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

G. Martirano[1], M. Bonazountas[2], S. Formosa[3], M. Nolle[4], E. Sciberras[4], F. Vinci[1]

[1]*Epsilon Italia*

[2]*Epsilon International*

[3]*University of Malta*

[4]*Malta Environment & Planning Authority*

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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

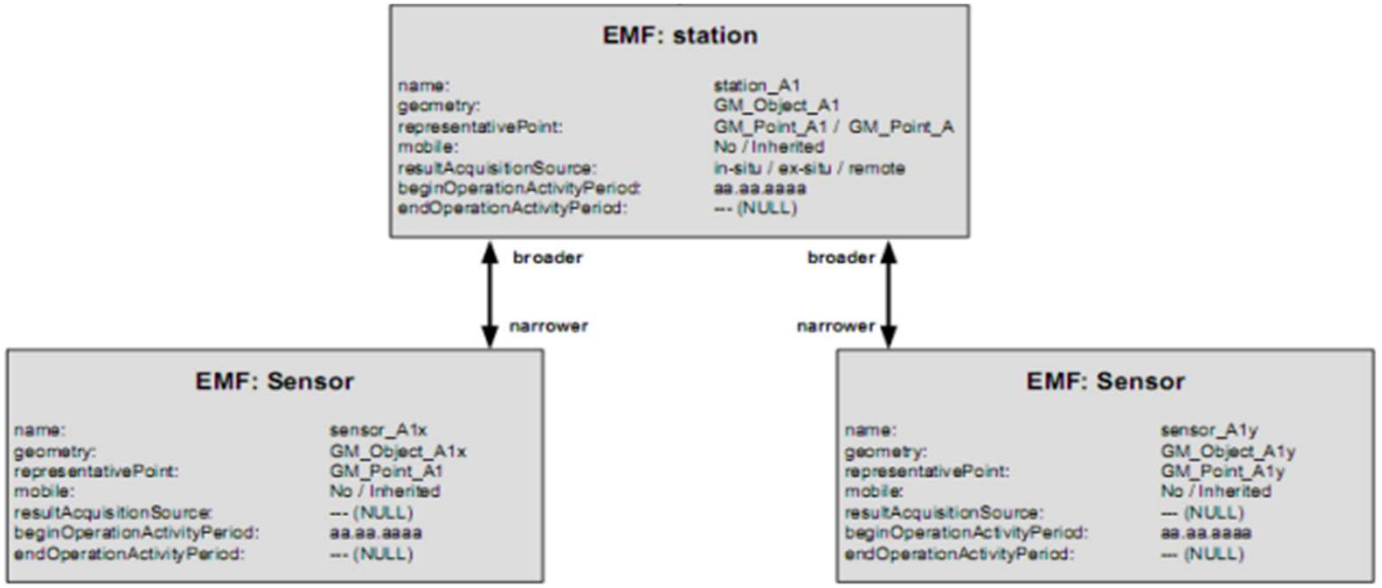
The INSPIRE Environmental Monitoring Facilities data model has been structured in order to be adapted to the modelling of different typologies of data.

