GINIE: Geographic Information Network in Europe

IST-2000-29493

Spatial Data Infrastructures: Country Reports

FINAL

D 5.3.2(b)

Project Co-ordinator:
University of Sheffield - USFD

Partners:
Open GIS Consortium (Europe) -OGCE
European Umbrella Organisation for Geographic Information-EUROGI
Joint Research Centre of the European Commission- JRC

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September 2002

Disclaimer: The views and opinions expressed in this report are those of the editors alone and do not necessarily represent either those of the participants in the meeting nor of the organisations they represented.

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Background

There is an increasing recognition that some of the main challenges of modern society such as protecting the environment, increased security, better transport, socially just development, and enhanced services to citizens require decision-makers to identify where need is most pressing, and means to effectively target intervention, monitor outcomes, and assess impacts. For all these tasks, geographic information is crucial. Such information must not only exist, but it must be easy to identify who has it, whether it is fit for the purpose in hand, how it can be accessed and integrated with other information. It is therefore necessary to have in place a framework of policies, institutional arrangements, technologies, data and people that makes it possible to share and use effectively geographic information. The term Spatial Data Infrastructure (SDI) encapsulates such framework.

The importance of an SDI for good governance, economic, and social development, has lead most countries in the world to engage in the process of developing such infrastructures. A survey[1] completed in December 2001, indicates that 120 of the 192 nations in the world are working on their national spatial data infrastructure, with half having already established catalogues of key data resources searchable on the Web. Whilst there is clearly a lot of variability on the extent and quality of such endeavours, this finding indicates that SDIs are not just a luxury of wealthy nations, but a perceived strategic development for both developed and developing countries.

In Europe, most countries are in the process of developing SDIs at national and/or regional/local levels. There are world-class examples of best practice, side by side with very patchy developments that have only recently started to make some visible progress. These variations are partly a function of the institutional and cultural heterogeneity of Europe, but also of the varying levels of awareness and political support that exist across the continent. As Europe becomes economically and socially more integrated, there is also a growing recognition that some of the processes that need to be addressed at a Europe-wide scale, such as environmental change, security, transport, and social cohesion, require Europe-wide frameworks of spatial data with at least some minimum common denominator across all countries.

With this in mind, a recent major initiative has been launched by the European Commission to develop an Infrastructure for Spatial Information in Europe (INSPIRE). The vision of such initiative, which is the first step towards a European SDI, is that:

- 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, e.g. detailed for detailed investigations, general for strategic purposes

[1] Crompvoets J. and Bregt A. 2002. World Status of National Spatial Data Clearinghouses. http://www.urisa.org/Journal/Under_Review/articles_under_review.htm

- Geographic information needed for good governance at all levels should be abundant and widely available under conditions that do not inhibit 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
- Geographic data must become easy to understand and interpret because it can be visualised within the appropriate context and selected in a user-friendly way.

Whilst INSPIRE is developing the legal framework needed to underpin the creation of a European SDI, starting from priorities in the environmental field, it is clearly important to evaluate the extent of progress of SDIs in Europe, and identify key issues that need to be addressed to ensure complementarity between European and national/regional developments. For this purpose, GINIE[2] convened a meeting of experts in the field of SDIs, coming from 13 European countries and the US. The meeting took place at the Joint Research Centre of the European Commission in Ispra, Italy, 6-8th May 2002. The list of participants in included in Appendix A.

The meeting built on two previous ones organised in 1999 and 2000 on "Geographic Information Policies in Europe: National and Regional Perspectives" and "Geographic Information and the Enlargement of the European Union" respectively. The reports of these earlier meetings area available from the GINIE Web site (http://www.ec-gis.org/ginie/). Additional information and analysis of the broader policy framework within which NSDIs in Europe are developing, and in particular their relationship with e-government initiatives is the subject of another GINIE workshop and report, soon available from the GINIE Web site.

This report is based on the presentations made and discussions held at the meeting, with some additional material where required. We were also able to include the important SDI experiences of Finland and Portugal, whose representatives had been invited at the meeting but could not attend. They were however able to send the material required at a later stage for inclusion in this report. The report is structured in two parts: Part I presents a summary of each country's experience in relation to the development of a national (or regional) SDI. Part II, provides a synthesis of the national experiences, with comparison, and evaluation, and recommendations for actions from a European perspective.

[2] GINIE is a project funded by the Information Society Technologies Programme of the European Union with the purpose of developing a cohesive Geographic Information Strategy at the European level. Its partners are EUROGI, OGCE, the Joint Research Centre, and the University of Sheffield.

Part I:

The Experience and Development of Spatial Data Infrastructures

Austria

Context

Austria is a federal republic of around 8 million people in an area of 84,000 km^2. In terms of its political and economic administration it is organised in 9 states, that play an active part in the development of state level SDIs.

Foundation and Legal framework

The Austrian legal framework for the collection, use and dissemination of public sector information is partial, with federal states and the private sector having their own regulations. There is a legal framework for the cadastre, but not one specific to an NSDI.

Funding

It has also been suggested that public funding is favoured at present but this depends on political decisions to be taken on pricing policy for the public agencies.

Educational aspects

Educational aspects are not really considered until now.

Co-ordination

Key actors are the Austrian national mapping agency, Bundesamt fur Eich- und Vermessungswesen (BEV) founded in 1925, and the AGEO, the Austrian Umbrella Organisation for Geographic Information that was founded in 1998. However, no discussion forum exists for government institutions in relation to an NSDI.

Federal government is in principle responsible for coordinating the SDI activities of the states, six of which are particularly active. There is however a degree of difficulty in achieving such coordination whilst trying to keep all the actors involved without a specific body having the overall responsibility. There has been some discussion of Public Private Partnerships to aid in the development of the NSDI. The issue of funding has led to discussions about Intellectual Property Rights (IPR) and pricing between public institutions. What is required is to start bringing together the developments at state and local level.

Data content

In Austria core data sets include those created for public interest or those required by law. Examples include land information, topographic maps, addresses and environmental information, the latter being freely available after the implementation of the 1990 EC Directive. Other information exists including more extensive coverage of planning information and addresses, although provision is dependent on the decisions made by the federal states and so there is not a complete coverage for the entire country.

Access to information

Data access and geoprocessing services have been set up where data access is partly regulated by laws or through by-laws for services provided to the public, with only a few restrictions on private data in this context. Data documentation is partly regulated depending on the type of information involved and there are strict regulations for land

information in particular. In contrast, any semantic interoperability issues are felt to be more or less market regulated. Discovery services exist for data users as metadata exists for certain data at provincial and federal levels, alongside a complete metadata set for land registration. AGEO is currently planning an Austrian metadata service by linking existing services, but this is yet to be developed.

Standards

The market is seen as a determining force for the present, with no real standards being applied. Regulation may, however, come through a new e-government initiative, where some progress has been made for all administrative items. This initiative aims to exploit public information as far as possible but clarification is needed for competence within the federal agencies.

User expectations and benefits

Driving applications are mainly spatial planning and emergency services that could provide funds for the SDI development. Initiatives such as e-Government and e-Europe, currently implemented, are proceeding well for all administrative items and SDI is seen a key element for the exploitation of Public Sector Information. Existing (individual) SDI have to be merged.

Catalunya (Spain)

Context

Spain has a population of some 41 million inhabitants over 506 Km^2. It is a parliamentary monarchy organised in 17 autonomous communities.

Foundation and Legal framework

No legal framework at present underpinning the development of an SDI in Spain at either national or regional (autonomous community) level. Hence, a "national" SDI does not exist yet. There are however, several initiatives undertaken by individual autonomous communities such as Galicia, and Madrid, with more expected to start. Currently, the most important regional SDI is that of Catalunya, which with a population of over 6.3 million inhabitants is one of the largest autonomous communities in Spain, and with its capital Barcelona, the economic powerhouse of the kingdom. The land area of Catalunya is 32,000 Km^2, or 6% of Spain's total.

The Catalan government has been working on a project (IDEC) to develop their SDI. The project will last two years and will form a permanent institution with a foundation and consortium. It was promoted in 2000 by the Catalan Section of Spanish Association of GI (AESIG) and started in January 2002.

Funding

IDEC is funded by the Ministry for Universities, Research and the Information Society of Catalonia and sponsored by the Department for the Information Society (in terms of funding) and the Cartographic Institute of Catalonia, which is the Agency responsible for its development

Educational aspects

Overall the aims of the IDEC Project is to change the culture of public administrations in terms of the way they handle and share spatial information. It will offer a forum for those involved with spatial information to meet, including the various actors involved across the sector.

Co-ordination

Government of Catalunya.

Data content

The IDEC Project's main data sources are Topographic data, Orthophotos, the Cadastre; and data from Urban and Land planning, all acquired at large scale (ranging from 1:500 to 1:5,000 scale). There will also be a series of thematic data including environmental and agricultural data sets and some local geodata.

Access to information

The development of metadata and related services is central to the IDEC project. In the first year the priorities are creation of metadata, creation of a metadata server, and development of a culture of data sharing among departments in the autonomous government. In the second year, it is envisaged to develop further the facilities of the catalogue server with OGC specifications and ISO standards so as to have a fully functioning Web Map Server (WMS), and Web Feature Server (WFS), able to generate e-commerce transactions.

The starting point of implementation is to make available free of charge software for metadata capture, which will be distributed to any organization interested in it, and a pilot project about sharing data (interoperability) in four departments of the administration. However, language problems have already been noted, such as provision of information in Catalan, Spanish and/or English, alongside a need to develop the technical support to provide a useful service. The catalogue server that accompanies this will initially involve hosting the metadata on a "central" catalogue for consultation (WMS) before a link is opened with other servers and the WFS is developed.

Standards

ISO standards and OGC specifications adopted. Language problems required the development of specific software for metadata capture.

User expectations and benefits

It is hoped that such a process will provide an opportunity to develop the geoinformation market, help to diffuse public use and understanding of GI and rationalise some of the activities of their public administrations. There is also a desire to draw in the private sector and academic institutions into these developments. The IDEC project's first application will focus on diminishing transaction costs in the GIS sector, such as access to geodata and services, alongside other sectors such as real state.

Czech Republic

Context

The Czech Republic has 10.3 million inhabitants and it covers 79,000 km2. It is organized in 13 regions plus the region of the capital Prague. Administrative reorganization is taking place as part of the process of accession to the EU (1999 - 2002).

Several key elements of an NSDI exist but there had been a lack of coordination and of strategic plan/programme for further development up to 2001.

Foundation and Legal framework

The programme of further development of the National Geoinformation Infrastructure (NGII) for 2001-2005 has been set in place in 1999. In 2001 the most important state administrative bodies adopted it as well as the private sector (i.e. all members of the Association Nemoforum). The Governmental Council also supports the NGII Programme because it is seen as helping to deliver the State Information Policy and its activities connected to e-Europe and e-Government.

The NGII Programme has ten priority areas including the development of the organizational, legislative and financial framework, core data, metadata, standards, qualification of professionals, and education and skill development. Particular attention is being given to the development of the policy framework including conditions for access to public sector information, with specific conditions for public administration and education establishments, and the update of the copyright framework.

A number of priority projects have been identified, every one having a lead player who is responsible for coordination and linkage with related developments either at national or EU level (e-government, e-Europe).

Funding

In addition to the funding of specific projects from the individual organizations involved, a central fund has been established for the Action Plan of Implementation of the State Information Policy. The bodies and organizations responsible for carrying out the projects set out in the Programme can therefore apply for support from this fund.

