

INSPIRE – First steps towards the Environmental Spatial Data Infrastructure in Europe from point of view of cartography

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ABSTRACT

The proposal for a European Directive establishing an Infrastructure for Spatial Information in Europe (INSPIRE) sets out a legislative framework to implement the European Spatial Data Infrastructure. In spite of its environmental focus there are many fields traditionally studied by cartography, which are within the scope of the Directive.

After an overview of the recent developments of the Directive the paper points out the possibilities that pave the road from the shared vocabularies towards the collaboration between the cartographic and GIS communities in the areas of shared interests.

INTRUDUCTION

The state of the environment is one of the most important factors that determines the quality of life. For understanding the interaction between its various elements including the human impact, responsible management of natural resources, and adequate response to the natural hazards it is necessary to monitor, document and study it both at local and global scale. Spatial information can play a special role in this approach as it allows to integrate information from a variety of disciplines for a variety of uses. Consequently such an infrastructure is needed, which is readily available where and when spatial information is required. This infrastructure allows to discover the data that has been previously harmonised, and also provides custom licence agreement about the condition of the use.

The Infrastructure for Spatial Information in Europe (INSPIRE) will be composed of metadata, spatial datasets and services, network services and technologies; agreements on sharing, access and use; and will include coordination mechanisms and procedures.

IMPLEMENTING RULE SEVELOPMENT

Concept of SDICs and LMOs

INSPIRE has entered into the Co-decision legislative process, where the Commission interacts with Council and European Parliament to discuss and further shape the proposal. Parallel to the legislative procedure the preparation of the detailed implementing rules has started as stated in the INSPIRE Work Programme published in April 2005.

The Work Programme identifies a step-wise approach for the definition and preparation of the detailed implementing rules, with broad involvement of the stakeholders of many thematic and geographic communities both from user and data provider sides. This approach guarantees that the European Spatial Data Infrastructure will be based on the existing best practices of national and international level, as required by the Proposal.

With these considerations in mind, an open call was launched in March 2005 for the registration of interest by Spatial Data Interest Communities (SDIC) and Legally Mandated Organizations (LMO), which has remained opened. The SDICs as self-organised communities bring together the human expertise, technical competence, financial resources and policies of users, producers and transformers of spatial information organized by geographic region, societal sector or thematic issue. LMOs represent those organizations that exercise a formal legal mandate in formulating policies at local, regional, national, or international level.

The SDICs and LMOs may play different voluntary roles in the development of implementing rules. Both of them may provide reference material, giving initial impetus to the process. By registering projects they supply useful information on issues of practical implementation and also provide testing environment. Lastly, but not least the implementing rules will be developed by groups of experts nominated by the SDICs and LMOs. For

reasons of efficiency the Drafting Teams were kept small, usually consisting of 5-6 recognised experts. When necessary, further specific expertise can be called upon from the Supporting Teams, or the whole list. The selection of experts was done by the Commission services with advice from the INSPIRE Expert Group. Five Drafting Teams and support teams have been established to address the issues of Metadata, Data Specifications, Network Services, Data and Service Sharing, Monitoring and Reporting. The kick off meeting of these Drafting Teams and Supporting teams took place on the 3-4 October 2005.

The first drafts providing technical (for metadata, data, network services, implementation monitoring) and legal (for data sharing, monitoring) specifications are expected to be delivered in the second half of 2006. Then an iterative consultation process is foreseen, when in the first round the registered SDIC and LMOs can refine the implementing rules based on their expertise or directly testing their data and systems against the proposed implementing rules. This latter brings specific value in the process, as issues of feasibility and cost can be assessed and compared with the possible benefits. The iteration within the SDICs and LMOs are to be completed with public consultation, in order to achieve the widest possible support. Well prepared, consensus-based proposals for the implementing rules will give a smooth go in the comitology process to be started right after the adoption of the Directive.

