

Examples of Data Transformation



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Introduction

This self-learning module provides an example of transformations of a source dataset into a dataset compliant to the technical requirements of the relevant Implementing Rules and Technical Guidelines of INSPIRE.

It shows, step by step, a schema transformation process, starting from the analysis of the source dataset and of its data model and the study of the applicable INSPIRE Data Specification.

The module shows the use of the mapping table as useful tool to document the mapping process between the elements of the source dataset and the INSPIRE data model elements and explains how to identify and solve some common mapping problems.

Through the use of a selected tool, the transformation process is practically explained, showing also the "live" validation of the mapping being performed against the relevant INSPIRE application schema. At the end, a demonstration is given of how to generate a harmonized GML dataset.



Learning outcomes:

After the module, the participant will be able to

- Identify and understand the source and target data models
- Fill in a mapping table
- Perform a data transformation from a non-harmonized source dataset
 into a harmonized dataset
- Export a harmonized dataset into a harmonized GML dataset file.

Intended Audience:

GIS and ICT professionals aiming to harmonize their datasets against INSPIRE Data Specifications.

Pre-requisites:

- Basic knowledge of INSPIRE Directive.
- Module "Procedures for Data and Metadata Harmonization".



Referenced files:

- 1. Com2011.shp: a sample dataset of Italian municipalities.
- 2. ID_table.csv: table associating dataset of municipalities to related boundaries.
- **3. AU_Mapping_Table.xls**: INSPIRE mapping table (extended and filled in).
- **4.** AdministrativeUnit.halez: Hale project covered by present training module. The *.halez* file contains the complete project i.e. source and target schemas, source data and alignment.
- **5. AdministrativeUnit.gml**: INSPIRE compliant gml dataset file, obtained by means of the data transformation described in this training module.

Referenced transformation tool:

 HUMBOLDT Alignment Editor (HALE) downloadable at <u>http://www.esdi-community.eu/projects/hale/files</u>



Summary

- Source Data Model
- Target Data Model
- Mapping table: instruction for use
- Common mapping problems
- Open source Hale transformation tool
- Data Transformation
- Data Validation
- Creation and validation of a harmonized GML dataset.



Source Data Model



Source Data Model

Here follows a list of the attributes of the dataset of Italian municipalities (com2011.shp) which represents our source data model.

Attributi dei Comuni: shapefile poligonale "com2011"

Campo	Definizione
COD_REG	Codice ISTAT della Regione
COD_PRO	Codice ISTAT della Provincia
PRO_COM	COD_PRO e COD_COM concatenati
NOME_COM	Denominazione del Comune
NOME_TED	Denominazione, in lingua tedesca, dei Comuni della Provincia autonoma di Bolzano/ <i>Bozen</i>



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Target Data Model

Among the Data Themes identified by the INSPIRE Directive, the Administrative Units one is the most suitable for the transformation of a dataset of municipalities.

Our Target Data Model is described in the INSPIRE Data Specification for the spatial data theme Administrative Units and can be downloaded from the INSPIRE website.



Target Data Model

At the INSPIRE website the Data model is available in different formats: UML, HTML, Mapping table and GML Application schemas (XSD files).





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Attributes of the com2011 shapefile shall now be mapped into corresponding attributes of the Administrative Unit Feature Type. In this process the use of mapping tables available at the INSPIRE website could be very handy.

In the case of our exercise we need to download the AdministrativeUnits Mapping Table.xml file, which contains a list of the feature types, data types and code lists associated to our target model and related attributes. Associations between feature types are described as well.

More detailed description of how to download mapping tables can be found in the module "Procedures for Data and Metadata Harmonization".



	Α	pplication Schem	a 'Administrative	Units' (version 3	.0)			
Туре	Documentation	Attribute Associa tion	Attribute / Association role /	Values / Enumerations	Multiplicity	Voidable / Non- Voidable		Туре
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dary	administrative boundary Aline of demarcation	beginLifespanVersi	Name begin	DateTime	1	voidable		
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		geometry	Name geometry	GM_Curve	1			
		inspireld	Name inspire id	Identifier	1			
		legalStatus	Name legal status	LegalStatusValue*	1	voidable		
		nationalLevel	Name national	AdministrativeHierarchyL	16			
		technicalStatus	Name technical	TechnicalStatusValue	1	voidable		
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AdministrativeUnit	Name							
	administrative unit Unit of administration	beginLifespanVersi	Name begin	DateTime	1	voidable	-	
	where a Member State	country	Name country	CountryCode* BE*	1			
	has and/or exercises jurisdictional rights, for	endLifespanVersio	Name end lifespan	DateTime	01	voidable	-	
	local, regional and	geometry	Name geometry	GM_MultiSurface	1			
	national governance.	inspireld	Name inspire id	Identifier	1			
		name	Name name	GeographicalName	1*			
		nationalCode	Name national	CharacterString	1			
		nationalLevel	Name national	AdministrativeHierarchyL	1			
		nationalLevelName	Name national level	LocalisedCharacterString	1*	voidable		
		residenceOfAuthori	Name residence of	ResidenceOfAuthority	1*	voidable		
		condominium	Name	Condominium	0*	voidable		
		boundary	Name boundary	AdministrativeBoundary	1*	voidable		
		lowerLevelUnit	Name Iower level	AdministrativeUnit	0*	voidable		



