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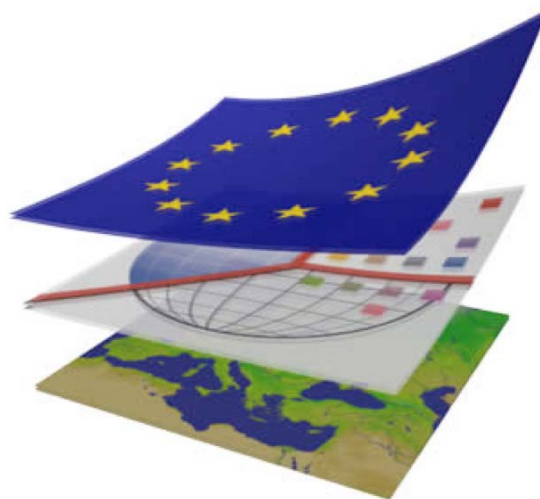
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1. Introduction

HUMBOLDT is a 6th Framework Programme EU project that aims to facilitate cross-national harmonisation of spatial data. Its project coordinator is the Fraunhofer Institute for Computer Graphics Research (IGD), Germany. HUMBOLDT started in October 2006 and runs for four years. In this project 28 partners from 14 European countries collaboratively work on the development of IT solutions to support the harmonisation of spatial data to be used within Spatial Data Infrastructures (SDIs). In HUMBOLDT harmonisation is understood as a process of transforming the available geodata (Spatial Data Infrastructures) into informations, that can be used across various applications and information products (Geo Information Infrastructure).



The project is funded by the GMES (Global Monitoring for Environment and Security) programme and aims at supporting the implementation of the European Directive INSPIRE in GMES-related applications.

The reason why Alexander von Humboldt was chosen as eponym is that his primary aim was to integrate the knowledge of his time to gain new insights and to further all areas of science. Consequently, the project aims to provide solutions that simplify the usage of spatial data wherever requested. It is the intention of HUMBOLDT to base on existing know-how within and outside the GI community (hence the project's philosophy is: *REUSE the existing, EXTEND by need, ARRIVE at the ESDI and PROSPER by application*) to manage and advance the implementation process of a European Spatial Data Infrastructure.

This integrated network of systems providing data and services will allow the sustained use of existing services as well as the development of new applications and business models. The availability of data is – des-

pite ongoing efforts – still highly scattered and heterogeneous. A harmonisation can contribute to the creation of new knowledge by combining data that previously could not be integrated at all – or only with prohibitive high effort. Also, entire new processes replacing complicated existing activities and being of higher efficiency can be developed on the basis of the envisaged system.

HUMBOLDT aims at contributing to the implementation of a European Spatial Data Infrastructure (ESDI) that integrates the diversity of spatial data available for a multitude of European organisations. High-quality and easily accessible geoinformation will deliver enormous value to different fields of application in politics, government, research and business. The implementation of Spatial Data Infrastructures tries to open the potentials resulting from this situation. The software tools and processes created will support the feasibility and advantages of an Infrastructure for Spatial Information in Europe as planned by the INSPIRE initiative, meeting the goals of Global Monitoring for

Environment and Security (GMES). An essential element of the HUMBOLDT project is the development of user-driven, cross-border, GMES-related application scenarios where the different components are applied and tested under realistic conditions. They will use data themes from the INSPIRE Annexes in their use cases and apply INSPIRE Implementing Rules wherever possible. Moreover, the scenarios are used to provide clear and realistic requirements for the development of software tools and components to support spatial data harmonisation processes. The first two years of HUMBOLDT already led to several major results:

As key result, a framework was implemented, which supports the search for existing data and transformations according to given information product specifications. The selected subset covers the necessary harmonisation processes to integrate geodata acquired for one particular use into several fields of application. Based on the model-driven architecture and approach of this framework, a model editor is currently under development, with the purpose of complete and easy specification of data schemas. In accordance to this

approach, an alignment editor (tool for the specification of a transformation between source and target model) will be realised as a next step.

According to the planning at the beginning of HUMBOLDT, two new scenarios (European Urban Atlas and Transboundary Catchment) were installed following the Mid Term Call. The scenarios that had been collected to cover a broad range of potential geodata applications in the GMES context now represent current developments.

This Annual Report presents the activities of the second project year. It contains information about the activities of the HUMBOLDT consortium, the technical and scientific results achieved so far (see Chapter 2). Moreover, it informs about the results of the Mid Term Call and presents two scenarios in detail: Protected Areas and Ocean (see Chapter 3). Another topic is the development of the HUMBOLDT User Community (see Chapter 4).

Further information as well as the Annual Report of 2007 can be found at the project's website <http://www.esdi-humboldt.eu>.

2. Activities and Results Achieved

Cost Benefit and Process Analysis

One of the major challenges of the project is the analysis of existing data integration processes which provides ongoing results and serves as background for identifying the core optimization potentials in data harmonisation. This task was conducted within the Cost and Process Analysis activity to understand and improve the possibilities of the HUMBOLDT framework for more effectiveness and sustainability.

Process analysis describes the methodology elaborated for the analysis of scenario processes and presents analysis and specification of three selected HUMBOLDT scenarios: Forest, Urban Planning, and Ocean. Three main aspects are shown for the scenarios: current state processes (as is), future state processes (after implementation of the HUMBOLDT framework), and implementation of data harmonisation processes.

There were three main goals in process analysis activity:

1. To collect data and to analyse processes related to the HUMBOLDT framework, thus to build a background for the analysis of efforts and expenses needed to implement the harmonisation procedures and join the HUMBOLDT framework.
2. To collect information and to show data harmonisation processes foreseen by HUMBOLDT

scenarios' participants. That allows an initial review and prepares a background for the activities of concept development during the data harmonization process.

3. To show , by examples of (E)SDI processes how the establishment of an (E)SDI and related network will affect the efficiency of an organisation.

The figure below describes how geodata processing will work in a harmonised SDI with mandatory standards, proposed common tools, and a common framework. Data are transferred in standardised formats and application-specific data models are provided.