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

Matching table

Application Schema 'Environmental Monitoring Facilities' (version 2.0)												Source location of information					Database mapping				
Feature Type	Documentation	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
EnvironmentalMonitoringNetwork Supertypes: *AbstractMonitoringFeatureAbstractMonitoringObject*	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	I. Measuring networks\Ne	Malta		Providing a unique	EMNetwork	inspireID_localId		Used the same value for the attribute "ID_ref"	
							namespace	Namespace	CharacterString	1						Providing a correct	EMNetwork	inspireID_namespace			
							versionId	The identifier of	CharacterString	0..1	voidable						EMNetwork	inspireID_versionId			
							versionId_void	Reasons for	VoidReasonValue * Unknown*								EMNetwork	inspireID_versionId_void			
		name	Plain text denotation of the environmental monitoring	CharacterString	0..*												EMNetwork	name	Measuring networks	Join between EMNetwork and Name tables by	
		additionalDescription	Plain text description of additional information not	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	See DataType sheet for references on LegislationReference DataType					See DataType sheet for references on LegislationReference DataType					See DataType sheet for references on LegislationReference DataType			Join between EMNetwork and LegislationReference	
							legalBackground_void	Reasons for void values.	VoidReasonValue * Unknown*								EMNetwork	legalBackground_void			
		responsibleParty	Responsible party for the environmental monitoring object	CI_ResponsibleParty	0..*	voidable						"Attard station	Person in charge +	Michael Nolle + Unit D,			EMNetwork	respParty_*			
							responsiblePartY_void	Reasons for void values.	VoidReasonValue * Unknown*								EMNetwork	respParty_void			
		beginLifespan	Begin of the lifespan of the digital object	DateTime	1	voidable											EMNetwork	beginLifespan			
							beginLifespan_void	Reasons for void values.	VoidReasonValue * Unknown*								EMNetwork	beginLifespan_void			
		endLifespan	End of the lifespan of the digital object	DateTime	0..1	voidable											EMNetwork	endLifespan			
							endLifespan_void	Reasons for void values.	VoidReasonValue * Unknown*								EMNetwork	endLifespan_void			
		geometry	Geometry associated to the environmental	GM_Object	0..1												EMNetwork	SHAPE			
		reportedTo	The Legal Act which the Abstract Monitoring Feature is reported to	ReportToLegalAct	0..*	voidable	See DataType sheet for references on ReportToLegalAct DataType					See DataType sheet for references on ReportToLegalAct DataType					See DataType sheet for references on ReportToLegalAct DataType			Join between EMNetwork and ReportToLegalAct	
							reportedTo_void	Reasons for void values.	VoidReasonValue * Unknown*								EMNetwork	reportedTo_void			
		hasObservation	The Observation(s) attached to the Abstract	OM_Observation	0..*																
		setUpFor	Specific set of Abstract Monitoring Features used	EnvironmentalMonitoring Program	0..*																
		observingCapability	A link pointing to the explicit capability of an	ObservingCapability	0..*																
		broader	A link pointing to a broader definition of an Abstract	AbstractMonitoringFeature	0..1												EMNetwork	broader			
		narrower	A link pointing to a more detailed definition of an	AbstractMonitoringFeature	0..*												Hierarchy	narrower		Join between EMNetwork and Hierarchy tables by	
		onlineResource	A link to an external document providing further information on the Environmental Monitoring	URI	0..*	voidable											OnlineResource	onlineResource		Join between EMNetwork and OnlineResource	
							onlineResource_void	Reasons for void values.	VoidReasonValue * Unknown*								EMNetwork	onlineResource_void			
		organisationalLevel	Level of organisation	LegislationLevelValue * international* european* national* sub-national	1	voidable											EMNetwork	organisationalLevel			
							organisationalLevel_void	Reasons for void values.	VoidReasonValue * Unknown*								EMNetwork	organisationalLevel_void			
		contains	A link pointing to all Environmental Monitoring	EnvironmentalMonitoring Facility	0..*												NetworkFacility	ID_sta		Join between EMNetwork and NetworkFacility tables	
NetworkFacility	Lifespan of the link between Environmental Monitoring	**linkingTime**	Lifespan of the link	TM_Object	1	voidable											NetworkFacility	linkingTime_begin + linkingTime_end		Join between EMNetwork and NetworkFacility tables	
							linkingTime_void	Reasons for void values.	VoidReasonValue * Unknown*								NetworkFacility	linkingTime_void		Join between EMNetwork and NetworkFacility tables	
Hierarchy	Lifespan of the hierachical link between Environmental	**linkingTime**	Lifespan of the link	TM_Object	1	voidable											Hierarchy	linkingTime_begin + linkingTime_end		Join between EMNetwork and Hierarchy tables by	
							linkingTime_void	Reasons for void values.	VoidReasonValue * Unknown*								Hierarchy	linkingTime_void		Join between EMNetwork and Hierarchy tables by	