	Α	pplication Schem	a 'Administrative	Units' (version 3	.0)		
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		condominium	Name	Condominium	0*	voidable	
		boundary	Name boundary	AdministrativeBoundary	1*	voidable	
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	administration where a Member	beginLifespanVersion	Name begin lifespan version	DateTime	1	voidable							
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		upperLevelUnit	Name upper level	AdministrativeUnit	01	voidable		See Administr	ativeUnit feature typ	е	
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	grammaticalNumber	01							singular		
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Matching Table	Data Type										
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Common Mapping problems

While filling in the mapping table we realise we are not able to map the association between the Administrative Unit feature type and the Administrative Boundary feature type, as we have no information in our source dataset (no shapefile nor table) linking municipalities to related boundaries.



Common Mapping problems

In the case of this example we created the dataset of boundaries using GIS tools capabilities on com2011.shp file (splitting the perimeter of the polygons into polylines). For convenience of use we also created a table to associate municipalities to their boundaries i.e. Administrative Unit Ids (PRO_COM field) to related boundaries IDs (ID_Boundary field).

А	В	С	D	E	F	G	Н	1	
N_ID_Boundary	PRO_COM	NOME_COM	ID_Boundary						
6	76070	Rotonda	Boundary_78083_76070						
3	78136	Saracena	Boundary_78083_78136						
7	76028	Chiaromonte	Boundary_78083_76028						
5	76097	Viggianello	Boundary_78083_76097						
1	78033	Castrovillari	Boundary_78083_78033						
4	78084	Mormanno	Boundary_78083_78084						
2	78111	San Basile	Boundary_78083_78111						
6	78083	Morano Calabro	Boundary_78083_76070						
3	78083	Morano Calabro	Boundary_78083_78136						
7	78083	Morano Calabro	Boundary_78083_76028						
5	78083	Morano Calabro	Boundary_78083_76097						
1	78083	Morano Calabro	Boundary_78083_78033						
4	78083	Morano Calabro	Boundary_78083_78084						
2	78083	Morano Calabro	Boundary_78083_78111						



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HALE transformation tool

The mapping between source and target properties defined in the matching tables can now be used to set the encoding rules needed to obtain an harmonized dataset by means of a software transformation tool.

Among the many available software, in the case of this example focus has been given to open source tool HALE (HUMBOLDT Alignment Editor), to define and evaluate conceptual schema mapping and to transform geodata based on these mapping.

http://hale.igd.fraunhofer.de/2.8.0/help/index.jsp



HALE transformation tool

The general workflow for transforming source data according to target schema using the HALE tool is as follows:

- Load the schema of the source data
- Load the target schema
- Load the source dataset
- Operate the mapping
- Save the transformed data to a GML file.
- Validate harmonized GML dataset.



Set up the project in HALE

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Import source and target schema

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Import source data

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Import target schema

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The Hale Workbench: the Default perspective





The Hale Workbench: the Data perspective

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SME / SPIRE

Type Relations





The Join function

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Mapping the association between municipality and its boundaries

To map the association between the Administrative Unit feature type and the Administrative Boundary feature type (i.e. to link each municipality to its boundaries) we have to link the *href* attribute of the *boundary* element in the Administrative Unit feature type to the ID of the boundary contained in the ID_table.





Mapping the association between municipality and its boundaries

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Complete Hale project



Summary

- Introduction
- Source Data Model
- Target Data Model
- Mapping table: instruction for use
- Common mapping problems
- Open source Hale transformation tool
- Data Transformation
- Data Validation
- Creation and validation of a harmonized GML dataset.

Data Validation in Hale

When targeting a specific schema, HALE verifies that your transformation result follows the target schema's structure (i.e. performs a schema validation). Moreover HALE checks whether your mapping follows some of the constraints defined by the schema, like mandatory properties and restrictions on property values.

Validation of instances in HALE is currently supported for XML based schemas and can be performed:

 \succ on the transformed instances available in the mapping phase ('live' validation)

> on the exported transformation result (validation of 'exported data')

Summary

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Export transformed data into a GML dataset file

Validate GML dataset file

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