

# Building a European Spatial Data Infrastructure

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## Abstract

INSPIRE (Infrastructure for Spatial Information in Europe) is a recent initiative launched by the European Commission and developed in collaboration with Member States and accession countries. It aims at making available relevant, harmonised and quality geographic information to support formulation, implementation, monitoring, and evaluation of Community policies with a territorial dimension or impact. The Joint Research Centre, acting as Scientific and Technical Coordination Body, is involved in several key developments, including the creation of an EU GeoPortal and specific map services to support interoperability. Implementation of relevant GI and Technology standards is fundamental, as well as initiatives to harmonise content through the creation of common data models. These activities are summarised in this paper.

On 1<sup>st</sup> May 2004 the European Union expanded from 15 Member States to 25, increasing the population of the EU from 380million to 455million. This enlarged EU covers 3.9 million square kilometres and 20 official languages are recognized. Within Europe, spatial information is still characterized by fragmentation, gaps in availability of geographical information, duplication of information collection and problems of identifying, accessing or using data that are available. Particularly at the European level, these factors cause problems for effective policy making and assessment, which are increasingly significant for trans-national issues, of which environment is the most obvious example. These difficulties have led to a number of initiatives which aim to create a European Spatial Data Infrastructure (ESDI).

A Spatial Data Infrastructure may be defined as a framework of policies, institutional arrangements, technologies, data and people that makes it possible to share and use effectively geographic information<sup>1</sup>. It is generally agreed that SDI include several components:

- Geographic data and attributes, organized in distributed repositories
- Sufficient documentation (metadata)
- Geoinformation services (catalogue, map, feature, transformation...)
- A set of agreements on the technical, organizational and legal issues, needed to coordinate and administer spatial data, information and services on a local, regional, national or transnational scale

Most European countries are in the process of developing SDI's, although a recent review<sup>2</sup> concludes that operational National SDI's (NSDI) as defined by the Global SDI (GSDI) Cookbook<sup>3</sup> do not exist, even though various key components are in place or under development, and activity is very much focused on the public sector.

Thus in creating an SDI there is a technical dimension, together with a policy/legal/organizational framework. For technical issues, it is essential that existing recognized standards are adopted in order to ensure interoperability of underlying GI systems by developing and providing interoperable geoinformation services. For thematic standards, for example agreement on a common conceptual data model for transportation networks, its encoding and the interfaces of related geoinformation services, key stakeholders must come together to arrive at a consensus, and even this process of agreement should be according to standard methodologies. Clearly, given the number of actors, the range of tasks they are performing and the cultural diversity which exists in Europe, the creation of a European SDI represents a major challenge.

At the European policy level, there are several driving forces towards creating these ESDI components. The 1998 Aarhus Convention<sup>4</sup> which came into effect in 2001 contains key provisions which implicitly cover geographic information. The 2003 Directive on Public Sector Information<sup>5</sup> specifically mentions the role of the Public Sector in collecting, producing, reproducing and disseminating, *inter alia*, geographical information. In specific thematic domains, EU policy begins to explicitly mention GI and GIS, examples include the Water Framework Directive<sup>6</sup> (2000) and the amended IACS regulation<sup>7</sup> (2000) dealing with the Common Agricultural Policy.

Against this background, and to provide a common framework for these various initiatives, a European Commission Proposal is now being developed for the establishment of an Infrastructure for Spatial Information in Europe (INSPIRE), with the objective of supporting environmental policies and policies that affect the environment. INSPIRE aims to trigger the creation of an ESDI, using the building blocks of NSDI and according to the following core principles:

- Data should be collected once and maintained at the level where this can be done most effectively
- It must be possible to combine seamlessly spatial information from different sources across Europe and share it between many users and applications
- It must be possible for information collected at one level to be shared between all the different levels
- Geographic Information needed for good governance at all levels should be abundant and widely available under conditions that do not restrain its extensive use
- It must be easy to discover which geographic information is available, fits the needs for a particular use and under what conditions it can be acquired and used

In the proposal preparation phase (2001-4), expert groups were established in the following areas:

- Reference data and metadata
- Data policy and legal issues
- Implementing structures and funding
- Architecture and standards
- Environmental thematic user needs
- Impact analysis

Stakeholder involvement, in addition to participation in these expert groups, was ensured through an extensive internet consultation during 2003 and findings were incorporated in a modified proposal with a revised scope. INSPIRE has a long term scope – if accepted, transposition into national law and implementation would likely be in the period 2007-13, but there are already many activities underway which are helping to build ESDI. These activities need to be consolidated and given common direction according to the scope of INSPIRE.