User driven approach

The implementation rule development should be driven by the requirements of the users. If the groups of users are underrepresented in the SDICs and the LMOs, it is crucial to search for the sources of real use-case scenarios. A part of the requirements may stem from the Member States' reporting obligations as stated in the European legislation. Such requirements are laid down for example in the Water Framework Directive (2000/60/EC), or the „Noise” Directive (2002/49/EC). Naturally, fulfilling reporting obligations in a harmonised way would not be proportional with the extent of a directive. Important cross border environmental issues (water and air pollution, floods, draughts, forest fires) and the need for timely response in prevention and mitigation create further requirements for harmonisation. In this task regional knowledge is of special value.

TECHNICAL ELEMENTS OF INSPIRE

Metadata

The loss of time and resources in searching for existing spatial data or in discovering if they may be used for a particular purpose is a key obstacle to the full exploitation of the data available. The main purpose of metadata is to document information resources and facilitate their re-use by the resource owner, and others either within or out of the original community of interest. Therefore metadata is needed both for spatial data and spatial data services. Keeping in mind, that only actual metadata is valuable, it is necessary to elaborate procedures for their regular updates. INSPIRE metadata shall include information on the

- conformity of spatial data sets with the implementing rules referred to in Article 11(1);
- rights of use of spatial data sets and services;
- quality and validity of spatial data.

The implementation rules for metadata shall be in conformance with the European and international standards, with current practices of stakeholders (e.g environmental, mapping, geological, marine and meteorological sectors), and are compliant to the relevant European initiatives such as e-Government, and the EU interoperability framework.

The metadata component of the European Spatial Infrastructure will be implemented in a stepwise way, with the following focus

- Discovery of data sets linked to Annexes I, II, and III
- Enrichment of metadata for evaluation and use based on revealed demand
- Ease of implementation and organisational capacity to sustain the process over time.

The maintenance of the metadata component requires continuous monitoring and taking account technological and market developments.

Harmonised spatial data and spatial data services

The implementing rules provided for in Article 11(1)(a) shall be designed to ensure that it is possible for spatial data sets to be combined, or for services to interact, in such a way that the result is a coherent combination of spatial data sets or services that represents added value, without requiring specific efforts on the part of a human

operator or a machine. This is currently hampered by the wide diversity of formats and structures in which spatial data are organised, which results in

- lack of interoperability on the Member State and European level
- data distribution and overlapping (including parallel activities of different organisations)
- different world views (topography, cadastre, forestry, land cover, etc.) and conceptualisations

The picture is further complicated by the differences in software and hardware platforms, in the application schemas (varying aggregation levels and attribute sets, different geometric representations) and semantic heterogeneities.

The scope of data themes for which a coherent and widely accessible spatial description is required throughout the Community is given in three distinct annexes. Each of these themes refers to spatial data needed by a broad range of environmental policies. Common “reference” data underpin the environmental thematic data. The annexes define at the same time a kind of prioritisation of the implementation rule development. Initial priority is given to Annex 1 and 2, which define the common reference frame of the thematic data listed in Annex 3. Never the less, modifications are possible according to the status of the ongoing initiatives and projects in the thematic communities. The implementation rule development must leverage existing standards and specifications; must comply to the general principle of user-driven approach with the specification – testing – modification – testing life cycle.

The Directive does not specify what spatial data harmonisation means, and how it can be achieved. It only gives some aspects concerning some issues of semantics and geometry. As the data component of the European Spatial Data Infrastructure does not foresee new data collection or data re-engineering, the harmonisation is likely to take place at the level of the existing similar application schemas. However, a common European reference model is needed at conceptual level, and also the question of quality cannot be overlooked.

Depending on how far the harmonisation process goes in terms of semantic interoperability, the harmonisation process can be solved by more or less automatic, on-demand conversion (schema translation) to the INSPIRE application schema

Network services

Network services are necessary for sharing spatial data between the various tiers of public authorities in the Community. They should make it possible to discover, transform, view and download spatial data and to invoke spatial data and e-commerce services. The services of the network should work in accordance with commonly agreed specifications and minimum performance criteria in order to ensure the interoperability of the infrastructures established by the Member States. The network of services should also include upload services to enable public authorities to make their spatial data sets and services available.

