Harmonizing geospatial data at the local level for global benefit: HUMBOLDT Urban Atlas – a case study

Z Khan*, C Giger+, J Althoff+, D Ludlow*
* University of the West of England, Bristol, UK
+Swiss Federal Institute of Technology, Zurich, Switzerland

Context:

One of the major requirements for the realization of an integrated environmental monitoring system is the availability of tools and services to harmonize and integrate environmental spatial data, originating from various governmental and other agencies connected horizontally at the local level, using standards like INSPIRE, OGC, etc. Equally, the flow of information across the levels of governance in a vertical perspective from local, to regional, national and EU levels, particularly in relation to the fulfilment of specific EU reporting and monitoring requirements, is a further major focus for the development of tools and services for data harmonization.

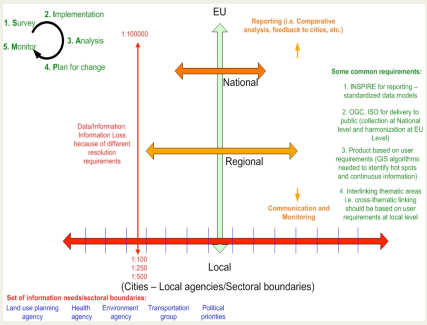

Figure 1: Horizontal and Vertical Integration

The HUMBOLDT Project:

The FP6 HUMBOLDT project provides various INSPIRE and OGC compliant state-of-the-art harmonization tools and services (e.g. Humboldt Alignment Editor (HALE), Conceptual Schema Transformation (CST), etc) establishing a platform for developing cross-thematic harmonized environmental applications. These HUMBOLDT tools and services are applied to various environmental scenarios from the GMES domain, where they are developed in respect of real-life use cases with the objective to demonstrate the effectiveness of the HUMBOLDT framework and compliance to INSPIRE and OGC standards.

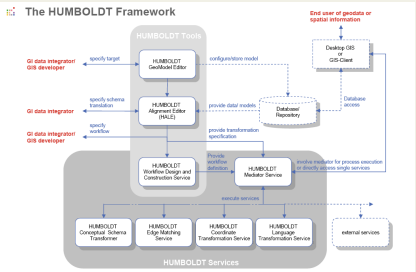

Figure 2: The HUMBOLDT Framework
Source: http://www.esdi-humboldt.eu/home.html

Acknowledgments:

This work was partly funded by the EC FP6 HUMBOLDT project. We acknowledge the support from the HUMBOLDT Consortium and especially to the following main contributors of the HUMBOLDT Urban Atlas scenario:
- University of the West of England, Bristol, UK.
- Environmental Studies Centre, Vitoria-Gasteiz, Spain
- ETHZ – Swiss Federal Institute of Technology, Zurich, Switzerland
- Indra Espacio, Madrid, Spain

HUMBOLDT Scenarios:

HUMBOLDT Scenarios represent real-life domain specific applications used to define user perspectives for the development of the HUMBOLDT Framework tools and services.

Figure 3: The HUMBOLDT Scenarios
Source: http://www.esdi-humboldt.eu/scenarios.html

Case Study: The Urban Atlas Scenario:

Urbanisation processes not only in Europe but also globally, are a major force for socio-economic evolution generating significant environmental impacts. The complex and inter-related drivers of change at the urban level that fuel the urbanisation process create adverse human health outcomes, biodiversity loss, and urban sprawl, which in turn exacerbates climate change.
The HUMBOLDT Urban Atlas scenario addresses some of these issues. The HUMBOLDT Urban Atlas scenario is an attempt to mitigate the cross-thematic harmonization challenges providing the key to unlock the prime concerns of the policy end user to secure integrated intelligence that is critical to effective decision-making and policy integration.
The HUMBOLDT Urban Atlas scenario demonstrates how non-standardized spatial environmental data from the Sustainable Observatory of the city of Vitoria-Gasteiz (CEA) becomes compliant with European standards using the HUMBOLDT framework, providing interoperable communication with other European Spatial Data Infrastructures (ESDIs) and generating new environmental indicators at the local level.