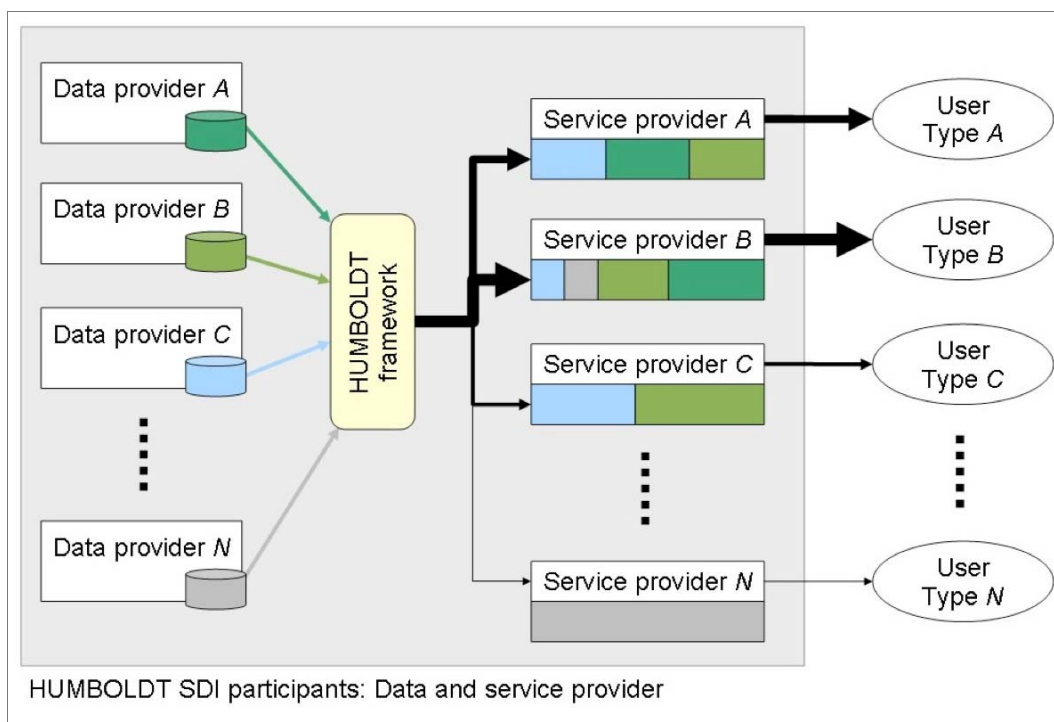


Figure 1: Geodata processing in a harmonised SDI (reduced to the aspects of data management and harmonisation)

The HUMBOLDT framework produces harmonised and standardised data which could be used in several services. Integration and combination of data is facilitated and provides better, more comprehensive results. The user benefits from more highly qualified information provided.

The cost benefit analysis considers besides cost analysis, the analysis of cost reduction potentials and the identification of functional benefits. It features an allocation of costs of current processes in specific HUMBOLDT scenario use cases and analyses potentials for cost reduction and benefits as a result of spatial data harmonisation. The main objective of the analysis was

the identification of costly and lengthy procedures in current data management, that have a large improvement potential from HUMBOLDT tools and the identification of expected internal and external benefits that may occur as a result of improved data harmonization procedures.

A survey of foreseen data harmonisation processes has been prepared for three HUMBOLDT scenarios. It shows the particular harmonisation steps that should be performed by presented scenarios, and specifies basic aspects in foreseen data harmonisation tasks which serve as a background for cost analysis and other assessment activities. The survey provides initial understanding of the foreseen harmonisation processes, based on the chosen examples (e. g. Forest scenario). They present their data harmonisation pro-

cedure well set and described in very detailed steps an initial guideline of the harmonisation workflow. This has been established for other scenarios and new participants of the HUMBOLDT framework.

Foreseen processes in the scenarios show potential benefits provided through the framework which will support in data searching – better source exploitation and easier metadata description. All scenario participants expect that issues related to compliance with INSPIRE guidelines will be more easily solved within the HUMBOLDT framework.

For further information please take note of the documents “A2.1-D2 Report on Process Analysis” and “A2.4-D1 Software Distribution Strategies and Business Models” that are available at the project’s website www.esdi-humboldt.eu.

Scientific Results

After analysing 176 software tools and about 60 national and international projects and documented methods on data harmonisation during the first year of HUMBOLDT, the second year was dedicated to a more detailed investigation of harmonisation processes. Several aspects in spatial data harmonisation processes appear constantly. These aspects can be grouped in the following main tasks or phases:

1. Specification of harmonisation goals und harmonisation methods (including the definition of a target conceptual data model)
2. Analysis of source and target data and definition of necessary harmonisation steps
3. Execution of process steps for harmonisation
4. Collecting feedback on the harmonisation result and possibly repeating single process steps

All investigated methods and approaches showed that spatial data harmonisation generally requires the knowledge and interaction of human experts. There were no fully automated harmonisation processes documented and many authors even doubted their existence. Only after a first complete and successful execution of a harmonisation process, single process steps (or in trivial cases even the whole harmonisation process) can be executed automatically.

The majority of software tools on the market consider syntactical, e.g. structural interoperability of spatial data. Among these tools are format converters which operate on the logical representation of data models, e.g. as in databases. Only very few commercial or open source tools consider semantic interoperability, especially operating on the model-driven approach (MDA) as propagated by the Object Management Group (www.omg.org). Nevertheless, we found that a majority of the investigated research and development projects on data harmonisation were based on MDA.

Performing Data Harmonisation in Scenarios

In the second year of HUMBOLDT we analysed two application scenarios (disaster management in a flooding situation and management of protected areas) and documented their harmonisation requirements. Existing methods and tools were used in order to judge whether and how they need to be extended. In this context interesting conclusions on modelling principles could be drawn.

As an example, street data of the lake Constance area (border area for Germany, Austria and Switzerland) was investigated. While trying to define a transformation for German data, it became apparent that street data from adjacent German states differed in its structure, number, name and values of attributes. This effect was especially notable when two different states used the same data model (ATKIS) and the same transfer format (Shape). The problem resulted from an incomplete usage of the MDA: the encoding, i.e. the

mapping of the conceptual model on a specific transfer format was never generally defined for Germany. The two German states simply used different interpretations and encodings based on the know-how of the involved individuals. No schema transformation (schemas are already the same) and no format conversion (formats are already the same) will solve this problem. Only inefficient interpretation, manual work and different ways of transformation of the two data sets in another (well-defined) data model can help.