In order to assist the integration of the national infrastructures into the infrastructure for spatial information in the Community, Member States should provide access to their infrastructures through a Community geo-portal operated by the Commission, as well as through any access points they themselves decide to operate.

The development of the network services implementation rules should start from clarifying the requirements of the users. It make sense that a minimum number of services (discovery and viewing) should be made available to the public free of charge.

The network services implementation rules will address the following issues:

- General architectural model
- Security (access to the service and data transfer) when applicable
- Technical architectures and protocols
- Distributed discovery & gazetteer
- Essential requirements for considered components

Like to other component of the infrastructure the implementing rules shall be based on existing standards and specifications and shall be developed in iterative way paying special attention for testing. At the end of this process it will be possible to define what is necessary to achieve interoperability by usage/profiling/extension of European Standards. The implementation rules will also provide a strategy for operation and maintenance, including updating the implementation rules themselves. The final technical specification should be underpinned by cost benefit analysis.

As Network Services and the European Geo-portal are in the forefront of the European SDI (being the first place for interaction with the users) the issues of multilingualism should be adequately addressed. Even though translation can be handled at the level of services, it is necessary to collaborate with the metadata and data specification groups in development of multilingual thesauri.

IS CARTOGRAPHY INVOLVED?

In the INSPIRE proposal the term of cartography is missing. Based on the wide use of GIS in the modern map compilation the involvement of cartography is obvious. In addition, we can find such terms and requirements in the Directive, where cartography can play an important role in further scoping and technology development.

Shared vocabulary – shared topics of interest

The explicit shared terms of the traditional cartographic and the geo-information world in the proposal for Directive are coordinate reference systems, geographical names, scale, data quality and accuracy, geographical location. Apart from this very formal and didactic approach it is not difficult to see that cartography directly deals with description that part of the Universe which gives the spatial context for various applications. We should not forget about the huge experience that cartography has in integrating and communicating thematic knowledge according to the need of the users.

Scale

The scale in context of digital data is not straightforward. Clearly, its classical definition (ratio of map and “real” distances) is not valid in this environment. The capability of GIS tool to zoom in and out and display information at “continuous” scales may suggest that this category has lost its importance. Even conceptual modelling may seem scale-free as it deals with semantics by defining (or selecting from a catalogue) the objects, their relationships and attributes. However we should not forget about the semantic resolution requirements set by the purpose of the modelling, e.g. by the requirements of the user. The semantic resolution defines the granularity (level of details) of the model. Based on the requirements the same phenomenon may appear at object or aggregation level, with simpler or more complete attribute set. Therefore the terms used to describe the Universe of Discourse vary according to the semantic resolution; the “scale of reasoning”. It is not difficult to see that there is no theoretical limit for increasing the semantic resolution. Never the less each model has its own limit. This limit usually is connected to spatial resolution level, however spatial resolution is not the only classifier in this process (e.g. landmarks – like churches, single trees, etc. - are not reclassified or aggregated). Due to the long traditions and experience cartographers may successfully describe the interdependency of spatial and semantic resolutions, or formalise the contextual classifiers of object.

Multiple representation, generalisation

The Directive requires that “implementing rules shall be designed to ensure consistency between items of information...which refer to the same object represented at different scales”. As data derived from the same source is often stored at different level of details the notion of generalisation has been associated with multiple representations. Multiple representation is an important question for the implementation of INSPIRE, as data themes are available at different levels of detail in the Members States. Therefore it seems to be reasonable to define several granularity for each theme where data can be compared and consolidated.