Educational aspects

A specific project has been set up to train employees in the public administration in the field of geoinfomation. Moreover, new study subjects in geomatics and geoinfomatics are being included in the study programmes of universities and secondary schools (project GLOBE).

Co-ordination

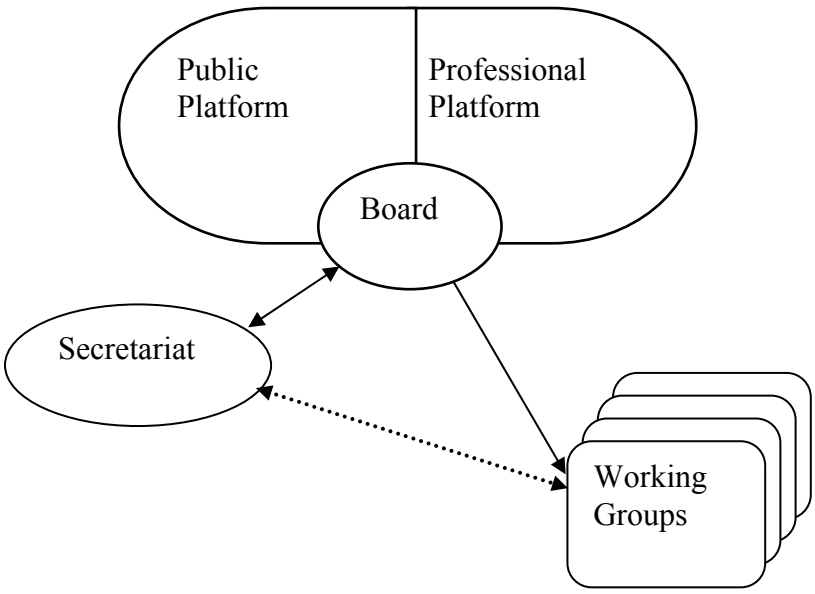
The Office of Surveying, Mapping and Cadastre and the Czech Association for Geoinformation (CAGI) have a leading role in coordinating the NGII development programme. In addition, a platform for co-operation (Association Nemoforum) involving both public administration, the private sector, and other stakeholders such

as professional unions, and universities, was established in 1999, and now plays an important role in the development of the NGII.

Table 1: Nemoforum members

The Public platform:	*The Professional platform*:
Czech Office for Surveying, Mapping and Cadastre, Ministry of Finance, Ministry or Regional Development, Ministry of Interior, Ministry of Agriculture, Union of Towns and Municipalities of the CR, Office for State Information System.	Association of Real Estate Offices of Bohemia, Moravia and Silesia, Czech Association for Geoinformation, Czech Society of Certified Property Valuers, Chamber of Notaries of the CR, Chamber of Surveyors and Cartographers, Masaryk University Brno, Union of Land Owners and Private Farmers in the CR, University of West Bohemia in Pilsen, Utilities East Bohemia, Utilities West Bohemia.

Figure 1: Nemoforum structure



Data content

The most important core data sets of the NGII in the Czech Republic include the spatial reference frame of geodetic control points, the state map series in analogue and digital forms and the fundamental base of geographic data (ZABAGED). Additional important projects being developed include the ortho-photo database of the territory, the digital cadastral map, and the basic register of spatial identification and real estates. Important thematic layers focus on environmental data and the database of tourist resorts.

Access to information

Some basic registers of public sector information systems are already available. The main geographic information metadata service MIDAS has been developed by CAGI (http://gis.vsb.cz/midas/), and there is considerable attention being paid to the development of the INSPIRE initiative.

In general terms, access to information is regulated by the law on free access to information on public administration activities and actions. Geodata datasets produced and managed by public administrations are available under very different conditions depending on the bodies and authorities themselves. No general approach or regulations exist.

Standards

The CEN pre-standards were adopted as Czech technical norms. They are in use for metadata and efforts are under way to revise the specifications in the light of recent ISO developments. A project has been started to define the set of standards for geodata transfer and the release of a common glossary.

User expectations and benefits

The main followed goals include especially:

- Simpler practical access to geoinformation for the public and private sectors as well as the general public based on metadata service and transfer standards.
- Multiple use of different thematic geoinformation sources based on unique core datasets.
- Transparent and fair conditions for access to geoinformation for all, especially of geoinformation managed by public administrations.
- Improvement of knowledge of information potential of geoinformation and its use in all sectors and by the general public.

Finland

Context

Finland has long been recognised as a country with exceptional data sources. With a population of 5.2 million inhabitants, it covers an area of 338,195 km^2, of which 33,615 km^2 is surface water, making it a state with one of the lowest population densities in Europe (17 inhabitants per km^2). This near unique geography has contributed to Finland's interest in managing their natural resources and in developing their technological infrastructure to connect a dispersed population.

Foundation and Legal framework

The Finnish SDI has developed an institutional framework that brings together government, , governmental institutions, local administrations, industry and users, along with the Finnish Council for GI (FCGI) (see Fig 2). A Land Information System managed by the National Land Survey (NLS) integrates both rural and urban information systems to provide a common service for the whole country. Updates in the structure of the system and services it provides are foreseen based on new legislation planned for 2003.

Funding

Funding of the national basic registries is mainly provided by the Government. However the funding of the maintenance of the national topographic database and cadastral system is based on partial cost recovery.

Educational aspects

Awareness raising is clearly recognised as a priority under responsibility of the Finnish Council for Geographic Information. Universities are very active in GI research and education. Several national seminars are organised in GI technology and applications every year by scientific associations, ProGIS and various institutions.

Co-ordination

Several actors are actively involved:

- The Finnish Council for Geographic Information coordinating the NSDI development,
- the Finnish standards association (SFS) deals with their SDI's technical standards.
- The National Land Survey (NLS) is responsible for the real estate register and topographic database.
- The Ministry of Agriculture and Forestry (MAF) is coordinating the development of the Land Parcel Information System.
- The Ministry of Justice is supervising the land register.

The central part of the institutional framework is the Finnish Council for Geographic Information, an official advisory board in GI affairs. It was instituted at the end of July 2001 and the 17 members of the council are key stakeholders. There are three working groups and a part-time secretariat, with chair responsibilities coming from the MAF. The Council has the following tasks:

- To act as official advisory board in GI related affairs;
- To evaluate the status of the Finnish SDI;
- To promote wider use of GI and identify unnecessary overlapping activities;
- To foster economic efficiency in data collection and data services;
- To specify any general research needs in the GI sector; and
- To prepare the national GI strategy (which is the SDI strategy).

The members of the Finnish Council for Geographic Information council are:

- State departments
  - Agriculture&Forestry, Defense, Finance, Interior, Transport&Communication, Environment
- Governmental organisations
  - Geodethic Institute, Geological service, National Land Survey, Maritime Administration, Environmental Institute, National Technology Agency, Statistics Centre, Population Register Centre
- Local administration
  - Association of Finnish Local and Regional Authorities
- Industry and GI data service companies.

Promoting awareness of the SDI has come through a number of avenues. POSITIO, the national GI journal has been a common place to discuss the SDI and in 1996 the Consultative Committee for Data Administration in Public Administration published a SDI report: *NGII of Finland: starting point and future objectives of the information society* (http://www.nls.fi/ptk/infrastructure/index.html). The Council and the national association for GI (ProGIS, http://www.progis.fi) have adopted the role of promoting the idea of SDI in Finland. .

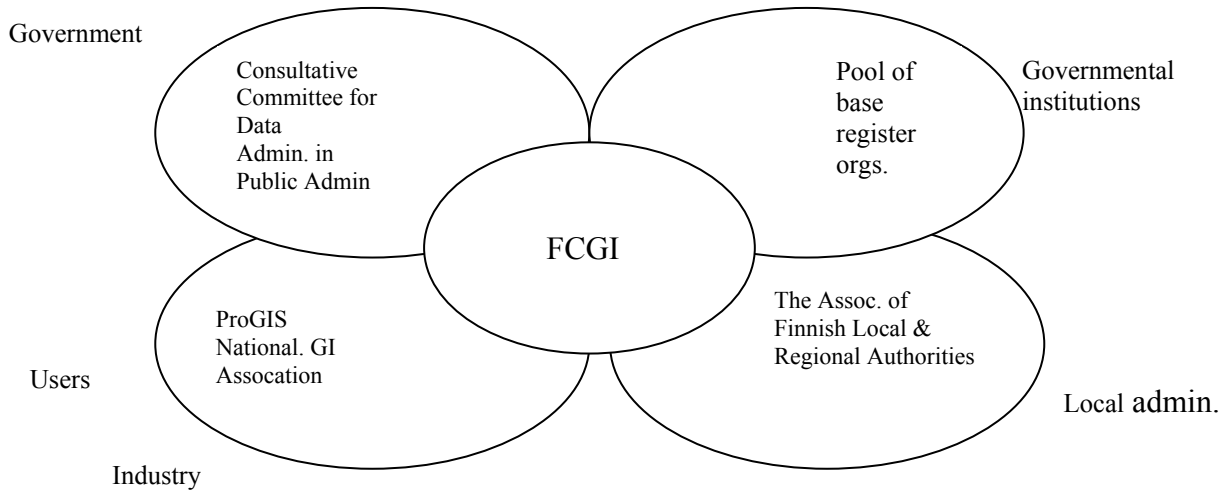


Figure 2: The Finnish SDI Institutional Framework

Data content

In Finland the national official base registers draws together important features also for a national SDI, including personal identification that allows a great deal of socio-economic data to be attributed to spatial locations. The diagram below sets this in the context of national and local GI datasets (see Fig. 3: Elements of a Finnish SDI).

Alongside these elements of their SDI, Finland has a clearly set out cadastral system. The land register comes under the supervision of the Ministry of Justice and includes the local courts, the register of legally confirmed titles, the mortgage register, the conveyance register and related data services.

The National Land Survey (NLS) is responsible for the real estate register for Finnish rural areas covering 90% of the country. The 86 cities are responsible for their own real estate register covering the remaining 10% of the country. NLS is also responsible for the national topographic database that currently covers 90% of the country. A project has begun to harmonise the quality of the basic topographic data and complete homogenous coverage of the country is expected by 2006. The system also partly draws on the work of the local authorities that annually provide data for updating the road and building features, with all others being amended by the NLS within five to ten years.