Even more difficult to handle than this incomplete usage of MDA is the following effect: In the context of testing harmonisation processes in HUMBOLDT we found that there are two fundamentally different principles for the conceptual modelling of spatial data. Both principles are based on the MDA but result in fundamentally different consequences for subsequent harmonisation processes:

Principle 1:

Offering a maximum number of pre-defined elements. Modelling is done by defining constraints or limiting/proscribing the usage of specific elements as well as extending existing elements.

Principle 2:

Offering a minimal number of pre-defined elements. Modelling is done by extending existing elements.

The first principle is e.g. used for ISO/TC211 standards, which are currently the basis for INSPIRE data specifications. The second principle is used in a few projects on data harmonisation (e.g. Italian GeoUML) and in the Swiss national standard for spatial data modelling and transfer, INTERLIS.

Both principles provide different advantages and disadvantages for users and for the development of technical tools to support data harmonisation. Roughly summarised, we can state that the first principle (maximum number of elements) mainly supports end users by avoiding the necessity to invent own

new concepts and elements for data modelling. Whereas the second principle ensures that software systems can be based on a limited number of elements and concepts and thus can rely on being able to handle a resulting data model. For the first principle, we experience the effect that not all software systems are able to handle all basic elements and thus may not be able to process an arbitrary given data model. This effect is also known from the raster format TIFF, where not all software systems are able to handle all the encoding and compressing algorithms, which are allowed for the standard. Generally, there is the possibility to transform models which were built

according to principle 2 into models according to principle 1 and vice versa. However, in both cases different aspects of reality are mapped and such transformations may always lead to a loss of information and at

the same time have to be enhanced by human knowledge during the transformation process. Automatic transformations between two models (defined according to the two different principles) are not possible.

In the tests in HUMBOLDT we experienced the following problems for models, which were defined according to principle 1:

1. If we found problems in the processing steps and were unsure whether the delivered data was correct according to the documented data model, automated checking was not possible. Inefficient manual checking was necessary.
2. Even for simple target models (e.g. EuroRoadS, www.euroroads.org) the analysis had to be executed on a relatively big and complex UML model, for which some classes or attributes were restricted through OCL constraints. These constraints could not be reflected in any transfer format and thus be used in subsequent processing steps.

Approaches in HUMBOLDT

In HUMBOLDT the MDA is used for the development of tools to support data harmonisation processes. In the second year we developed the HUMBOLDT Model Editor to support the specification of conceptual data models according to the second modelling principle (minimal number of pre-defined elements) as described in the previous chapter. The editor uses a domain-specific modelling language in order to allow only spatial data modelling according to the requirements and recommendations given by the documents of the INSPIRE drafting team "data specifications". Thus, we can support the users in the 8 HUMBOLDT application scenarios by avoiding to read all relevant ISO/TC211 standards and all INSPIRE documents and keeping them in mind while defining data models.

In addition, HUMBOLDT has the clear goal to generally support data harmonisation processes in many, if possible most applications. The usage of a limited (minimal) number of basic elements for modelling does not contradict this goal, but significantly reduces the effort and complexity of tool implementations for the harmonisation steps. Currently, we started working on the development of a HUMBOLDT Alignment Editor, which will be able to read source and target models from the HUMBOLDT Model Editor as input parameters. The HUMBOLDT Alignment Editor will then provide methods and tools to specify efficiently the necessary transformation steps in order to control a harmonisation process from source to target.

Technical Results

The HUMBOLDT framework provides a most essential contribution within the project – to enable organizations to document and harmonize their spatial information, supporting the implementation of a European Spatial Data Infrastructure (ESDI) that integrates the diversity of spatial data available for a multitude of organizations.

State of the Art & Development Process Specifications

The HUMBOLDT framework has three tiers:

The HUMBOLDT Harmonization Toolkit contains applications that can be used by geodata experts to specify conceptual schemas and to define the transformation between the conceptual schemas. The HUMBOLDT Service Integration Framework is based on cross-cutting service components that allow collaborative usage across organizations, countries and domains. The final tier of the HUMBOLDT Framework is formed by individual transformation services, each of which can address a specific harmonization problem.

As data harmonization is a complex activity that is required in many different application domains, the HUMBOLDT framework has a multitude of things to

accomplish. Amongst those are the handling of many different types of data for transformation and presentation in very different environments and processes. These environments and processes are concretized more and more as the scenario requirements are identified.

Therefore it was necessary to create a basic infrastructure within the HUMBOLDT framework dedicated to the “technical harmonization process”, while taking into account the different data structures used in the application scenarios and also the need to support the “target definition process”. This is accomplished via a component architecture that contains both horizontal, cross-cutting service components and vertical, task- and domain-oriented service components.

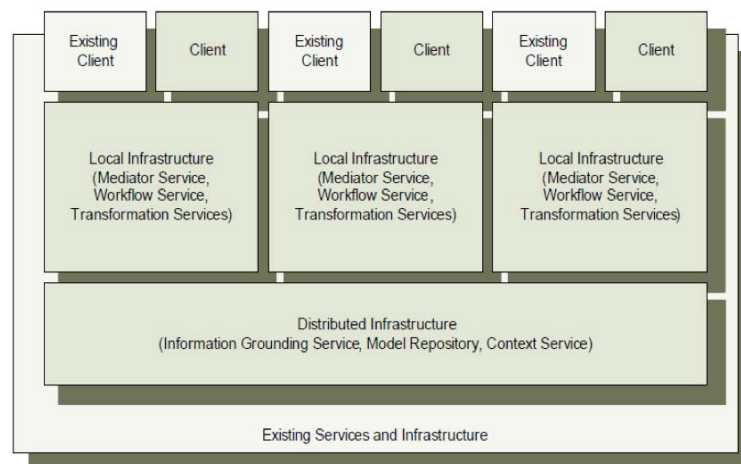


Figure 2: Infrastructure levels of the HUMBOLDT service integration framework: Public distributed infrastructure services, organisation-specific non-public services and clients

The overall HUMBOLDT architecture integrates two major tiers that are loosely intertwined with the existing infrastructure of data portrayal, data provision, data processing and data cataloging services:

1. A distributed, common infrastructure tier that gains its value from collaborative usage across organizations, countries and domains.
2. A localized, more specific infrastructure that gains its value from being specifically adopted to the needs of a single domain and/or organization.