Reference data are those data which everyone involved with geographic information might use to reference his/her own data as part of their work, and is a common link between applications. Consequently they must represent an unambiguous location, and must be able to be merged with data from other sources. ETRS89 has already been proposed as the most appropriate geodetic datum to use within Europe, and work is underway to agree the standard for a European Geographical Grid System and a European Vertical Reference System for height measurements. Recommendations for standard European Map Projections for different scales and purposes have also been made<sup>8</sup>. The current INSPIRE Proposal covers electronic, spatial data (and services built on these data) in three priority categories. Annex I data themes are:

- Coordinate reference systems
- Geographical grid systems
- Geographical names
- Administrative units
- Transport networks
- Hydrography
- Protected sites

Annex II data themes are :

- Property Identifiers
- Elevation (including terrestrial elevation, bathymetry and coastline)
- Land cover
- Cadastral parcels
- Ortho-imagery

In order to allow the seamless combination of these data, there must be a process to agree on common, harmonized spatial data specifications, developed according to standard methodologies. Standards for interoperable data provision and access functions to spatial

data will need to be defined, as well as agreement on unique identifiers, updating and maintenance of spatial objects, standardized classifications (including multilingual thesauri), data models and how to deal with the interrelationships between spatial features. Several significant initiatives on data harmonization are ongoing at European level, for example covering road transportation networks<sup>9</sup> and geology<sup>10</sup>. These efforts should not mean that every user community is obliged to use the same data models internally – translation mechanisms can be devised that link existing data models to the common conceptual European model.

For many technical issues related to SDI, the standards of the International Standards Organisation (ISO), particularly the ISO191xx family of Geographic Information Standards<sup>11</sup>, as well as the specifications produced by the OpenGIS Consortium<sup>12</sup>, will provide the necessary framework. CEN, the European Committee for Standardisation, is active in the field of digital geographic information and will provide the specific European context (CEN standards are often compulsory in EU legislation, whereas ISO standards are not necessarily so), and will co-operate closely with ISO to avoid duplication of work. Not all standards and specifications are finalized or approved though, and considerable work remains to be done to translate these into usable specifications which can be easily adopted by GI professionals. These standards have to work in conjunction with the appropriate standards for the base underlying technologies (W3C, OMG, UDDI etc).

Metadata for public sector datasets listed in the scope of the Annexes of the INSPIRE Directive should be created, maintained and published free of charge. Also, services based on these datasets must be adequately described. Here, a well established standard for metadata is available in ISO19115, with Dublin Core<sup>13</sup> recommended for information discovery, but again work remains to establish profiles which meet the needs of specific user communities and to build crosswalks between different metadata standards.

Various geoinformation services shall be implemented to support the following :

- discovery services
- view services
- download services;
- transformation services (reprojection);
- geoprocessing services

Discovery services (the “GI Search Engine”) are a part of the Catalogue Services that form the heart of a SDI, and should support users and applications in finding geographic information (and services) that exist anywhere in a distributed computing environment.

View services (web map services) provide a standard mechanism to portray spatial information quickly and easily for most users. ISO 19128 Web Map Server Interface and OpenGIS Web Map Server (WMS) specifications are established and widely supported.

Download services provide a delivery mechanism to the end user, for where the user requires possession of the data themselves. The OpenGIS Web Feature Server specification allows for serving of data, using the Geography Markup Language (GML) as a format for data exchange.

Authoritative coordinate transformation services are required (including certification) to ensure that the correct parameters are used – this is a process which currently introduces much potential for error when such transformations are performed by users with incomplete or incorrect knowledge. Other “Application” services may perform more advanced functions such as geocoding and modeling.

The focal point for these metadata, data and services will be the “GeoPortal”. A prototype INSPIRE GeoPortal has been built (<http://eu-geoportal.jrc.it>) providing basic metadata publishing and browsing and viewing capabilities. The current version is based on “harvesting” of metadata from remote publishers, whose metadata are gathered and indexed in a centralized repository, whereas future developments will investigate the feasibility of distributed catalogues and creation of a multi-lingual portal.

Coordination of these developments is a major task, requiring clear definition of roles and responsibilities. Discussions are now underway to define an INSPIRE Work Programme which, like the preparatory work of the expert groups, is a bottom-up, collaborative process. Detailed rules and guidelines which provide the specific instructions on how to implement the various aspects of INSPIRE must be prepared. By necessity, this will be a step-by-step approach. The types of structures which must be put in place include a permanent INSPIRE secretariat, a network of INSPIRE National Focal Points, Thematic Spatial Data Interest Groups. The Joint Research Centre will support these initiatives, acting as the technical and scientific coordination body. Stakeholders at all levels must be involved in this process – at European level there is already extensive collaboration between the Commission (Directorate General Environment<sup>14</sup>, JRC<sup>15</sup>, Eurostat<sup>16</sup>), the European Environment Agency (EEA<sup>17</sup>), Research organizations (AGILE<sup>18</sup>, EuroSDR<sup>19</sup>), umbrella organizations (EUROGI<sup>20</sup>), Mapping Agencies (EuroGeographics<sup>21</sup>) and many more.