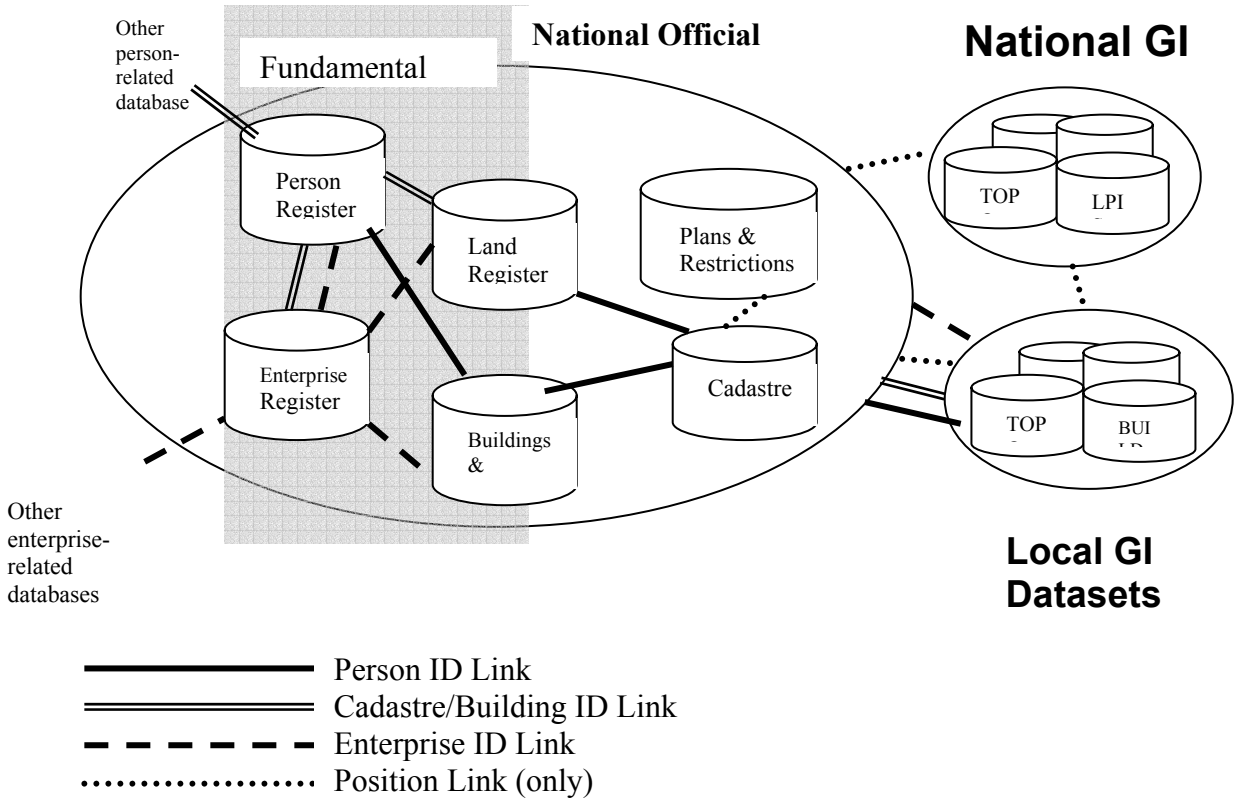


Figure. 3: Elements of the Finnish SDI

A third core dataset comes in the form of an agricultural Land Parcel Information System. This element of their SDI is co-ordinated by the Ministry of Agriculture and Forestry (MAF) that sets out guidelines, legislation, agreements and a second level of control for information produced for this system. This system is particularly important to manage the agricultural subsidies and is an integral part of the Integrated Agricultural Control System (IACS) required by the EU.

Access to information

The access network in Finland can be looked at in terms of data policy and data services. Data policy relies on good access, state and institution copyrights, use licenses and open pricing principles. Finland has had a long tradition in promoting the shared use of GI. The Finnish data services include their national data catalogue that has existed since 1992, although it has been suggested that it needs modernising. NLS has been maintaining an internet map service since 1995 (http://www.kartta.nls.fi) and a new version is due at the end of 2002. The largest scale of the basic maps within the service is 1: 20,000 and the maps are presented in raster form. Two versions of the map site exist, with a free one for citizens and a professional one that has charges. The NLS and private companies also actively distribute national GI data to users.

Standards

The Finnish standards association (SFS) is an independent, non-profit making organisation that co-operates with trade federations, industry, research institutes,

labour market organisations, consumer organisations, government and local authorities. Specific to the GI sector there is a set of technical recommendations for public administrations (JHS) that are co-ordinated by the Consultative Committee for Data Administration in Public Administration (JUHTA). These complement the official standards of the SFS and are used as GI standardisation tool in the public sector. A new proposal to adopt ETRS98 as reference framework is currently waiting for comments, as are preparations to adopt the ISO 19100 family of standards.

User expectations and benefits

The assessment of expected benefits of NSDI is considered priority task of Finnish Council for Geographic Information: 1) for wider use of GI and removal of unnecessary overlapping activities, 2) to foster economic efficiency in data collection and data services.

Flanders (Belgium)

Context

Belgium is a federal parliamentary democracy under a constitutional monarch, with a population of 10.3 million people. It is organised in three regions: Flanders, Wallonia and Brussels, and 10 provinces. Each region is developing its own SDI: 'GIS Vlaanderen', RW-Infrasig in Wallonia, and UrBIS in Brussels. There are also three organisations operating at federal level: the Cadastre, the national mapping agency, and the Bureau of the Census. Of the regional SDIs, the one in the Flanders (GIS Vlaanderen http://www.gisvlaanderen.be/) is the most important, covering a population of some 6 million people, in a land area of just over 13,000 Km^2 and is discussed below.

Foundation and Legal framework

GIS Vlaanderen was set up between 1994 and 1995, with a formal decree in 2000 giving it legal status. It operates in a legal framework that involves several levels of governance including: regional administrations, regional institutions, provinces and the local administrations.

Funding

Funding comes from a government base, with special funds for the development of a large scale topographic base, while other projects utilise partner funding. Pricing policy for data is set by a steering committee that includes all stakeholders. By and large data is freely accessible to the members of the consortium and charged for external users. GIS Vlaanderen is very closely linked to the eGovernment initiative.

Educational aspects

Educational aspects are on a project-by-project base.

Co-ordination

Coordination is ensured by the technical committee of GIS Vlaanderen which includes 84 staff.. Other key actors include Vlaamse Landmaatschappij (the "Flemish Land Agency") who are responsible for areas such as land development, land consolidation and natural development and a manure bank. The institutional setting of GIS Vlaanderen can be represented by the following diagram

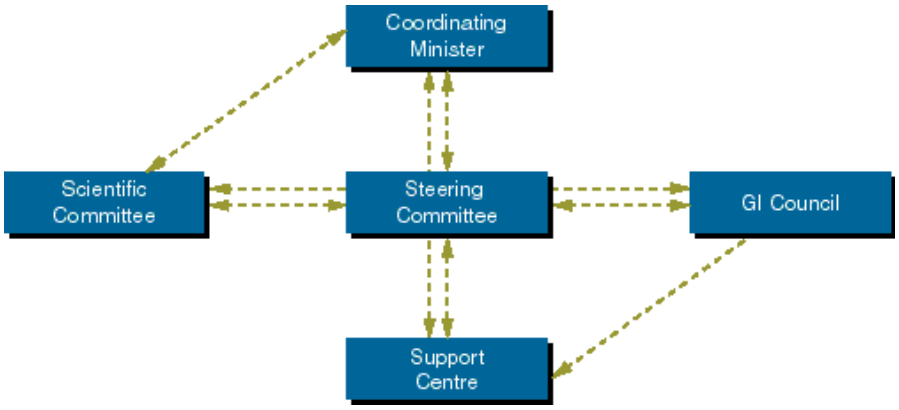


Figure 4: Actors in GIS Vlaanderen

Data content

The content of GIS Vlaanderen has a range of existing core datasets including:

- mid-scale base map GIS-Flanders;
- topographic maps for 1:10,000 and 1:100,000;
- black and white digital orthophotos (taken in 1995 and 2000);
- Flanders' hydro-geographic atlas (VHA);
- cadastral map: KADSCAN;
- large-scale maps (CARDIB) at 1:500 scale covering 40% of the territory.

Other thematic data exists for Flanders including a land-use map of the Flemish Region (1995), a soil map, forestry map, and designated/protected areas. There are also regional zoning maps and an annual agricultural parcel map (that includes the manure bank). A large scale reference map-base, colour orthophotos at 1:4000 and 1:12000 scales, Digital Elevation Models (DEM), and an address database (CRAB) are also being developed. Additional datasets such as the Census are linked to this reference base, following a decentralised philosophy, i.e. that the data must stay with their parent agency.

Access to information

Data documentation has involved a metadata management system (SPIDI), that contains an online documentation tool of data sources and a catalogue of data, and GRB, involving a data dictionary with concepts, specifications, illustrations and field examples. SPIDI has been limited as more extensive catalogues are only available for newer layers and directories only include those data that are within the system. Since 2002 GIS Vlaanderen has been providing search and location, online information and online distribution (via CD-ROM or FTP) services via Geographical Information Retrieval Application for Flanders (GIRAF). Geo-Vlaanderen provides online map services that combine central geographic data with remote thematic content from other sources. It utilises a uniform light-weight interface where users can build themes over base maps. The last example is FLEPOS, a public service RTK-GPS network that will be active from mid 2002, utilising a decentralised model of data shops with leases. This will provide uniform and cheap large scale co-ordinates available to all.

Standards
The spatial information directory is based on CEN pre-standard.

User expectations and benefits
Geo-Vlaanderen provides online map services combining geographic data with remote thematic content. The intention is to develop the service further in the context of the e-Government initiative.

France

Context
France has a population of around 60 million inhabitants, over a land areas of some 550,000 km². From the time of François 1er up until 1982, the country has had a centralised form of governance. Since 1982 there has been a great deal of decentralisation. The administrative structure includes 22 regions, 99 départements and 36,000 communes.

Foundation and Legal framework
France is in the unusual position of creating an NSDI without even realising it. Therefore, the NSDI as such is not considered to be an issue. Instead, the major areas of policy that are relevant to this endeavour include:

- Policies relating to the development of the Information Society include the Programme for Government Action (PAGSI: http://internet.gouv.fr) launched in 1998, and subsequent follow ups (Mission Bacquiast 1998, Mandelkern Report 1999, Carcenac Report 2001). These activities aim at increasing access to public sector information, and develop the infrastructure necessary for e-government. A framework law on the Information Society is currently before Parliament for discussion.

- Policies related to decentralisation have been enshrined in legislation starting from 1982. They include not only new responsibilities for communes, agglomerations, and other administrative levels but also thematic legislation on the environment, urban planning, and more generally territorial management. In this respect the framework enacted in 2000 on Solidarity and Urban Renewal (SRU) is important because it introduces two new instruments for territorial management, SCOT (Schema de Coherence Territorial) and PLU (Plan Local d'Urbanisme) both of which are heavily reliant on geographic information.

- Finally, the set of policies more closely linked to the development of an SDI follow from the Langagne Report of 1999 which recommended the development and maintenance of a national framework of reference at large scale (RGE) to include relevant topographic databases, the cadastre, administrative boundaries, and postal addresses.

Funding

Most of the core activities to develop the RGE are centrally funded by government. However, as they require partnership among many different organisations with different funding regimes, the picture is rather complex. In principle, there are four main mechanisms:

- pure public funding (often with public tendering)
    - e.g. rasterisation of cadastral maps, electronic nautical charts, geodesy, aerial survey, local governments' GIS, ..,
- barter funding (with local government and the utilities funding some areas)
    - e.g. vectorisation of cadastral maps: local governments and utilities funding the initial capture, Cadastral service updating for free to the partners
- partial public funding (particularly for subsidies and license fees for most of the products of the national mapping agency) and
- purely private funding.

Hence, when different organisations are tendering for public contracts, the situation may arise where competition law requires partly-funded public agencies to bid as if they operated at full cost, potentially leading the taxpayer to pay multiple times for the same service of product. This is a burning issue at present that needs addressing.

Educational aspects

Traditionally, in France the authorities hire people coming from the "école d'ingenieur". However, most SDI-relevant education is probably carried out at universities.