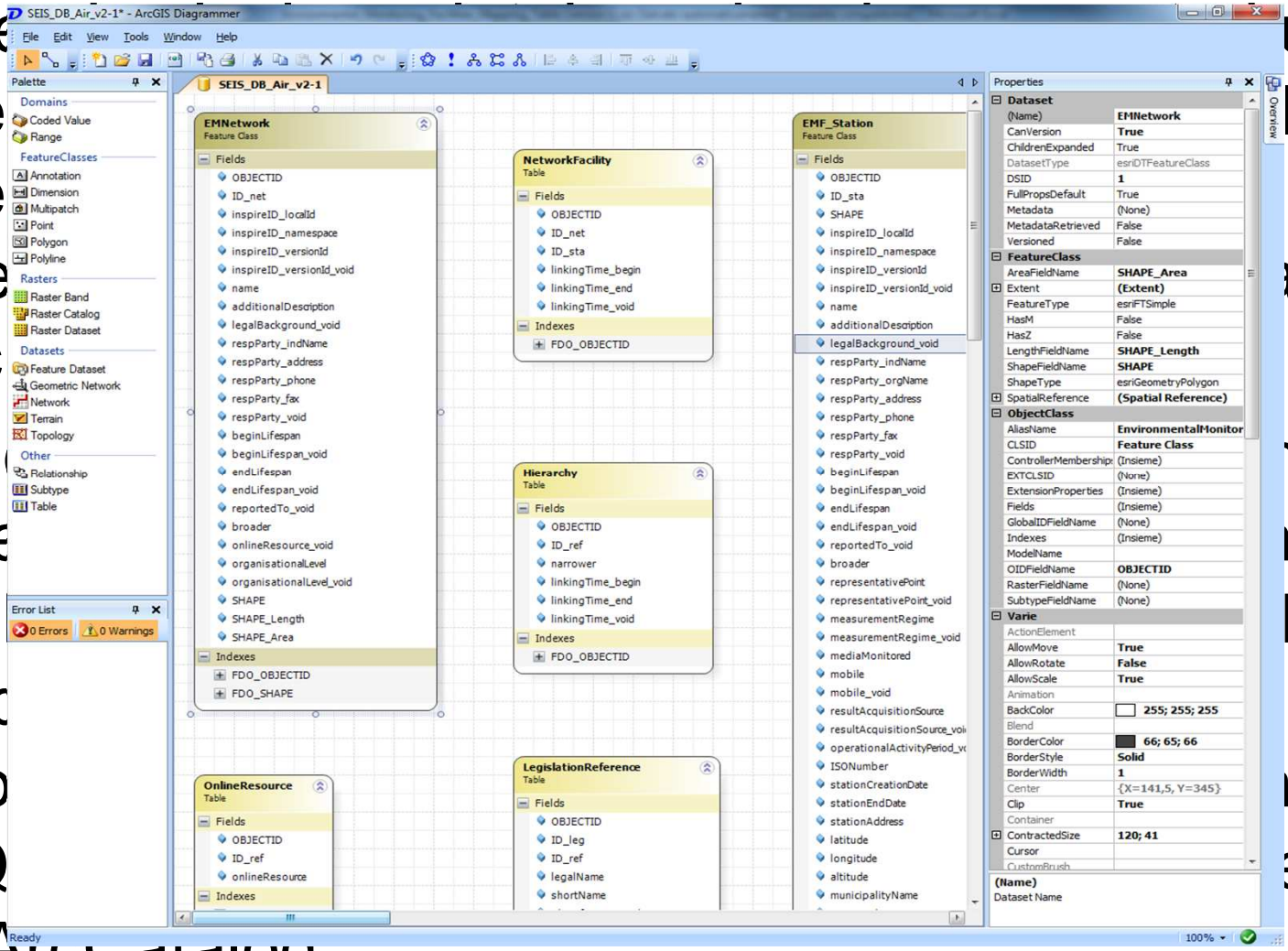
Matching table

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 [illegible] using the [illegible] llowing the [illegible] (Fe[illegible]ains, etc[illegible]
- On[illegible] has bee[illegible]ts“, an ES[illegible] hange and Wo[illegible] SQ[illegible]ection in ArcCatalog.



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