Urban Atlas User Requirements:

CEA operated an environmental information system (SI@M) from 1990, using proprietary ESRI ArcGIS software. Today, CEA faces new challenges to enhance effective integration in the decision-making and participatory processes, to adapt to the new technological and legal scenarios arising from the INSPIRE Directive, and to progress from environmental towards sustainable development in line with the EU Urban Thematic Strategy. In the Urban Atlas Scenario two major use cases were derived directly from CEA requirements.

- The first use case transforms existing metadata for environmental geodata in SI@M according to national (in this case - NEM - "Núcleo Español de Metadatos") and EU (e.g. INSPIRE) standards by maintaining the complete information of the existing SI@M metadata as basis for new interfaces and especially to provide OGC catalogue interface.
- The second use case concerns the usage of different locally available data sets from various sources for the generation of indicators for monitoring and assessment of the Sustainable Mobility and Public Space Plan of Vitoria-Gasteiz.

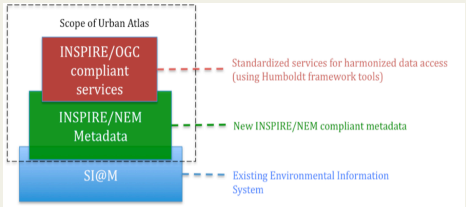

Figure 4: Scope of the HUMBOLDT Urban Atlas Scenario

Use Case 1:

HALE is used as the mapping solution because:
- it offers all required mapping options for harmonizing spatial and non-spatial data, and
- offers simplified handling and reduced effort in training various stakeholders such as data custodians and integrators.

Rigorous conceptual mapping between SI@M, NEM and INSPIRE ISO 19115 profile was defined.
Significant pre-processing was required for SI@M data cleaning to make it suitable to be used in HALE for the following reasons:
- poor documentation of data,
- incomplete data structure,
- no referential integrity constraints,
- data delivery in various formats e.g. MS Access database without XML schema, etc.

This process led to the definition of a generic process to preprocess the data with following steps:
i) Analysis and rebuilding,
ii) Export to XML and schema creation, and
iii) Manipulation of the generated XML schema.

After this, mapping in HALE is performed for the generated export target ISO-19139 compliant schema so that further transformation and processing can be undertaken.

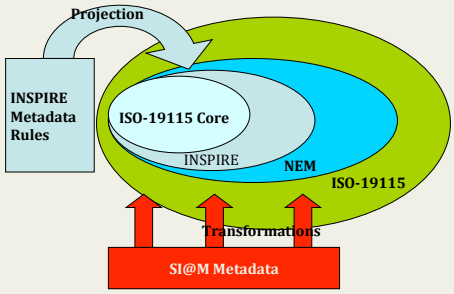

Figure 3: SI@M, INSPIRE and NEM relationship

Use Case 2:

In relation to the second use case of the Urban Atlas scenario, SI@M does not offer INSPIRE/OGC compliant downloading, viewing, processing and cataloguing services (e.g. WFS, WMS, WPS, WCS) depriving it of a minimal interoperability with other ESDIs.
As part of HUMBOLDT Urban Atlas scenario development, various mobility indicators such as proximity to the pedestrian network, proximity to the public transport network and proximity to the bike network were considered for prototype implementation where data for the above indicators originates from various local data sources (e.g. Municipal Census Bureau, TUVISA, IT Department of Municipality, etc.).
The processing of the indicators was implemented using web processing service interface of 52North with the objective to utilise the outputs in other on-going projects in Vitoria-Gasteiz.

Conclusions:

In conclusion, it is anticipated that there will be many similar or and even more complex examples in various other European cities, in which effective decision making is blocked by unstructured data, no metadata, missing information, etc.
In such circumstances the HUMBOLDT Urban Atlas scenario results offer an excellent example of how to undertake the necessary processing steps to secure compliance to INSPIRE and OGC standards using the HUMBOLDT Framework at the local level, and to facilitate information flows vertically across the various levels of governance from National to EU.
The Urban Atlas scenario demonstrates that the HUMBOLDT Framework provides all the necessary tools and services for data harmonization, even if, some processing tasks are still work in progress for the HUMBOLDT Framework.

FP6 HUMBOLDT Project (2006-2011)
Contact: David Ludlow David.Ludlow@uwe.ac.uk
Faculty of Environment and Technology,
University of the West of England, BS16 1QY, Bristol, United Kingdom