Co-ordination

At the national level there are two organisations coordinating SDI activities, both established in 1986: CNIG, the national council for geographic information, is the official policy advisor to the government on GI and coordinates the activities of central government department. AFIGéO, the French Association for GI, is instead a forum to coordinate activities and promote the use of GI among both public sector and private sector organisations. In addition to these national organisations, one hundred "Comités départementaux de l'information géographique" (Departmental Committees for Geographic Information) were established between 1994 and 2002, with several more also set up at the local level. The Ministry of Economy, Finance and Industry is responsible for the cadastre (100% funded) and national statistics (100% - itemized budget). Nautical charts (100% itemized budget) are under responsibility of the Ministry of Defence. IGN, the national Mapping agency, is an "établissement public" of the Ministry of Public Works (approximately 50% independent budget). The NMA has the role of integrator for the "Référentiel Géographique à grande Echelle – RGE".

Local SDIs initiatives are increasing and provide data services for cadastral information, orthophotographs and topographic data to local partners. Examples include the infrastructure established for the Urban Community of Greater Lyon, and departmental initiatives such as those in Vendée, and Haute Savoie.

Data content

The content of the French SDI is dependent on a number of sources. Core data sets are those of the RGE (topographic databases, the cadastre, administrative boundaries, and postal addresses), nautical charts, geological data, and socio-economic data from the National Statistical Institute. There is also a geodetical service through a permanent GPS network that is administered by the national mapping agency, municipalities and universities, amongst others. Whilst some of these data sets are already available from the respective agencies, the development of full coverage for the RGE will require a few more years of sustained effort and investment. The foreseen continuous updating of RGE requires semantic interoperability of data coming from different sources.

Access to information

There are several metadata services in place to provide access to public sector information in general. These include for example La Documentation Française (http://www.ladocumentationfrancaise.fr), and specific sites for legislation (http://www.jurifrance.com and http://www.legifrance.gouv.fr). In respect to geographic information, there are well developed sites for coastal information and geological information, but a more generic geoportal is not yet developed. CNIG hosts a "catalogue des sources" but this needs to be updated and improved. In terms of geoprocessing services the EDIGéO library is accessible with free coordinate transformation software.
The access to digital information is reviewed by the National Commission of Informatics and Liberty. There is an on-going debate about the implications for privacy.

Standards

EDIGéO was adopted as national standard in 1994. At that time France was also very active in the development of international standards having the chair of the CEN/TC 287 Committee between 1992 and 1998. In 1998 it adopted the CEN ENv as experimental French standards (in use with free sw available on line). The National referencing system: RGF93 is based on Euref and there is a on going work on "common framework for interoperability of administration information systems" (e-France / ATICA).

User expectations and benefits

Driving applications include free access to environmental data, risk management and all applications in local government including those reinforcing the collaboration at inter-municipality level. eGovernment, eEurope are strengthening contacts and pushing for Territorial information systems with shared GI at departmental level.

Germany

Context

Germany is a federal republic with 81 million inhabitants over 357,000 Km^2. Its administrative structure includes 16 states (Länder) and over 8000 municipalities. Each Land is responsible for its own topographic service, land and property register, environmental and statistical data collection, and in general for data policies. The

development of a German SDI has therefore tended to be decentralised and the extent of development variable. Recently though there have been major initiatives raising the political profile of a federal SDI (Geodaten Infrastruktur – Deutschland: GDI-DE), as well as developing framework for coordination.

Foundation and Legal framework

A key report on how to improve coordination in the field of GI was submitted in 1998 to the federal cabinet, resulting in the decision to establish a permanent "Interministerial Committee for Geoinformation" (IMAGI http://www.imagi.de) under the chairmanship and management of the Federal Ministry of the Interior (BMI). The BMI has delegated the management of this Committee to the Federal Agency for Cartography and Geodesy (BKG) which had been established in 1997. Further political support came at the start of 2001 when the Deutscher Bundestag had a debate on GI and passed a resolution on the 15th of February to implement rapidly the German SDI and promote the interdepartmental use of GI in the public sector. It also established the co-ordination of GI activities by the federal government, with support by the Länder and set about developing collaborations with the private sector and academia. The federal schema calls for a clear definition of responsible at different level.

Funding

Funding of NSDI is considered responsibility of the Government. At Regional level some interesting examples are emerging of Public-Private partnership and co-funding throughout e-commerce services (eg Northrhine Westphalia SDI).

Educational aspects

Focus is on awareness raising through the publication of an information brochure on spatial data, an interactive multimedia CD, the Web presence of the Inter-ministerial Committee for Geoinformation (IMAGI) and some presentations on the use of spatial data for members of parliament and federal authorities

Co-ordination

The coordination of the reference data as the fundamental part for the GDI-DE is based on the agreement between the topographic agencies of the 16 Länder, their Joint Working Committee (AdV), the agency of the military, and the federal agency BKG. The latter employs some 300 staff and is particularly responsible promoting the geodetic framework, coordinating federal mapping provision, and linking to international activities. The objectives of the agreement among these partners are to provide homogeneous reference data (as part of GDI-DE) and improved customer service. The importance of the coordination activities is crucial in a federal system, but also needs to encompass agreements with the private sector, such as the telecommunication industry, that have very large databases of addresses central to georeferencing activities.

As indicated earlier responsibility for data policies and pricing guidelines rest with the Länder. Therefore, the BKG is required to follow such guidelines. However, there is a clear understanding that the GDI-DE is a public infrastructure and policies for access to data are being developed consistent with this vision.

Data content

The GDI-DE relies on a number of core datasets or National Spatial Data Bases, totaling at present around 1000 Gb of information. The foundation is ATKIS, the Authoritative Topographic Cartographic Information System, featuring an object-oriented topographic database at 1:25,000 for the whole of Germany. This provides the basis for the smaller scales, and is constantly being updated and refined with additional features. As ATKIS is based on 16 slightly different data models, efforts are under way to integrate them more closely. Other key core databases include the digital elevations model, administrative boundaries, gazetteer of place names, and the cadastral information system ALKIS. The latter is based on a relatively old data model and efforts are in place to update it together with ATKIS.

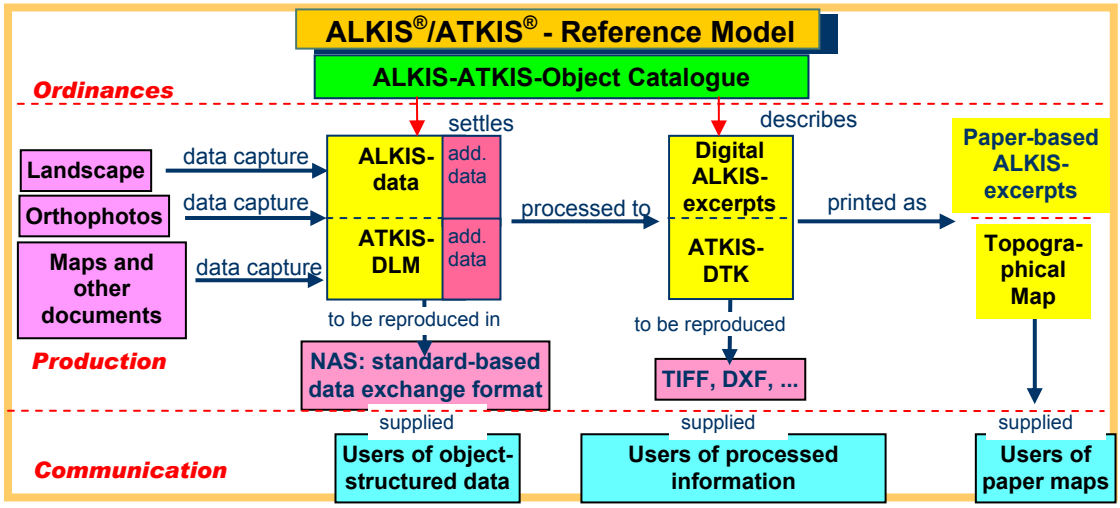


Figure 5: ALKIS/ATKIS Reference Model

Access to information

Given the federal structure of Germany and the number of agencies involved in the collection and maintenance of GI, it is not surprising that there are more than 50 metadata services related to GI. Therefore, a prototype discovery service ("GeoMis.Bund") has been set up by BKG to provide a platform independent Internet application with web-based query tools. It is provided in both German and English (input mask) and is capable of supporting spatial, temporal and thematic searches. It is hoped that this can eventually develop into a "GeoPortal.Bund".

Standards

A common data model has been defined for all reference data (ALKIS/ATKIS). Data modelling is done according to international standards (ISO/OGC)

User expectations and benefits

The German NSDI (GDI-DE) is to be a public infrastructure comprising meta data, integrated geodata, services and applications (GeoPortal.Bund) of the Federal Government and the Länder. Access (legal, technical, pricing) is expected to be improved. In addition the GDI-DE will stimulate the commercial use of spatial data and the cooperation with private companies taking into account the international context (contributing to the projects of EU and UN).

Greece

Context

Greece covers some 131,000 km^2 with a population of 10.5 million inhabitants. Its administrative structure includes 51 prefectures and 1 autonomous region.

Foundation and Legal framework

The legal frameworks that are pertinent to the SDI are those relating to the Hellenic mapping and cadastral organisation's founding laws and other areas of law that deal with the use and dissemination of personal data, and general national security issues. However, it has been noted that there is no sufficient legal framework for the protection of IPR in Greece and that a clear pricing policy on information has yet to emerge. As a result there are wide variations in the pricing schemes among government departments, and also within the private sector.

Funding

Funding of SDI is provided by EU Structural Funds and by eGovernment initiatives (proposals are now under evaluation).

Educational aspects

A master degree is achievable at the National Technical University of Athens (no bachelors degree in Geoinformation). Education of users is until now mainly responsibility of software vendors organising specific seminars.

Co-ordination

The key stakeholders for the development of an SDI mainly come from government institutes and some actors from the private sector. An important public actor is the Ministry of Planning, Environment and Public Works who is in charge of the Hellenic Mapping and Cadastral Organisation, as well as the Departments of Planning and Environment, and the cadastral project, Ktimatologio S.A., which is funded by the EU. Another important institute is the Ministry of Defence who provide the Hellenic army and navy geographical services and the national meteorological service. Responsibility for topographic services and the secretariat for registries is held by the Ministry of Agriculture with the national statistical service existing in the Ministry of Economy. The last actor is the Hellenic Association of Geographic Information (HellasGI). All these actors are playing a role in the emerging Greek e-government activities.

Whilst there are several stakeholders active in developing components of the SDI, a clear framework for coordination is not yet in place, thus hampering the overall development. There is however an increasing level of awareness and moves towards launching a formal HellaSDI initiative with wide participation and linkages to the e-government activities, and other relevant European initiatives such as INSPIRE.

Data content

Three scales operate for the operations leading up to the HellaSDI. At the small scale, the Ministry of Environment's Department of Planning began a project in 1995 to digitise 1:250,000 scale maps (DB250K). At the medium scale the same department ran a project from 1998-1999 to digitise 1:50,000 scale maps (DB50K). The National

Statistics Service in the Ministry of Economy has completed work with land cover data that utilises the CORINE methodology and the National Statistics nomenclature. Also at this scale there is a need to deploy CORINE Land Cover 2000 but this has not been launched yet. There are also issues about the lack of updating procedures at this scale. At the large scale cadastral information covers about 15% of Greece (at 1: 1,000, 1:5,000 and 1:10,000 scales). The Ministry of Agriculture has also generated orthophotographs at a 1m. resolution for 80% of the country (1996 and 1999). A final source project involves the National Statistics Service and photogrammetric diagrams (with a positional accuracy of 0.5 m.) for all their cities with a population of more than 2,000 inhabitants.

Access to information

In this context is has been noted that there is a lack of documentation and catalogue services. A pilot project to establish data on the web has been set in place by the Ministry of Environment and Planning (see http://mapserver.minenv.gr/website/pilot).