Another important aspect of the HUMBOLDT framework was to be least invasive into current infrastructure. HUMBOLDT cannot be seen as something that will replace existing systems, but rather support and amend them in several specific places. To be able to do so, functionality is well-isolated from the interfaces by which it is accessed, resulting in components that can be adopted easily for different deployments and process synchronization styles, as shown in Figure 3 below.

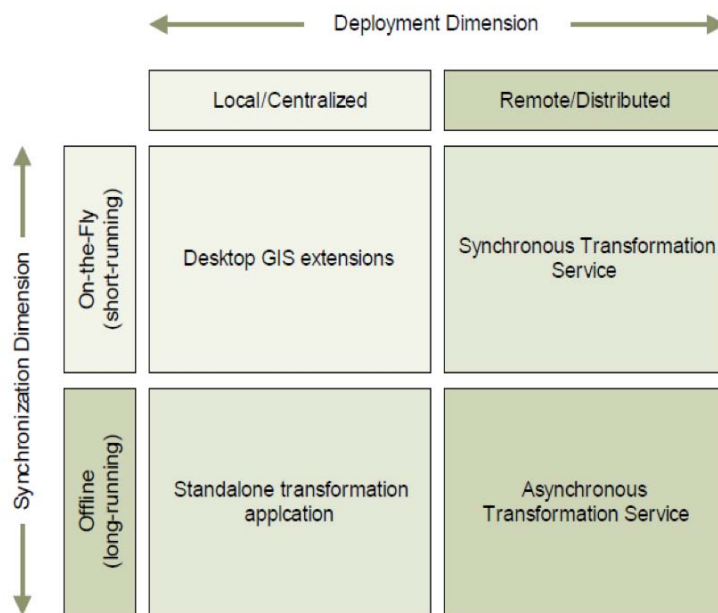


Figure 3: Components of the HUMBOLDT integration Framework can be packaged and used both for off-line and on-line harmonisation, i.e. independent or dependent of a concrete request

Further to the goal of being minimally invasive, established, standardized interfaces are used and HUMBOLDT infrastructure as a whole is designed to appear as a transparent proxy to users working on harmonized geodatasets.

The framework is considered to be a collection of service components that can be used in wholly different deployment contexts. These components are designed in such a way that they can be re-used functionally also as often as possible. However, the components

are not meant to be used directly by any of the end user groups defined for the project; they are rather something a developer would use to provide those main user groups with the tools they need.

In 2008 the main components of the framework have been designed and refined, based on the experiences from the prototype implementation and specification. Following a component-based approach, where the specification for each component went through sever-

al steps of refinement and acceptance they could be extended bit by bit to the full functionality.

One of the core elements of the HUMBOLDT philosophy is to re-use the existing. The state of the art documents confirmed that there are quite a few suitable

HUMBOLDT Framework Specification

Specification work is a very important part within the HUMBOLDT project. It facilitates the collection, coordination, and formalization of different stakeholder requirements that can be integrated in a proper working software system which will enable its users to cope with their respective tasks accordingly. A well-written and comprehensive specification also supports developers in keeping the development consistent through all phases of implementation, reducing the overall risks of implementation.

V1.0 was the first version of the HUMBOLDT Framework Specification to be distributed to a larger group of stakeholders. At this stage, these stakeholders were developers and researchers from the HUMBOLDT scenarios and from associated projects. It provided them with a good idea of the capabilities of the framework

standards and tools that can be incorporated into the HUMBOLDT framework. Almost all elements that were regarded as mandatory (15 out of 18) and many recommended and optional elements (16 out of 33) are already incorporated.

and thereby facilitated the reporting on prototype experiences.

The HUMBOLDT framework V1.0 specification was developed based on an approach to system design known as Reference Model of Open Distributed Processing (RM-ODP). This Reference Model provides the coordinating framework for ODP standards creating an architecture within which support of distribution, interworking and portability can be integrated. The RM-ODP family of recommendations and international standards defines essential concepts necessary to specify open distributed processing systems in an incremental manner and focused on five prescribed viewpoints.

The picture below shows schematically the viewpoints and their relation to typical artifacts of an IT system definition.

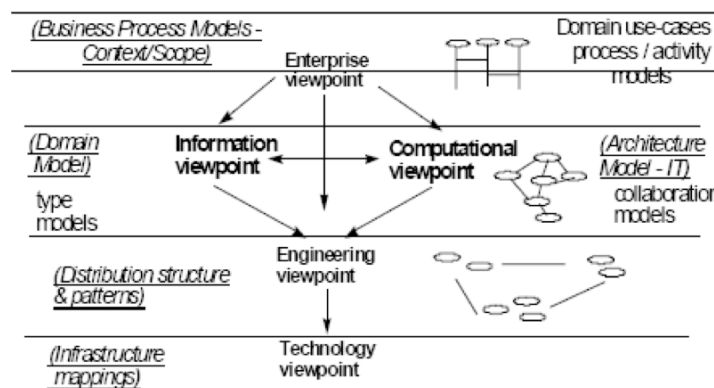


Figure 4: Viewpoints of the RM-ODP and their relationship

The architecture of HUMBOLDT was defined as a set of components, connections and topologies described through the series of views proposed by the RM-ODP. The HUMBOLDT framework will have multiple kinds of users and developers and each group will view the system from their own perspective. The purpose is to provide a description of the system from multiple viewpoints. Furthermore, this architecture helps to ensure that each view will be consistent with the requirements and with the other views.

The main specification process, as defined during the prototype specification phase was also applied in the V1.0 development. This process has to be driven by

actual, complete, current and relevant requirements from the scenarios. Therefore, the process focused on technology which was used during the prototype phase is being replaced by a process that reflects the ways of interaction between application and specification from the next specification and implementation phase on (which started in 09/2008). The process is designed to be open, transparent and flexible in order to be adapted to all groups in the project, using a range of options available for them. Several tools and accompanying templates (like Polarion, Volere or a Web Forum) are used for the harvesting of architecture requests, requirement requests and specification requests.