Generalisation has been widely used in cartography, taking the advantage that different (smaller scale) products can be derived from a single (detailed) data collection. As cartographic generalisation encompasses both model and graphic generalisation, the discipline valuably can contribute to deciding which extent generalisation should be used in INSPIRE? Is it enough if we restrict it to the model generalisation that focuses at the cognitive aspects of the objects? Are the well structured conceptual models that help to disclose similarities, differences, and relationships between the features sufficient to arrive at the different representation levels?

Or, on the other hand we cannot fully ignore communicative requirements? Visualisation is a powerful tool in GIS, which is used both for analysis and decision making. Moreover it is obvious, that each level of detail requires a certain positional accuracy and an appropriate precision of coordinates. Rough geometries will not satisfy accuracy requirements of highly detailed databases, while increased number of points and coordinate precisions meaninglessly burden the databases of smaller scales Whether to apply or not; and if yes which graphic generalisation methods and algorithms should be used can be adequately answered by cartographers.

Data quality and usability

The requirements of the user define the level of details, the level of the details require some “acceptable” quality of the description, which in its turn define the applicable data collection methods.

In traditional mapping the objects that depict the real world are often defined by regulations, giving the obligatory content according to the intended use, the selected scale, and the desired quality of the end product, which fixes the applicable technology too. The legally mandated levels of accuracy are achieved through the allowed measuring methods. Data collection, editing and portrayal form a unique technological process with

high human involvement and continuous quality control. The integrity of the end product is maintained by the (practically) non-alterable base, by the paper itself. Metadata like scale, measuring method, producer, time of publishing, etc. is documented on the information carrier, therefore data and metadata integration and the data authenticity is ultimately solved and guaranteed by the publisher.

The similar well-established system for digital data collection has lagged behind the technology. According to McGlamery (2001) when information is transferred to digital format the issues of integrity and authenticity are overlooked. As soon as the data is taken out of the initial context, the integrity of the quality and the intended use is not guaranteed any more.

Data quality is a pillar in any GIS implementation and application as reliable data are indispensable to allow the user obtaining meaningful results. Data transfer, sharing and integration are common practices by many users. In GIS applications, data from different sources, with different levels of accuracy and with differences in quality can be combined. The errors should be recognised, documented and properly dealt with.

The data quality in the Geographic Information Systems is often understood only as metadata, as an a posteriori report about the purpose, use, lineage, completeness, logical consistency, precision, positional, temporal and thematic accuracy of the data. These reports are usually stored separately from the data. In highly distributed environment like the web feature service the origin of data can be different even at object level. Naturally the users do not want to waste too much time on reading metadata for each element; they need a simple and quick way for communication. When data quality elements are integrated to the application schema the quality visualisation offers an effective “on the spot” judgement about the “fitness for use” and data uncertainties. Developing such visualisation methods is another field for involving cartographers.

Portrayal

Chapter 4 “Network Services” of the Directive states the following requirements: [Member states shall establish]... “View services making it possible, as a minimum, to display, navigate, zoom in/out, pan, or overlay spatial data sets and to display legend information and any relevant content of metadata”. This typical web-mapping task raises some requirements for portrayal. It is necessary to decide about the projection system, about displaying the information and the connected legend.

The Directive does not contain any provision on this topic. The question of which extent portrayal rules need to be addressed will be decided by the Drafting teams. Contributions of the cartographic community in the field would be highly appreciated.

Conclusion

Parallel to the co-decision procedure the drafting of the INSPIRE implementing rules has begun. The European Spatial Data Infrastructure for the Environment will be built upon the existing infrastructures of the Member States. The interoperability of system and data harmonisation will be implemented through technical and legal specifications that are to be developed driven by the requirements of the users, and with wide involvement of the stakeholders.

The wide-spread knowledge of cartographers in spatial cognition and communicating information according to thematic needs of the users gives promising perspective to their involvement in the implementation rule development. These fields include issues of scale, generalisation, multiple representation, data quality and usability, portrayal, but can be enlarged in the future according to the process of the implementation rule development.

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