Standards

A unique reference system GGRS'87 based on GRS80 spheroid is used in all projects and Agencies since 1990. Transformation parameters to convert from/to WGS84 and from all previous systems used in Greece before GGRS'87 are available. Other Standards are on project base.

Italy

Context

Italy has a population of 57 million inhabitants over a land area of just over 301,000 km^2. Its system of government is organised through 20 regions, 106 provinces, and over 8000 municipalities. Since the devolution of the 1970s the regions became responsible for land-use planning and territorial management, and in 1990 a second decentralisation gave powers to the provinces in respect to environmental management.

Foundation and Legal framework

Since the 1970s, the regions have played a major role in producing topographic maps, but the lack of a clear division of responsibilities between them and the national mapping agencies resulted in fragmentation, and different standards. With this in mind, the agreement reached in 1996 between the State and the Regions for the development of a common Cartographic Reference System is very significant. This has been followed-up by an Integrative Agreement in 2000 signed by:

- Ministry of Environment and Land Protection
- Ministry of Defence
- Ministry of Finance
- Treasury
- AIPA (Authority for Informatics in Public Administration)
- National Mapping Agencies
- Regions
- Provinces (UPI) and Municipalities.

The core of the Agreement is that "State and Regions agree on the necessity to concentrate all efforts towards the coordinated development of geographical databases essential for the creation of the geographic information systems of the Public Administrations at national, regional and local level". In practice, this involves:

1. Technical specifications
2. Data compliant with technical specifications
3. Activities to publish and make available geographical information (catalogue)

Funding

Overall coordination is under the Ministry for the Environment, with National funding coming from the Treasury, the Ministry of the Environment and Land Protection, and some European funds for Objective 1 regions. This initiative is now also framed within the e-government policies coordinated by the new Ministry for Technological Innovation.

Co-ordination

Overall coordination of the NSDI rests with the Ministry of the Environment, with a Steering Committee representing the agencies signatory to the Agreement, and supported by a Co-ordinating Technical Committee.

The main producers of geographic information at the national level are the National Military Institute (IGM), which has traditionally been responsible for mapping at 1:25,000 scale and smaller, the Navy's Hydrographic Institute (IIM), the Air Force Geo-topographic Information Centre (CIGA), and the Cadastre under responsibility of the Ministry of Finance. Larger scale topographic mapping is undertaken by the municipalities, provinces, and regions for their own territory.

Data content

At the national level, some key layers are already available or being completed including the geodetic network, raster topographic data at 1:10,000-1:25,000 scales, orthophotos (B/W and colour) and the Digital Elevation Model, and key vector layers such as Administrative boundaries, Hydrological Grid and Basins, Railways and Motorways, Gazetteer, Urban Center and Residential areas boundaries. Larger scale datasets are also available but their coverage and varies strongly from region to region.

Access to information

Given the decentralised structure of the providers of geographic information in Italy there are several services at national and regional level providing discovery and access services. Their coverage is variable, and a major project is the development of a single portal for the reference data which is core to the NSDI. This service is being developed by the Ministry of the Environment and is expected to be available online within the near future (http://www.sistemacartograficonazionale.it)

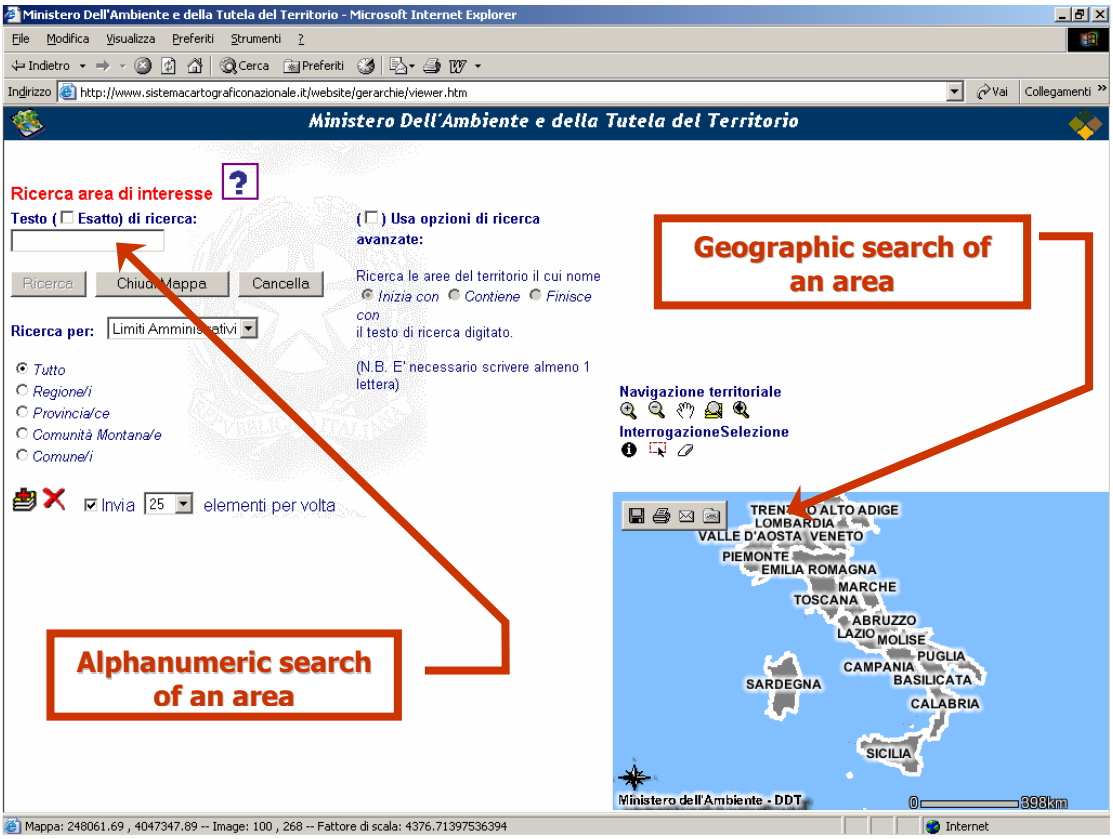


Figure 6: The query engine of the Ministry of Environment

Standards

Common rules and standards have now been defined. The objective is to have the whole territory at 1:10,000 scale for at least the main themes such as road and river networks, geodetic framework, and administrative boundaries by 2006 together with at least 10% of the national territory, covering the main population centres, at large scale 1:1000-1:2000. To support the work of the municipalities, over two hundred technical centres are envisaged across the country to help develop and maintain the database, and integrate it with other information coming from the utilities and the cadastre.

User expectations and benefits

The general principle underpinning the new system is that of decentralisation, with databases developed and maintained by their institutional owners or custodians, but with access available to all. The agencies participating in the Agreement have free access, while those outside the agreement are encouraged to participate by publishing their own data, in exchange for access to existing databases. Citizens and the private sector are allowed free access for consultation (viewing) but not downloading.

Norway

Context

Norway has a population of around 4.5 million inhabitants over 324,220 km^2. The administrative structure is organised through 19 provinces and 435 local authorities. The development of a NSDI is well advanced, and as Norway is a relatively small country in population terms, there is a strong degree of informal collaboration among key individual and agencies without the need for complex legal frameworks.

Foundation and Legal framework

The legal framework for the Norwegian NSDI is based around their Land Division Act 1995, that will be augmented by an upcoming Land Registration Act. The leading role in GI production, maintenance, and coordination of NSDI-related initiatives is taken by the Norwegian Mapping Authority (NMA), under the responsibility of the Ministry of the Environment. The NMA's responsibilities extend not only to topographic databases but also to nautical charts, land registration, addresses and buildings, and to the development of relevant legislation and wide consultation. (http://environment.norad.no/centres.cfm?orgid=1008). The development of a NSDI is part of a broader policy for e-government lead by the Department for Industry and Trade. The national plan *eNorge 2005* has been published in May 2002, and includes the strategy to increase access to public sector information and exploit electronic content (*Strategi for Elektronisk Innhold).*

Funding

Funding comes from government, user charges, and 'joint ventures' with public authorities and public owned organisations. Discussions are also taking place about the establishment of public private partnerships (PPP), although no large projects have yet been initiated.

Educational aspects

In general there is a lack of awareness about NSDI and policy aspects.

Co-ordination

The Co-ordination of the Norwegian SDI comes from their NMA and the Ministry for the Environment. The core data sets at large scale are updated and maintained through a process of cooperation (the Geovekst forum) among different key players including municipalities, the utilities, the road and railways administrations and the NMA itself. Other data producers and users in the private sectors have recently formed the Association of Enterprises in Geomatics (GBL) to interface with the public sector and improve cooperation. Within Geovekst, annual geodata plans are agreed to implement projects of common interest. Each partner contributes to the projects with funding and personnel and the resulting databases are accessible to all participants. External accesses to these databases are regulated through a series of agreements on usage rights and marketing rights.

Data content

Core data sets are well developed in Norway through the Geovekst framework, and through the Arealis programme that deals with land cover data, environmental data, planning information and other data sources that are useful for a SDI. Arealis includes

the participation of all the municipalities in Norway. Examples of available core data sets include:

- geodetic networks;
- SATREF, broadcasted GPS correction service at cm level,
- large scale data at 4 levels;
- small/medium scale topographic data with 100% coverage;
- hydrographic information that will be complete in 2006;
- a complete real property register that is continuously updated. Map coverage is at present at 50%;
- all addresses are continuously updated with coordinates;
- all buildings are continuously updated with coordinates; and
- data for all public and private roads longer than 50m are continuously updated with an accuracy between 1-2 m.

There is a clear content policy in favour of continuously updating from administrative resources (such as statutory development processes), and to support information flow from large scale to small scale through aggregation and generalisation that are combined with periodic updates.

Access to information

The main geodata portal in Norway is GeoNORGE (http://www.geoNorge.no), which is maintained by the national mapping agency. Data is documented based on the national standard SOSI, and there are several new initiatives under way to implement the ISO 19100 family of standards. The second version of the catalogue service "Geodatakatalogen for Norge" will be ready in the summer 2002, fully compliant to the IS 19115 metadata standard. The catalogue will be fully searchable through a clearinghouse concept, and online access to data will be secured at three levels using Open GIS Consortium specifications:

- Level 1: web map server (WMS, also ISO 19128) serving map layers in image formats
- Level 2: web feature service (WFS) serving geospatial objects in a GML (XML) formats
- Level 3: NGIS api - a rich functional interface for distributed, cross-organizational data management based upon ISO 19109, 19107, 19108 etc.

There is, however, a need to develop pricing models and more work is needed for fuller data management.

Standards

The SOSI (national standard for data exchange) is implemented 100% by public and private users (nearly no proprietary data exchange in Norway). The ISO 19100 series is planned to replace SOSI and implementation has already started (e.g. metadata, data documentations, access). OGC specifications are selected for specific geo-spatial services (wms, wfs especially).

User expectations and benefits

There is no a single driving application. I Norway there is a strong tradition of data management that can be observed at local, regional and central government levels, particularly in the fields of transportation, navigation, environment, and planning.

Poland

Context

Poland has roughly a population of approximately 38.5 million inhabitants in 312,683 km^2, with over a quarter of the land covered by forestry. Its administrative structure includes 16 provinces, 380 districts, and 2489 communities. Poland has yet to fully develop their NSDI but they have instituted projects to rapidly approach its development.