HUMBOLDT Framework Development

Specific components that have been developed are:

- The HUMBOLDT Model Editor
An UML editor specifically geared towards the creation of UML application schemas;
- The HUMBOLDT Alignment Editor
A tool that allows defining conceptual schema transformations;
- The Mediator Service
A proxy service that executes transformation chains to provide harmonized geodata;
- The Workflow Design and Construction Service
A service that analyses data sets and decides which processing is required to match a target product description;
- The Context Service
A simple service that can be used to define transformation products;
- Several transformation services
Services that are exposed as OGC Web Processing Services, such as a Coordinate Transformation Service and an Edge Matching Service.

Open Source Decision

One of the most important aspects of the HUMBOLDT project is to prepare the ground for a self-sustaining continued development of HUMBOLDT project results, especially with respect to the software and services that are being created.

With a careful and comprehensive review of various different distribution strategies it soon became obvious that an open source method was considered to be the

best solution for the software distribution strategy. All the details about the different strategies reviewed can be found in the deliverable A2.4-D1 Report on Software distribution strategies and business models. Another important analysis that facilitated the decision-making process in this context was the "Inventory and analysis of OSS business models" report of our partner project CASCADOSS.

After this analysis, the project established a business working group with partners from industry and research working on the best long-term approach for the exploitation of the HUMBOLDT software. Based on the work of this group, the decision was made to apply the GNU Lesser General Public License version 3 (LGPL v3)

to the HUMBOLDT framework software components at the consortium meeting in September 2008.

Furthermore, a time plan was agreed upon, which centers around the release of the HUMBOLDT Framework Milestone 1 on March 31, 2009.

3. How to use HUMBOLDT

Mid Term call (MTC)

The Scenario Mid Term Call development activity commenced at the Lisbon meeting and subsequently a programme for the call including the evaluation of proposals was defined with the aim to complete the process by the end of July 2008. The open call for new scenarios and potentially new project partners provided the opportunity to identify any gaps in the framework of scenario applications based on the experience of almost two years of project development activity. As indicated above, the MTC also required a full review of existing scenarios in order to identify not only potential "gaps" that could be filled by new scenario development but also any other potential

weaknesses that should be addressed. Following the MTC review process it was concluded that collaboration between the Water and Protected Areas scenarios would strengthen the effectiveness of both scenario applications. Subsequently a proposal was submitted for MTC funding to permit full integration of the Water and Protected Area scenarios in a transboundary context concerning the integrated management of cross border catchment areas. This proposal together with a proposal for additional funding for the Protected Areas scenario, and another proposal for the development of an urban atlas in the context of the Urban Planning scenario have been accepted for funding.

Sustainable Urban Atlas

Urban planning provides one of the most technically demanding applications of the HUMBOLDT framework and from which successful application offers some of the greatest rewards in terms of policy impact. Horizontal integration across the sectoral boundaries of the substantive policy themes allied with vertical integration between the levels of governance presents a myriad of harmonization challenges. These challenges provide at the same time the key to unlock the prime concerns of the policy end user to secure integrated intelligence that is central to decision-making and integrated policy formulation.

Policy integration is universally viewed as the prime requisite for successfully addressing the complex interrelated problems at the urban level in which issues concerning the model of evolution of the urban area are fundamentally interlinked with concerns for the appropriate form of urban economy and society, as well associated environmental impacts including climate change. Central to this new model of the sustainable city is the critical linkage that exists between peripheral urban expansion (urban sprawl) and climate change. Car based transport contributes to 30% of urban greenhouse gas emissions and so forms a major driver of global warming and climate change.

In this context this proposal specifically addresses key Mid Term Call evaluation criteria including:

- Strengthening, broadening and deepening current HUMBOLDT developments and;
- Providing direct linkage to the HUMBOLDT targets including the GMES perspective and the pan-European dimension within the scenarios

In particular the proposed Sustainable Urban Atlas offers added value as follows:

First, the proposal builds on the existing use case specifications in the HUMBOLDT urban planning scenario to explicitly address the issue of policy integration at the local level in the context of sustainable urban development, and thereby addresses gaps in the current HUMBOLDT urban planning scenarios regarding the core GMES perspective.

Trans-boundary Catchment (integrated management of cross-border catchment areas)

Introduction to the problem

In most of the cases big rivers flow along different countries and the borders of their catchments cross over national borders. I.e., nature, environment and ecology represent a continuum in which human borders disappear.

All cases where catchments cross the borders of countries imply that those catchments are managed by more than one state in different and often conflicting ways: in those cases it is needed to take into consideration the interests, the historical roots, the laws and rules of the neighbouring states across the national borders.

Water management in European transboundary catchments is then one of the major issues that needs to be addressed in the future. The Water Framework Directive (2000/60/EC) offers a conceptual framework for such purpose.

Second, the proposal provides direct linkage to the urban component of the GMES land monitoring core service and in particular it's specification for the development of the urban atlas. The GMES land monitoring core service provides the context for the elaboration of the GMES "top-down" perspective on pan-European service evolution, as well as the "bottom-up" perspective of service development by the realisation of new interoperability potentials at the local level. This proposal addresses issues that lie at the core of this dynamic.

Finally, this proposed extension to the HUMBOLDT urban planning scenario provides a direct contribution to the evolution of the DG Regio sponsored development of a pan-European Urban Atlas applicable to the 500 principle cities of Europe.

Moreover water resources development and management should address public needs and be based on a sustainability-based, farsighted and participatory approach, involving users, planners and policy makers at all levels. Solid partnerships between the policy makers and stakeholders on both sides of the border are in general essential for a successful and balanced management of all transboundary natural resources, and in particular of water which plays the fundamental role in those resources.

In some cases conflicts arise because of insufficient information available or insufficient information exchange: the aforesaid farsighted approach is based, inter alia, upon mutual knowledge and exchange. But in addition, also when existing, data is often scattered among different agencies and stakeholders: its exchange is a laborious task, sometimes cumbersome for stakeholders.

To summarise, insufficient or hardly operational communication between institutions and administrations

in charge of action in a catchment is a key point to be underlined, and it hampers correct management.

Objective of the scenario

To create a demonstrative but operational context showing how the HUMBOLDT Framework can support data harmonization needs in transboundary catchment areas. The Scenario is focused on the minimum of datasets required to create a work context for the management of such areas.

data framework to assist in decision making is out of the scope.

To meet these objectives the concept of a HUMBOLDT Transboundary Catchment Scenario has to integrate multi-source geographically referenced data, with a gateway to remote data sources.

