Physical geodatabase

- The the the the (Feature Class) etc
- Once been ES and Wo SQ in ArcCatalog.



using following
 gains,
 has
 its", an
 change
 section

Next steps and open points

- To make a second loop as soon as the 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

g.martirano@epsilon-italia.it