Foundation and Legal framework

The Ministry of the Interior and Administration commissioned a research project entitled the "Concept of the Polish Spatial Information System" (SIS) that was financed by the State Committee for Scientific Research and was conducted by the Institute of Geodesy and Cartography in Warsaw in 1998-2000. To be noted that in Poland there are over a 100 spatial information systems at both local, regional, and central levels, and at varying levels of development. Thematic or branch systems include geology (the National Geological Institute), forestry (the General Directorate of National Forests, and transportation (now the Ministry of Infrastructure). Hence one of the scopes of the SIS is to integrate existing developments as well as providing a pathway to future ones. It is envisaged that in the first instance governmental and local administrations would be the main users of the SIS.

A major step towards the implementation of the SIS was the Decree issued by the Minister of Regional Development and Construction on the 12th July 2001 establishing a "National Land Information System". Obligatory components of this included:

- the national reference system;
- the register of state and administrative boundaries;
- the geodetic network;
- the geodetic register of land technical utilities;
- the land and building register; and
- a set of topographical objects

The legal side of the SIS will be established either as a legal regulation or through the insertion of entries into existing legal acts that are applied to collecting, updating and making available spatial data. There will also be a legal definition of spatial data and information that will aid framing the circulation and dissemination of spatial information between administrations, and between an administration and other partners, providing also the legal basis for any fees charged to access Polish spatial information.

The timetable set for the implementation of the SIS foresees completion by 2006. This includes the definition of organisational and legal framework in 2002-03, the development of central and regional systems and centres for coordination in 2003-04, and the development of local systems by 2005-06.

Funding

Funding is mainly provided by the Government as part of the legal acts applied to collecting, updating and making available the data.

Educational aspects

There has not been any special project for educational purposes in the field of NSDI, but since last year the promotion of the Information Society has been treated very seriously. Many seminars on electronic documents exchange and public electronic services have been organised for representatives of administration and other public institutions. Also, specific international examples of best practice of local spatial information systems have been presented during these seminars.

Co-ordination

The key actors that are helping to shape the Polish SDI are the Ministry of Infrastructure (established in October 2001; includes several former ministries like Regional Development and Construction, Transportation and Navigation, and Economy), the Ministry of the Interior and Administration, the State Committee for Scientific Research, and the Surveyor General of Poland. A proposal has been put forward to establish a National Council for Spatial Information with inter-ministerial involvement and an executive committee to guide the coordination of the SIS. Thus far this has not happened, although an advisory team for geoinformation has been set up by the Surveyor General of Poland. This limits the extent of co-ordination and efficient implementation of the activities necessary to set up the SIS. It has been proposed that in the future the Institute of Geodesy and Cartography may become an office of the National SIS Council, with a relationship with the Surveyor General of Poland. In this role they would promote legal regulations and state of art IS designing methods. They would also be in charge of the creation of metadata databases, standards (norms) and the co-operation of Polish agencies with other countries' organisations (such as the EU).

Data content

The SIS is envisaged as a hierarchical system built on three levels, national, regional, and district/local. At the local level (communities, and 380 districts) spatial information will be held at: 1:500, 1:1000, 1:2000, 1:5000 scales. There will be a number of key layers including geodetic ground control, administrative boundaries, cadastre, land use and land cover, technical facilities, social facilities, and statistical data. At the regional level (16 voivodships) information will be available at 1:10,000 and 1:50,000 scales, with similar thematic layers as the local level. At the central (national) level Information will be held at 1:100,000 and 1:250,000 scales. This will mainly involve aggregated and generalised data to create a National Geographic Database with several thematic layers including basic information, natural environment, society, and economy.

The SIS Central database project is gathering momentum and the updating of modules has been scheduled. In 2002 SIS manual editions and law projects will be underway,

alongside the initial phases of the local, regional and central SIS projects and the completion of the vital geographical database and metadata. It is anticipated that the central level system of the SIS will be in operation in the coming years and that the regional system will enter into a pilot project phase. This will be followed by a project on the SIS model on regional and local level system, after which the operational version of the SIS will be completed.

These activities sit in the context of ongoing work involving features such as the national geographic database (1:250,000); and the topographic database and DTM (1:10,000) pilot projects that both run from 2000-2002. Two large projects concerning the building of the integrated cadastral system have been carried out. The first project (or rather a series of projects) has been funded by the EU under the Phare Programme. The second one is the MATRA project, funded by the Dutch government.

SWDE is a formal standard for exchange of land and building register data (incl. cadastral maps). The SWDE is obligatory within the Polish Geodetic and Cartographic Service. Further developments to regional and local GISs and the development of GI norms and standards are initiated as well, before the completion of the SIS.

Access to information

The documentation of data sets and development of a metadata service are central components of the future Polish SDI. The technical and human resources exist in Poland to implement the vision but there is a clear need to strengthen coordination and financial resources. Access and fees for the data of National Polish Geodetic and Cartographic Resources, which are the base of National Land Information System, are well defined, but only for data in traditional form.

Standards

Some of the CEN TC287 pre-standards for geographic information have been translated into Polish; however, none of them is officially approved by the Polish Normalisation Committee (PKN). Future developments therefore require the harmonisation of existing practices, and adoption of the ISO 19100 family of standards. Standards definition is under responsibility of the Normalisation Commission 297 for Geographic Information within the Polish Normalisation Committee (PKN).

Portugal

Context

Portugal is a country of around 10 million inhabitants in an approximated area of 98.000 km2 (mainland). It is organized in five regions (North, Centre, Lisbon and Tagus Valley, Alentejo and Algarve) within the mainland, plus two autonomous regions (Azores and Madeira). It is one of the first countries in the world with an operational SDI, available on the Internet since 1995.

Foundation and Legal framework

The process of the SNIG implementation started in February of 1986, with the publication in the Official Journal of the Portuguese Republic of the decision SEIC 2/86 of the Secretary of State for Research and Development that created a task force whose mission was to study the creation of a national geographic information infrastructure and to propose to the Secretary of State the corresponding actions to be taken by the Government.

As a result of the studies and activities carried out by this task force, the Portuguese National Infrastructure for Geographical Information (SNIG) was created in 1990 through the Decree-Law nº 53/90 that also created CNIG, the National Centre for GI, to coordinate and support the development of SNIG. Since its inception, the SNIG was intended to become the heart of geospatial data distribution and accessibility in Portugal. It was conceived as a fully distributed system consisting of nodes that serve data or metadata online, and was launched on the Internet in May 1995.

In 2001, the Portuguese government, in order to improved the efficiency of the public administration, decided to create the Instituto Geográfico Português (IGP) by merging CNIG (National Centre for Geographical Information) with IPCC (Portuguese National Geodetic, Mapping and Cadastre Agency). The IGP was then created in January 2002 and its organic law published by the Decree-Law nº 53/2002. So, presently, there is a legal framework both for the SNIG (Decree-Law nº 53/90) and for the institution that is responsible for its coordination (Decree-Law nº 53/2002).

Funding

The Portuguese government mainly provides the funding for the NSDI coordination and development through:

1. The budget of the Portuguese Public Administration that covers personnel and current expenses.
2. The Central Administration Investment Plan (PIDDAC) that covers investment projects excluding current and personnel expenses.
3. R&D Contracts awarded through competitive ITT, namely from DG XII, EUROSTAT, EEA, the Portuguese Foundation for Science and Technology, etc.

Educational aspects

Within SNIG, since its creation in 1990, there was a major concern about rising the level of awareness and knowledge about GI and its supporting technologies. So, besides a specific section dedicated to educational issues in SNIG homepage, IGP (and CNIG in the past) is supporting several initiatives to promote the diffusion of information and knowledge on the subject in Portugal. These initiatives include:

- Organisation of Conferences and Seminars
- Development of GIS courses
- Training programmes for university students
- Participation of CNIG staff in educational activities
- Production of documentation to help the institutions develop their SNIG nodes
- Production of GIS manuals and other publications.

Co-ordination

The Portuguese government through the IGP assures the co-ordination of SNIG. There are several institutions from public administration (including municipalities) that participate in SNIG by making metadata and data available through the homepage.

Data content

Besides the metadata catalogues that allow users to find where is the information they want and how they can access it, SNIG also includes data (aerial photos, ortophotos, maps and alphanumeric data) that can be visualised or downloadable on-line. Some data is available free of charge and other is charged.

Access to information

The access to information is provided either by SNIG homepage (mainly for institutional and technical users) or by GEOCID homepage created in 1999 with the purpose of contributing to make information available to the citizen, not only through the integration of information that citizens may need on its daily activities, but also providing simple tools to allow its exploration and use.

To help users there are metadata catalogues that allow them to find where is the information they want and how they can access it. There are also databases of institutions and companies related with the GI market.

Each GI producer defines the way users can access their information. Within SNIG there are some examples of information that is available free of any costs (e.g. Corine Land Cover (IGP), Environmental Atlas (IA)) and other examples of information that has to be paid before it is made available to the user.

Standards

Within SNIG implementation, metadata standards became increasingly important for the exchange of and search for GI among institutions. Since 1996, due to CNIG's participation in the European Spatial Metadata Infrastructure (ESMI) project, the metadata structure is CEN/TC287 compliant, but it covers more information, namely metadata about remote sensing imagery. Now the metadata model is being converted into ISO compliant model (ISO/TC 211). The ISO 19915 implementation within SNIG consists in a partially distributed metadata catalogue solution. The support is provided by a web-based application that is able to store metadata in XML documents according with the Document Type Declaration (DTD).

User expectations and benefits

The assessment of user expectations on the NSDI is strongly considered as a relevant task by IGP. Since SNIG’s creation several user-testing procedures were performed including the implementation of focus groups analysis, with users from the academic, private and public sectors and also with the citizens.

Sweden

Context

Sweden is a parliamentary kingdom with a population of 8.8 million inhabitants over a land area of 450,000 km^2. Its administrative structure includes 21 counties and 289 municipalities.

Foundation and Legal framework

It is important to note that for a long time Swedish agencies have been independent from the government, as set by the Swedish constitution. Lantmäteriet, the Swedish National Land Survey (NLS), is a governmental agency that is part of the state (Crown), and acts on behalf of the Crown when entering into contracts with third parties.

The principle of public access to information has been established in Sweden since 1776. For geographical information, the Crown claims copyright on information produced by or for Lantmäteriet, who also administer this copyright. The parliament has given NLS the right to set fees for services from the real property register and set principles for licence fees for use of geographical information. These fees cover the costs for information dissemination and make a contribution to its maintenance, based on a modified marginal cost principle. The pricing involved is intended to generate no profit but users are thought to see it as expensive. In comparison, the real property register contains personal data and as a result each request for access to it is met by a formal decision by Lantmäteriet. By comparison, the Swedish Environmental Protection Agency (SEPA) and the counties provide their environmental information free of charge.

Sweden has also been active in eGovernment and eEurope initiatives. The Parliament passed an IT Bill in April 1996 and the Swedish State e-Forum was established in 2000. Particular components of their vision are 24-hour agencies that are designed to make e-government a reality. This occurs in the context of Sweden receiving the highest rating as an information economy, according to the 2002 IDC/World Times Information Society Index (ISI).

Funding

For reference data at NLS the funding is partly governmental funds, partly cost recovery. For thematic data the situation is similar, or mainly governmentally funded.

Educational aspects

Education and courses addressing aspects of spatial data and its use are found at several universities. The StrateGIS project is a nation wide educational program aimed to enhance the use of geographic information in the public sector, especially at the local level.