The expected impact is also a contribution to support decision making. However a complete and complex

Involved User Groups

- Catchment management authorities
- Regional and local Administrations
- Water distribution companies
- NGOs and citizens
- European agencies for reporting
- Field specialists in Water Resources

For example, with reference to the application case, the following users are of relevance:

- France:
 - Conseil Général des Alpes Maritimes - Technical services
 - PACA Region - Technical services
 - Mercantour - Argentera Natural Parc
- Italy:
 - Regione Liguria
 - Province of Imperia
 - Catchment management Authority
 - Regional Parks (Liguria, Piedmont)

Scenario for Protected Areas

The main aim of the Protected Areas Scenario is to embed geo-information managed by park authorities in a seamless flow gathering data from diverse sources at different level, European, national, regional, enabling its exploitation for planning, management and tourism promotion. This is especially important in the European dimension where nature management and protection needs to take into account both heritage (e.g. landscape features) and human activity and impact (e.g. agricultural activity, infrastructures and transport network and their modelling).

More specifically the scenario use cases investigated are related to a strategy with the aims of:

- creation of a geo-spatial repository where stakeholders can contribute and share available geo-information from any source, and final users can friendly browse this information
- management, with a sound use of geo-information by planners and officers
- promotion of nature assets in a frame of sustainable exploitation, e.g. for durable tourism, with easy and universal access to geo-information by tourists and local people

Namely, the Humboldt Scenario Protected Areas is investigated in order to provide harmonisation support

for the interaction between different levels of work and administration:

- between the protected area management bodies and on the one hand the regional and national administration and on the other hand the diverse local stakeholders, for upload or update of different information layers relevant for planning and management
- between national authorities and the European agencies for reporting
- between the different bodies for joint projects and monitoring actions in the case of protected areas crossing the legislative or administrative borders Urban Planning Harmonisation Process:

Actors and stakeholders of protected areas and the need for harmonisation

Stakeholders at different levels face the need to harmonise data and information in their work and can be classified according to their purposes in using geo-data and geo-information:

- **preservation**, the basic commitment
- **re-naturalisation**, for example in the changing situations of human activity
- **exploitation**, for sustainable development
- **commercial use**, e.g. producers of geo-information for economic use
- **science and education**

Such situation becomes more and more complex because roles can change, and these actors, in different occasions, can play different roles. According to the classes proposed for Humboldt we recognize them as:

- end users browsing geo-information: decision makers, tourism operators, citizens, playing as:
 - end users of geodata, such as decision makers, who need to access information for taking decisions, browsing it via a friendly interface; leisure and tourism operators, who need to use geo-information in a very wide range of activity for promotion of the territorial assets

- end users of geoinformation: the lowest level of access to aggregated information, by citizens needing it for participation and awareness
- data integrators, collecting and analysing data and giving derived information in different forms (verbal, reports, maps) to different user groups. They can be split into:
 - planners and officers, with researchers the more involved in data processing and the closest to GIS skill, but in case assisted by IT specialists. They work for planning, exchange of information with other departments/administrations, reporting, communication to citizens
 - citizens, here considered as Associations and NGOs for preservation and exploitation, in some cases also as alternative planning actors
 - researchers, likely using all functions and operations required by other users and in case creating/customising them
- data providers, creating and processing data, "on catalogue" or tuned to specific uses. We consider here only commercial operators (Administrations are regarded as data custodians and not as mere provider. They can be geo-data providers and/or geo-services providers
- data custodians, including people or institutions providing data, harmonised or not. They can be considered a "super-set" of data providers, often responsible of production as well as of the full cycle of geo-data: production and documentation, standard compliance, maintenance, update.

Use Cases and Scenario Functionality

Two use cases (and related user stories) have been selected in the proposed ones and have been developed. The first one was used for the development of the Fast Track Scenario, implemented to serve as reference for further development of the Humboldt Scenarios. They are:

- **Tourism valorisation in a protected area.** It refers to the promotion of the area and implies access to geoinformation especially by citizens and commercial operators, as final users looking to browse tourism information. Main

task is to exploit the area and enjoy its offer of nature; final result would be to enable the user to build-up, display and print his/her own map.

- **Management of a protected area.** It refers to use of geoinformation by planners and officers. In general all of them are professional users at different levels mutually exchanging information and delivering it to citizens. Main task is to plan and manage the protected area; final result would be to deliver good geoinformation to planners and professionals to browse and analyse, to citizens to keep informed.

Main Harmonisation Requirements and Objectives

The major needs are related to:

- Spatial reference systems and grids
- Classification systems/schemes
- Conceptual data model and metadata profile
- Processing functions (parameters and formulas/algorithms)
- Terminology/vocabulary and multi-linguality
- Scale and amount of detail
- Portrayal
- Geometric consistency between datasets
- Data/Exchange format

Stakeholder Involvement

Partners of the scenario are data providers at national and at regional level. This allows a direct link with the national level, summing up the needs of the different stakeholders, as well as with the regional one, where administrations are data providers and custodians, but also planning and management authorities, offering then a comprehensive example.

Relation to GMES and INSPIRE

INSPIRE, and its already produced documents, is taken as reference in the development of the scenario to create the data profile and the data model. A comparison between the two situations (Humboldt Protected Areas and INSPIRE) has been then done, to which the below image refers.