An extended impact assessment was a pre-requisite for INSPIRE. Whilst many of the analyses of benefits of SDI remain qualitative (more integrated policy making, monitoring and evaluation; reduced duplication of data collection; increased public and NGO participation in decision making; creation of new added-value products and services; increased transparency etc), it is also estimated that the additional costs of implementing INSPIRE represent between 1-2% of current expenditure on similar activities which are clearly outweighed by the economic benefits.

Whilst INSPIRE tackles several key barriers to the creation of an ESDI, particularly in terms of gaps in spatial data, interoperability, metadata, incompatibility of different GI initiatives and aims to stimulate data sharing and re-use, there are still fundamental organizational issues to be addressed. Like any other infrastructure, for an SDI to be effective it must work at all levels, is maintained, is well connected to other

infrastructures and that responsibility for its development and maintenance are clearly defined. These are the immediate challenges as part of the long term strategic process of building a European Spatial Data Infrastructure.

*DISCLAIMER : Pending adoption by the Commission of the INSPIRE proposal, this presentation cannot be considered as an official Commission Position*

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<sup>1</sup> “Spatial Data Infrastructures: Country Reports 2002” – GINIE Report 5.3.2(b), European Commission Joint Research Centre, 2002 EUR20428EN

<sup>2</sup> “Spatial Data Infrastructures in Europe: State of Play Spring 2003” - <http://inspire.jrc.it/reports/stateofplay/rpact3v4.pdf>

<sup>3</sup> “Developing Spatial Data Infrastructures: The SDI Cookbook” – <http://www.gsdi.org/pubs/cookbook/cookbook0515.pdf>

<sup>4</sup> “Convention on Access to Information, Public Participation in Decision-Making and Access to Justice in Environmental Matters”, Aarhus, Denmark 1998 - <http://www.unece.org/env/pp/documents/cep43e.pdf>

<sup>5</sup> Directive 2003/98/EC of the European Parliament and of the Council of 17 November 2003 on the Re-Use of Public Sector Information - [http://inspire.jrc.it/reports/l\\_34520031231en00900096.pdf](http://inspire.jrc.it/reports/l_34520031231en00900096.pdf)

<sup>6</sup> Directive 2000/60/EC of the European Parliament and of the Council of 23 October 2000 Establishing a Framework for Community Action in the Field of Water Policy - <http://inspire.jrc.it/reports/WFD-EN-22-12-00.pdf>

<sup>7</sup> Council Regulation (EC) No 1593/2000 of 17 July 2000 amending Regulation (EEC) No 3508/92 Establishing an Integrated Administration and Control System for Certain Community Aid Schemes - [http://europa.eu.int/eur-lex/pri/en/oj/dat/2000/l\\_182/l\\_18220000721en00040007.pdf](http://europa.eu.int/eur-lex/pri/en/oj/dat/2000/l_182/l_18220000721en00040007.pdf)

<sup>8</sup> “Map Projections for Europe”, A. Annoni, C. Luzet, E.Gubler and J. Ihde (editors) [http://www.ec-gis.org:8080/wecgis/ECGIS.DYN\\_DOCUMENT.show?nome='425'](http://www.ec-gis.org:8080/wecgis/ECGIS.DYN_DOCUMENT.show?nome='425')

<sup>9</sup> [www.euroroads.org](http://www.euroroads.org)

<sup>10</sup> Geological Data Model International Collaboration - <http://ncgmp.usgs.gov/intdb/dmic/dmic-rep1.html>

<sup>11</sup> ISO Technical Committee 211 Geographic Information / Geomatics <http://www.isotc211.org>

<sup>12</sup> The OpenGIS Consortium – [www.opengis.org](http://www.opengis.org)

<sup>13</sup> The Dublin Core Metadata Initiative – <http://dublincore.org>

<sup>14</sup> European Commission Directorate General Environment - <http://europa.eu.int/comm/environment/geo/index.htm>

<sup>15</sup> European Commission Joint Research Centre – [www.jrc.it](http://www.jrc.it)

<sup>16</sup> European Commission Statistical Office - <http://europa.eu.int/comm/eurostat/>

<sup>17</sup> The European Environment Agency – [www.eea.eu.int](http://www.eea.eu.int)

<sup>18</sup> The Association of Geographic Information Laboratories in Europe – [www.agile-online.org](http://www.agile-online.org)

<sup>19</sup> European Spatial Data Research – [www.euroedr.org](http://www.euroedr.org)

<sup>20</sup> European Umbrella Organisation for Geographic Information – [www.eurogi.org](http://www.eurogi.org)

<sup>21</sup> [www.eurogeographics.org](http://www.eurogeographics.org)