Co-ordination

Lantmäteriet (National Land Survey, NLS), under the Ministry of Environment, is responsible for production, maintenance and dissemination of geographic information at scale 1:10 000 and smaller, and for the real property formation. The NLS has also

the responsibility to co-ordinate the development of a NSDI with the municipalities that create and maintain GI databases.

The 21 counties are also increasingly involved in spatial data collection and use but it is the 289 municipalities in Sweden who are responsible for large-scale mapping, in many cases real property formation, and the maintenance of key databases through administrative processes. Government agencies, such as the SEPA, National Road Administration, Swedish Post Office, and others are involved with and co-operate in data production and/or have responsibilities in different user sectors for spatial information. Another notable actor in this case is the Swedish Development Council for Land Information (ULI), a non-profit association of Swedish organisations working for more efficient use of geographic information. There are also private companies who are data producers for certain parts of the NLS and who are service providers for some forms of spatial information.

The last actor is the Swedish Standards Institute (SIS) that develops Sweden's national standards and encourages Swedish stakeholders to follow global trends. It should be noted that there is also an infrastructure for data dissemination in the public sector (SHS) and that there have been discussions about how best to exploit their public information.

Data content

The principal sources of reference data in the Swedish System are listed below:

Title	Type/Scale	Stage
Geodetic reference system	ETRS89 adjustment	Completed
	Projection	Planned
Units of administration	1:10000	Completed
Units of property rights	Cadastral register	Completed
	index map (1:10000)	2003
Addresses	Held by Post Office and Municipalities	Completed
Topographic elements	Elevation (50m grid)	Completed
Transportation	Swedish National Road Database	20??
Hydrography	1:10000	2003
Land cover	national SMD + CORINE Land Cover	2003
Buildings	-	Completed
Orthoimagery	-	Completed

Table 2: Key Components of the Swedish SDI.

This list refers to digital data at a national level and the scale refers to the scale it is intended to be used at. The real estate database is particularly well developed and includes personal data, such as owners' details. How far data from municipalities, apart from addresses, will be included in the system for both search and retrieval remains unclear. Most data will be completed in 2003 at the 1:10000 scale and will be stored in a national land-use and topographic database. There is also larger scale data at the local level but this has not been harmonised for national purposes. Other data exist including those of various government agencies who maintain data for environmental, agricultural, geological, transportation, statistical and other purposes.

Access to information

Sweden has been developing data documentation. A service (GeoLex) exists for metadata for Swedish reference data (http://www.lantmateriet.se) which follows an internal standard. A service for metadata on thematic data (Megi) is also provided by Lantmäteriet but this is currently not maintained.
There are also discovery services for reference data (MapSearch) on the Lantmäteriet website. This is not the only way that data is disseminated, as access and geoprocessing services for reference and thematic data come mainly through CD-ROM rather than the Internet. Separately, environmental data are held by EnviroNet (http://smn.environ.se/miljonat/english/) but not all of this material is spatially referenced.

Standards

Swedish standards (SS-series) concerning roads, addresses, and similar layers are well developed. Typically standards are established for data produced by co-operation between different organisations (e.g. the standardisation of hydrography will start in 2002). Sweden participates in global and European standardisation through ISO/TC 211 and CEN/TC 287.

Switzerland

Context

Switzerland is a federal republic with a population of 7.3 million inhabitants over 41,000 Km^2. In terms of government, Swiss federalism has existed since 1291 and administration comes through 26 Kantons since 1848.

Foundation and Legal framework

The Swiss Federal Geodata Strategy has been signed and published by the Federal Government in July 2001 (http://www.kogis.ch). The strategy links to the broader aims of exploiting public sector information and linking up the many initiatives already in place at canton and local level to develop a more cohesive e-government framework of services.

The development of the foundations for a federal SDI has been driven by the revision of official surveying between 1983 and 1993. As a result of that process, a system-independent data-modeling and data exchange mechanism has been developed (INTERLIS) based on which the data-structure of the official surveying data was defined. The system-independent model-driven approach (MDA) is now being implemented throughout Switzerland providing the backbone of the infrastructure. Although it has taken some 17 years to get to implementation, the advantage of system-independent MDA are now visible in terms of interoperability i.e. data transfer without information loss, computer based data checking and validation, schema extensibility whilst maintaining coherence, presentation services (portrayal) based on conceptual graphic description capabilities, incremental updates, and other features.

Specific to GI, the legal framework at the federal level includes the Swiss national code ZGB (ZivilGesetzBuch), the Federal Government's executive order

(BundesRatsBeschluss: BRB) on the federal office for topography (LandesTopographie: L+T), and the order on official surveying, the VAV (Verordnung amtliche Vermessung). A Federal Order has also established in January 2001 KOGIS, the coordinating body on geographic information for federal agencies. Funding in the Swiss case is split between federal funding for the official survey and KOGIS and mixed funding for standards, and specific projects.

Intellectual property rights (IPR) and pricing are heterogeneous. For example, there is an aim within KOGIS to allow basic data & maps at 1:25,000, 1:50,000 and 1:100,000 to be made available for free. Other services are charged for.

Funding

Funding of the Official survey and KOGIS is through the federal level, the development of standards is based on a mixed approach.

Educational aspects

To get the ideas, advantages and tools of the MDA operational, a considerable educational effort has been and remains necessary. The corresponding continuous education has been initiated by professional associations and has been successfully implemented by a collaboration of these associations with technical schools of applied sciences and universities.

Co-ordination

The NSDI is an important activity in Switzerland, with is being placed on a par with traffic and telecommunication infrastructures. A competence centre was developed in 1994 (MDA by INTERLIS) and a co-ordinating group for federal geographic information matters (KOGIS) was set up in 2001. Other key actors include the federal office for topography (L+T) that produces maps at 1:25,000, 1:50,000, 1:100,000 and lower scales, while cadastral data is managed by the V+D Directorate of Official Surveying (VermessungsDirektion). KOGIS coordinates the geo-data for all Swiss federal agencies and the SNV/SVVK (Swiss Standards assoc./Swiss Association of Surveying Engineers) manage the national and international standards.

Data content

The core data sets in the Swiss SDI provided by the official surveying include 8 key layers, as defined in the federal law of 1993: control points, land cover, single objects, heights, local names, ownership, pipelines, and administrative subdivisions. Other data include statistical information, located addresses through “geo-post”, utilities (including: water, gas, waste water, electricity, telecommunications) and roads (through the “strada” database).

Access to information

The INTERLIS data description and transfer mechanism provides the framework for (geo-)data documentation and exchange. The relational INTERLIS 1 with ITF (Interlis Transfer Format) as proprietary transfer format is currently being extended and updated to INTERLIS 2 which is object oriented and uses XML/GML as transfer format.

Several discovery services already exist at various levels:

- communal: Zurich (Geo-Shop, sn/ig), St.Moritz (gb/fp)

- canton: Basel (Geo-Shop, sn/fp), Aargau (gb/fp), Zug (gb/ig)
- federal: SIK/GIS catalog (DOS/fp) *

A new Geo-Shop will be launched at federal level in the Autumn of 2002 based on the KOGIS metadata-server profile compliant with ISO 19115. Geo-shop will provide opportunities for data discovery, selection, ordering, and access in different formats by e-commerce methods, and is system-neutral being based on the INTERLIS approach.

Standards

Several national standards have been defined including

- SN612010 Data security (SN = Swiss Norm)
- SN612020 Data reference model DXF (Drawing eXchange File)
- SN612030 INTERLIS 1, SN612031 INTERLIS 2
- SN612040 Addresses of buildings
- SIA 405, 2013, 2014 Utilities (SIA Swiss Engineers & Architec.)

New standards recently considered/adopted include:

- SN612050 Metadata (profile of ISO19115)
- ISO191xx application (xx = 03,07,09,10,11, 17,18)
- OGC principles for access to distributed maps.

Together with KOGIS the Swiss Organisation of Geo-Information (SOGI) will provide the national platform for geo-standards (NGN Nationale Geo-Normen), including beside the federal agencies (represented by KOGIS) all the technical organisations, private industries and professional associations needing geo-standards and corresponding support.

User expectations and benefits

Driving applications are official surveying, the cities and cantons on the Internet, utilities services, the national metadata server of KOGIS and the organization of national platform of geo-norms.
Exploitation of public information is actually possible on communal and cantonal level and will be possible on federal level.

United Kingdom

Context

Covering an area of 244,000 km^2, with a population of some 59 million inhabitants, the United Kingdom is made up of three nations; Scotland, England and Wales, and the province of Northern Ireland. This unique structure impacts on its governance, data provision and regulations. As an example there are two national mapping agencies, Ordnance Survey in Great Britain covering England, Scotland and Wales, and Ordnance Survey Northern Ireland for the province. Similarly, Scotland has a separate legal system, reflected in the Register of Scotland's land registry which is different from HM Land Registry in England and Wales. The administrative structure includes over 400 local authorities in England and Wales. Scotland Wales and Northern Ireland have elected assemblies and there is some discussion about creating elected assemblies also for the nine English regions in the near future.

Foundation and Legal framework

There is no formal NSDI in the UK, nor a single organisation with responsibility for its establishment and coordination. The National Geospatial Data Framework (NGDF), an initiative started in 1995 to assist in the process of getting industry players round the table to tackle some common issues has not been wholly successful and has recently been abandoned. Despite this, the country as a whole has a well developed GI sector, with extensive data sets available from both public and private sector sources.

These developments have taken place within a robust commercial framework, with central government also adopting a policy of cost recovery for some of its data resources. The positive outcomes of this policy have been the creation of one of the most detailed and advanced national geographic databases in the world, with funding by users ensuring that the products are customer driven and that the data is maintained. However, there have also been criticism that such commercially-lead policy is hampering informed governance and the further development of value-added services in the private sector.

A shift in government policy has started to emerge in the last three years through its agenda to modernise and better coordinate government departments, which hinges to a large extent on e-government, i.e. the availability of all government services at both central and local level in electronic form by 2005. Within this framework the importance of geographic information has been recognised at the most senior levels of government, leading also to a more general reflection on funding and regulatory regimes.

Funding

The many elements that contribute to the SDI in the UK are funded through a mixture of public funding and user charges.

Educational aspects

The provision of GI education is well established in the UK particularly at post-graduate level. There are however also specific undergraduate courses in GI as well as many GI module in several undergraduate course such as geography, planning, surveying, remote sensing, and earth-sciences/geology. These courses are internationally recognised to be at a high level of academic attainment.

Co-ordination

Until recently the UK has lacked a co-ordinating structure to implement its SDI but there are signs that this changing. There is no shortage of organisations that have a direct on indirect role in shaping the environment within which SDI-related activities take place. They include:

- The Cabinet Office, through its e-envoy (http://www.e-envoy.gov.uk) in respect to e-government policies, and through Her Majesty's Stationary Office (HMSO: http://www.hmso.gov.uk) for regulating the management of Crown copyright.

- The Office of the Deputy Prime Minister, that is responsible for both local government, regional development, planning and several new key initiatives (such as attacking the ills of social exclusion). http://www.odpm.gov.uk
- In Scotland the Scottish Executive fulfils much the same role as the ODPM in England. http://www.scotland.gov.uk
- In Wales the National Assembly fulfils much the same role as the ODPM in England. http://www.wales.gov.uk
- POSTCOM, the regulator of postal services including maintenance and access to a key dataset, the postal address file,
- The Improvement and Development Agency (http://www.idea.gov.uk) in relation to the information related to the activities of local government.
- Ordnance Survey of Northern Ireland the national mapping agency for the province providing the underpinning reference framework and infrastructure for Northern Ireland. (http://www.osni.gov.uk)
- Ordnance Survey, the national mapping agency for Great Britain providing the underpinning reference framework and infrastructure for Great Britain. http://www.ordnancesurvey.gov.uk
- The Chief Executive of Ordnance Survey is the official adviser to the Government on GI.
- The Inter-governmental group on GI (IGGI: http://www.iggi.gov.uk), which is a membership organisation to promote the effective use of GI across central government departments,
- The Association of Geographic Information (AGI: http://www.agi.org.uk), which brings together over 1000 members from government, the private sector, and academia to maximise the use of GI.