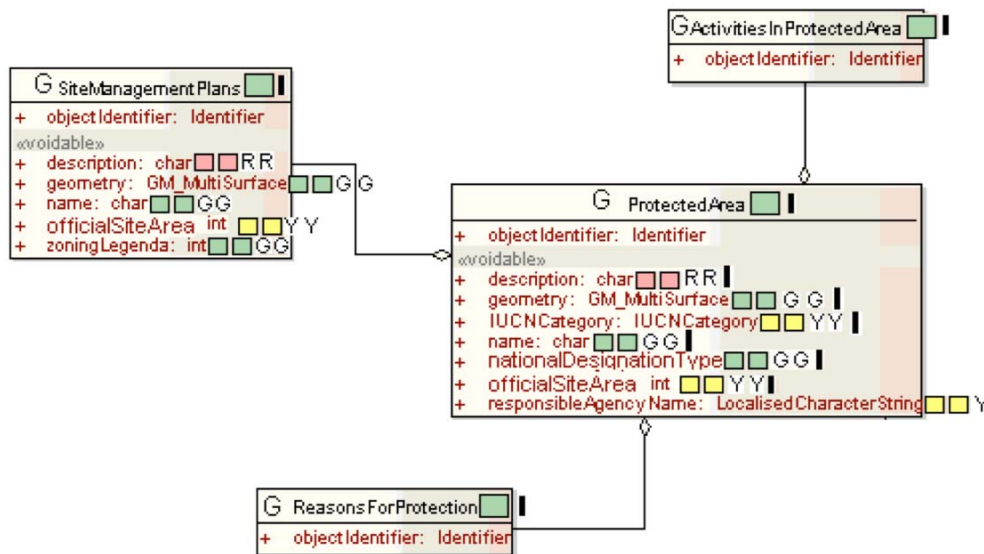


Figure 5: Matching the Scenario vs. INSPIRE

Connection to other HUMBOLDT Scenarios

Co-ordination with the other scenarios is pursued to verify possible synergy. As regards the Transboundary Catchment scenario, a shared prototype will be developed in a French-Italian area, testing the possibility for integration in actual data and real stories.

Current Scenario Status

The process of scenario development in the reported period can be briefly summarised as:

- Implementation of the Scenario Fast Track, on the basis of a user story and under the guide of the Technical Team
- Preparation of the protected areas data and metadata specifications, with the relation to the INSPIRE data specifications for the Protected Sites Data Theme
- Creation of a protected areas Conceptual Data Model
- Definition of a final list of hamonisation requirements for the scenario.

Scenario for Ocean

The Ocean scenario is one of nine scenarios (including the latest Mid Term Call additions) developed within HUMBOLDT. The scenarios aim to prove how the technology-components developed in the HUMBOLDT project can be implemented, configured and made useful for the easy, interoperable and combined use of different and heterogeneous (spatial) data sources.

The primary objective of the Ocean scenario is to test the HUMBOLDT framework for its ability to solve data

harmonisation issues in applications for assessing and managing marine and ocean oil/contaminants spill crises. In order to reach this objective it is very important that the framework developers are introduced into the Ocean domain specific standards and demands. Therefore a process has been created of defining the system specification for the scenario that supplies these demands in a structured way.

Harmonisation approach

The Ocean demonstrator will be based on two components:

- Data integration solving harmonisation issues using the framework components
- Visualisation of harmonised datasets using defined standards and components and thus proving the solution works.

The basis for the demonstrator can be found in existing developments in the Ocean domain. In four regions HUMBOLDT partners have been (and still are) developing models, viewing and decision support software to determine the best solution in case of an oil spill crisis. The modelling component based on physical oceanographic data, (waves, wind, currents etc) are very ocean domain specific and will not be effected by HUMBOLDT developments. However the input of datasets and output of the modelling software definitely will be. Harmonisation and standardisation

of input and output will make the data useful in a wider area, and will improve the set up time for a new case when a crisis occurs. Harmonised datasets, discoverable via a catalogue and accessible via services in a common protocol can easier (and much quicker and cheaper) be included in the decision support software.

Another important area is the cross-domain approach that is being taken. Two different information communities are involved in this deployment area, with specific technology and data: 'sea/ocean' and 'land'. Until now the viewing and decision support software lacked input from the land domain because appropriate datasets were hard to find and use. This is caused by a low degree of cross-border standardisation and harmonisation. This means for example that image data (raster) of the ocean part will be combined with topographic and ecological data (vector) of the beaches and shores.

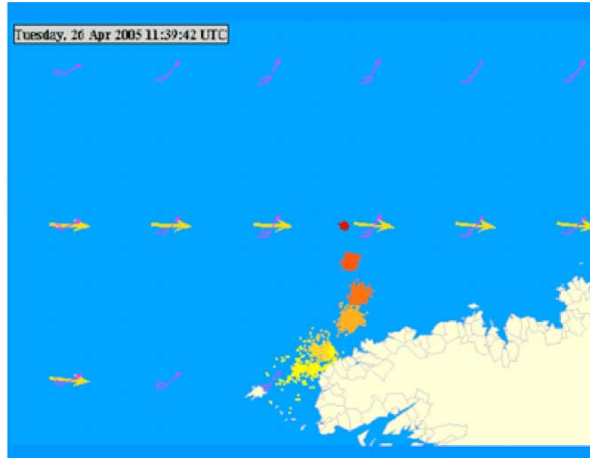


Figure 6: Example of output of the Mothy software – An oil spill reaching shore

A third area of deployment in the ocean community is transnational. Because of language and standard differences the same software and datasets can hardly (or not) be used in other seas or by other countries for the time being.

The HUMBOLDT framework software will help to bridge the different worlds, each traditionally with its own software, (meta)data, procedures, and standards.

Progress in Ocean scenario development

During the first two years of HUMBOLDT important effort has been spent on the following topics:

- Introducing the Ocean community standards to the other communities
 - Metadata standard – Very important for discovery in the Ocean domain. The leading standard is the Common Data Index (CDI), an ISO19115 compliant datamodel available with its own schema.
 - NetCDF – The leading format for gridded datasets (3D, 4D)
- ODV and MedAtlas – The most important ASCII formats for profiles and measurements
- Getting feedback from crisis managers to indicate necessary datasets, evaluate relevance of the search and visualization tools for crisis management.
- Aligning HUMBOLDT standards with developments in Ocean domain by presenting developments to the HUMBOLDT partners. Vice versa HUMBOLDT standards and developments are introduced and aligned to SeaDataNet.

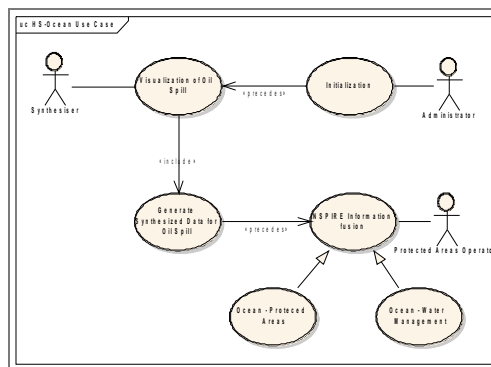


Figure 7: Example use case diagram

- Like in every Scenario the Ocean scenario has produced its System Specification. Since the Ocean scenario consists of 4 different regional scenarios each region listed:
 - Specific use case descriptions, where the use cases target harmonisation issues
 - Data harmonisation issues – Dataset description of existing and necessary standards and transport technologies implemented for using datasets
 - Available access to geospatial / temporal information from multiple providers (cf. Live Access Server or other data viewers)
 - Available Service and Data Search Interfaces based on OGC™, Catalogue Services Specification for the Web, and adapted to marine data
- Conceptual Data Model (draft) for ocean oil spill scenario. All datasets (with their attributes) needed to make an assessment of an oil spill crisis have been included in the Ocean CDM. This model is the target model for harmonising source datasets.

The HUMBOLDT framework supplies software components and processes to solve the harmonisation and standardisations in the Ocean domain, so to transform datasets from source to target model. Within the Ocean domain itself there are already many harmonisation solutions in place, but they are limited to the

Typical harmonisation issues found in the ocean scenario:

- Data exchange formats (local vs European formats)
- Metadata format
- Scale, external sources different scaling
- Portrayal, different legends for same datasets across borders
 - Languages, local languages are often used
 - Consistency between datasets representing the same entity -> Connecting coastlines/protected areas at borders
 - Consistency between datasets representing different entity -> Connection of coastline and 0m bathymetry, coastline and protected areas.

marine and ocean community. The HUMBOLDT software components will be tested if they have the capability to make the step from one domain to the other and if they take into account the specific Ocean demands.

4. users@HUMBOLDT: Development of the User Community

The main objectives for the second project year were to raise awareness and start establishing bi-directional connections to users. The project environment was fully established and all the instruments were made available for the user-driven development, according to the process description.

The involvement of project-internal users in the development process required more effort than expected. Therefore, more active involvement of project-internal users represented within the Scenarios was carried out during the second project year. This was especially reinforced during the specification work of Framework version 2.0, where application contacts (“sparring partners”) were assigned to each component.

Furthermore, it is evident that user involvement and communication with users can be catalysed by releasing project results for discussion and feedback. These results should not only include documents, but also real pieces of software and real examples/use cases. Therefore, it was decided to create two Task Forces in order to speed up the process of obtaining more concrete results. The Protected Areas scenario was put on a “fast track” meaning that we concentrated development efforts on this scenario, which resulted in a quick development of widely usable and understandable pieces of software including transformation components. The other task force concentrated on the widely-known problems of data harmonization and identified which ones of them can be solved by well-established solutions and which require further scientific investigation. This also resulted in transformation components that will be directly used within the HUMBOLDT Toolset. Important results were achieved in the active research area of conceptual schema translation as well.

The Mid-term Call for Scenarios proved to be a useful opportunity to further increase the number of GMES application areas covered by the HUMBOLDT Scenarios and also to enhance links to GMES users. As a res-

ult of the open call, new scenarios were established and existing scenarios were upgraded. The Protected Areas Scenario received additional support in its status of “fast track scenario”. The Urban Planning Scenario was complemented with a second part with very strong link to the GMES Urban Atlas initiative, and new partners were involved from the GMES Community. The Transboundary Catchment Scenario was established by transforming the existing Water Scenario into a new one put in the context of the Water Framework Directive, building on the results achieved so far; here again, additional partners were involved to enhance GMES links.

As for the further involvement of project-external users, the networking capabilities of our Consortium Partners proved to be very efficient in this respect. To establish a network of “trusted users”, over 30 Key Users have been identified by the project partners. These users are organizations or individuals with a strong interest in the outcome of the HUMBOLDT project and are also willing to influence the development, therefore volunteered to become a member of the HUMBOLDT Key User Network. The advantage of such a network is its visibility to the consortium and also the reliability of the users, as it consists of project-external users with close connections to at least one HUMBOLDT partner.

Links to and collaboration with other projects are also essential. Therefore, connections to numerous other international and national SDI- and GI-related projects were established, and collaboration started to ensure more efficient and effective work and an optimal use of (joint) resources. Besides the pre-existing links to

our "sister" projects, the recently established links towards newly started projects (e.g. ESDIN and NatureSDI+) are very promising from a user involvement viewpoint. Through these projects, experienced and reliable domain user communities with awareness of the HUMBOLDT project can be reached, who are willing to use the results and provide expert feedback. Further cooperation is therefore essential.

Dissemination was crucial in the last project year not only in raising awareness but also in enhancing dialogue with users. The HUMBOLDT Newsletter was cre-

ated and disseminated towards all registered HUMBOLDT Users (including Key Users). The HUMBOLDT project was represented at numerous conferences, workshops and joint project meetings. The successful organisation of the HUMBOLDT Data Harmonization Workshop at the 2008 INSPIRE Conference (Maribor, Slovenia) was one of the major achievements in dissemination and user involvement during this period. Moreover, a large number of GI- and ESDI-relevant newsletters, journals and other dissemination media were identified by the Project partners; the list is managed centrally and is used for dissemination activities.

5. HUMBOLDT Consortium

1. Fraunhofer-Institut für Graphische Datenverarbeitung IGD, Germany
2. ETRA Investigacion y Desarrollo, Spain
3. Help Service Remote Sensing, Czech Republic
4. LogicaCMG UK, UK
5. Institut Géographique National, France
6. Intergraph CZ, Czech Republic
7. ETHZ - Swiss Federal Institute of Technology Zurich, Switzerland
8. Delft University of Technology, Netherlands
9. University of Rome "La SAPIENZA", Italy
10. Institute of Geodesy, Cartography and Remote Sensing (FOMI), Hungary
11. Marine Information Service 'MARIS' BV, Netherlands
12. KTU Regional Science Park, Lithuania
13. INI-GraphicsNet Stiftung, Germany
14. Technische Universität München, Germany
15. University of the West of England, UK
16. Institut Français de Recherche pour l'Exploitation de la Mer, France
17. National Environment Research Council, UK
18. Hellenic Centre for Marine Research, Greece
19. Swedish Meteorological and Hydrological Institute, Sweden
20. Telespazio, Italy
21. GISIG - Geographical Information Systems International Group, Italy
22. Consiglio Nazionale delle Ricerche, Italy
23. Forest Management Institute, Czech Republic
24. Instituto Geográfico Português, Portugal
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