Ordnance Survey (GB) has taken the lead to promote a joined up approach to geographic information through several initiatives in the last 3 years:

- Developing common specifications and standards with OSNI and Ordnance Survey Ireland
- The development of the Digital National Framework, a set of standards and technologies to promote "joined up geography"(see below)
- Collaboration with the UK Hydrographic Office and British Geological Survey to promote a seamless transition into the offshore geography and sub-surface geology
- Collaboration with the land registries, local authorities, Royal Mail and the Valuation Office Agency to promote an integrated approach to land and property information.
- The development of a Pilot Pan Government agreement to provide easy access to many of the key government datasets for over 560 central government bodies and agencies, this mirrors a similar agreement providing data to over 550 local authorities and related bodies.

Data content

Several core databases are available nationally. They include:

- The underpinning geographic reference base from Ordnance Survey (GB):
    - The horizontal and vertical coordinate systems and transformations to/from ETRS89 for GPS users where a free web service is available

    - A detailed seamless database of over 400 million topographic features updated daily and marketed as OS MasterMap.
    - A national georeferenced address database including 26 million postal addresses
    - A transport network,
    - A set of administrative, electoral and postal boundaries,
    - A national elevation model and
    - Several derived datasets at 1:10,000, 1:25,000, 1:50,000, 1:250,000 and smaller.
- Ordnance Survey of Northern Ireland, provide or are working on similar products to Ordnance Survey (GB).
- UK Hydrographic Office for maritime features (coastal zone and offshore).
- Land and Property: from Her Majesty's Land Register, Registers of Scotland and the Land Department Northern Ireland.
- Addresses: from the Royal Mail/Consigna.
- Socio-economic data from the Office of National Statistics, and the Scottish statistical service (General Register Office for Scotland).
- Environmental data from the Environment Agency, and Scottish Environmental Protection Agency.
- Geological databases from the British Geological Survey

In addition there are several important data resources available from the private sector, for example historical maps, imagery, and geodemographic classifications, and from local government. The latter is taking an increasingly active role, particularly in relation to the maintenance of street names and addresses, and the development of a National Street Gazetteer. A major step towards linking these different data sources has been taken by the Ordnance Survey Great Britain in developing OS MasterMap™, a database which includes a unique identifier (TOID) for each of the features, such as building footprints, in the topographic database.

Another key project that will contribute to the development of the SDI in the UK is the National Land Information Service (http://www.nlis.org.uk). This project is providing a service through which it is now possible to search for property details on-line. It is a flagship project of the government and developed in a public-private partnership.

Crucial to its development is the ability to uniquely identify every single property in the country. This necessitates the completion of two other projects: NLPG – National Land & Property Gazetteer (http://www.nlpg.org.uk), lead by local government with the participation of the private sector, and NSG - National Street Gazetteer (http://www.nsg.org.uk), which is a partnership between Ordnance Survey of Great Britain (who are custodians) and local government.

At the core of the NLPG is the development of a Unique Property Reference Number (UPRN) for each property. The linkage of UPRNs, that have coordinates, to the TOIDS within OS MasterMap, will be a major step forward towards the completion of the SDI in Britain.

By 2005 England and Wales and Scotland separately intend to establish services to support all property transfer transactions, including all the legal and financial, transactions electronically, this is known as e-conveyancing.

Access to information

Whilst the provision of core data is well developed in the UK as shown above, less progress has been made thus far on metadata services (most of the data are only accessible offline). Central government is now developing the e-government portal (http://www.Ukonline.gov.uk), and a catalogue of public sector data (http://www.inforoute.gov.uk) using common metadata. Some progress has been made but there is still much work to do. Equally, on the GI side, an earlier attempt to develop a metadata service (SINES) in the mid 1990s was withdrawn for the difficulty of keeping it up-to-date, and its successor AskGIraffe which was maintained by Ordnance Survey (GB) with central government funding is also undergoing major changes, and will now be managed by the AGI under contract to the Ordnance Survey. Hopefully this new organisational set up will provide the winning solution to extend the service beyond central government departments, and more crucially to give it high profile and ensure its maintenance, with linkages to the e-government portals.

Standards

In respect to metadata, e-government resources are documented with the a standard based on the Dublin core, while the GI resources available through AskGiraffe are documented with a standard based on the American's FGDC. The British Standards Institute (BSI) has developed many standards of relevance to GI with the support of the user community represented by the AGI. In particular BS 7666 is the national standard for street addresses. The BSI plays a very active role in the ISO programme and it is expected that the ISO family of standards related to GI will be adopted in the near future. In relation to the national geography infrastructure, OS MasterMap is based on a set of standards for national georeferencing called the Digital National Framework (DNF). The DNF brings together all the essential components that make up the essentials of an SDI, reusing existing standards where that is possible. DNF has been developed over the past three years. Some of the development has been in collaboration with Ordnance Survey of Northern Ireland and Ordnance Survey Ireland as part of a joint programme to harmonise standards across the three organisations for the benefit of pan national customers (a joint web site aims to support the current situation: http://www.osmaps.org.)

Component	**Current level of implementation** (not planned, planned but not started, on-going, completed + % territory covered)	**Current use of GI standards** (e.g., ISO/TC211-oriented, OGC-oriented, CEN/TC287, national standard)
Coordinate Reference Framework	Completed 100%	Euref: ETRS89, EVRS2000 in future
Reference Data: Layers & themes, object identifiers	In progress, Topolayer/themes, other layers being integrated, TOIDs in use	OSi & OSNI collaboration – national stds, RICS, DNF SH57
Data communication and metadata services	In progress: Topo Layer 100% Discovery (incl askGIraffe) 30%?	OpenGIS, industry [& BSI] ISO
User (thematic) data and applications	On-going	BSI, ISO, DNF & Industry

Table 3 – main standards used in the UK

User expectations and benefits

Given the speed of technical change within Europe and globally it is little wonder that even the biggest commercial enterprises struggle to keep abreast of what it is that their customers really require. This applies to government, business, consumer and citizen environments. It is a duty of public projects to recognise and understand the nature and requirements of their customers in order to maximise the benefits to the user. At a basic level there is a need to have a clear picture of how closely the service or product will fit to the needs of its customers. It is therefore critical to "Know your users!" To do so, a clear picture and set of user metrics must be available at an early stage and include:

- What is the market? Segmentation of the market into stakeholder groups, including users, suppliers, special interest groups, business, industry and customer segments and user groups.
- Having given boundaries to the market, size the user base.
- Current & likely future products targeting the user.
- Gap analysis (which part of the market does/can the product target)
- Identification of type and depth of need by specific segment. This activity is about ensuring the technical development is in tune with actual and likely future uses and is key to the whole project.

We need to ask do the expectations fit the boundaries of what is on offer? Currently with no national SDI in place these expectations may be hypothetical or based on currently available substitutes. However expectations are likely to include requirements to access, view, interrogate, download, use and re-use data electronically through simple licensing terms. The information supplied should be of the appropriate quality for the purpose, up to date, and interoperable with other data sets. Charges will in part be determined by the increased business, personal or societal benefit to the organisation or user. Free to market services will have wider benefit to the community and be more than supplying free data for the sake of it. Charges may be partly a function of the historical and cultural background. For example within the UK, for many datasets, there is a successful and well proven model of user pays. Further discussions are revealing a future paradigm of users willing to pay for quality content. Where value is added people are more willing to pay.

United States

Context

The United States is a federal republic with a population of 278 million people, over an area of 9.8 million km^2. Its administrative structure includes 50 states and one district, over 3000 counties, and more than 7000 cities. The size of the county and its complexity means that it needs robust means to manage its information resources.

Foundation and Legal framework

The background to the development of the NSDI can be found in the policy of the first Clinton administration aimed at reducing the size of the federal deficit, and

sensitivity to the opportunity of making more effective use of the billions of dollars spent annually in collecting and managing geographic information. With this in mind, the Office of Management and Budget (OMB) Circular A-67 in 1990 reorganised federal agency interactions, and established the Federal Geographic Data Committee (FGDC). In 1993, Vice-President's Al Gore Reinventing Government Report supported the strategic plan drafted by the FGDC for the creation of an NSDI, which was then officially launched in 1994 with Executive Order 12906, which makes participation in the NSDI mandatory to all federal agencies. To note that under the American Constitution, the levels of government are independent. Therefore, Federal Government cannot mandate participation in the NSDI to state or local levels. Their participation is therefore a matter of voluntary commitment.

In terms of intellectual property rights (IPR), the NSDI was founded on a principle of "freedom of discovery" in order to promote awareness and access to all geo-information. The actors in the US context encourage the publication of all metadata for free with the metadata declaring access characteristics and property rights. Federal agencies must make all non-sensitive data available only at the cost of dissemination, but no standard fee schedule exists (per OMB A-130). Non-federal agencies and companies may charge for data.

In terms of e-government the OMB has established 24 initiatives across the US. It is anticipated that the US government can seek savings of scale and improve effectiveness by formalising re-usable Government-to-government (G2G) services.

Funding

The annual allocation to the FGDC Secretariat is approximately $3.6M. The Co-operative Agreements Program allots approximately $1M per year from this budget for sustainable NSDI-building projects. The FGDC budget covers secretariat expenses, interagency projects, and common-use infrastructure maintenance. Additional funding comes from FGDC member organisations that invest at least as much in SDI operations.

Educational aspects

FGDC has published educational materials and reference implementations of software to promote competence in NSDI concepts. FGDC also underwrites local, regional, and national training opportunities through a cadre of on-call trainers. In addition, research grants are provided to University Consortium for Geo Information Sciences (UCGIS) for NSDI research, curricula, and evaluation.

Co-ordination

The NSDI is coordinated by the FGDC, which includes 17 member federal organizations and has official liaison with 35 state geo-information councils, alongside other sectoral organisations. Other actors include the National US Geographic Information Council, the National Association of Counties, the National League of Cities and the universities (through the UCGIS). The last main actor is the private sector and vendor community represented by OpenGIS Consortium (OGC). FGDC encourages standards and specification development in ISO, ANSI, and OGC by all NSDI participants. The diagram below illustrates the FGDC's organisation (see Fig x: Organisation of the FGDC)

The FGDC secretariat consists of a minimal staff of around 15 individuals who provide a forum for policies and standards that can integrate into a coherent NSDI. The steering committee is staffed by agency managers who meet two to three times through the year to approve policies and FGDC standards. Beyond this, there is also a co-ordination group that is composed of the chairs all Working Groups and thematic subcommittees. Finally, there are also participants in the various Working Groups and Thematic Sub-committees that are made up of volunteers from experts in the field.

Data content

Core data are known as Framework and represent the most commonly used data in base mapping. They include such features as:

- Elevation;
- Hydrography (Surface Water);
- Governmental Units (Boundaries);
- Orthoimagery;
- Transportation (multi-modal);
- Cadastre; and
- Geodetic Control.

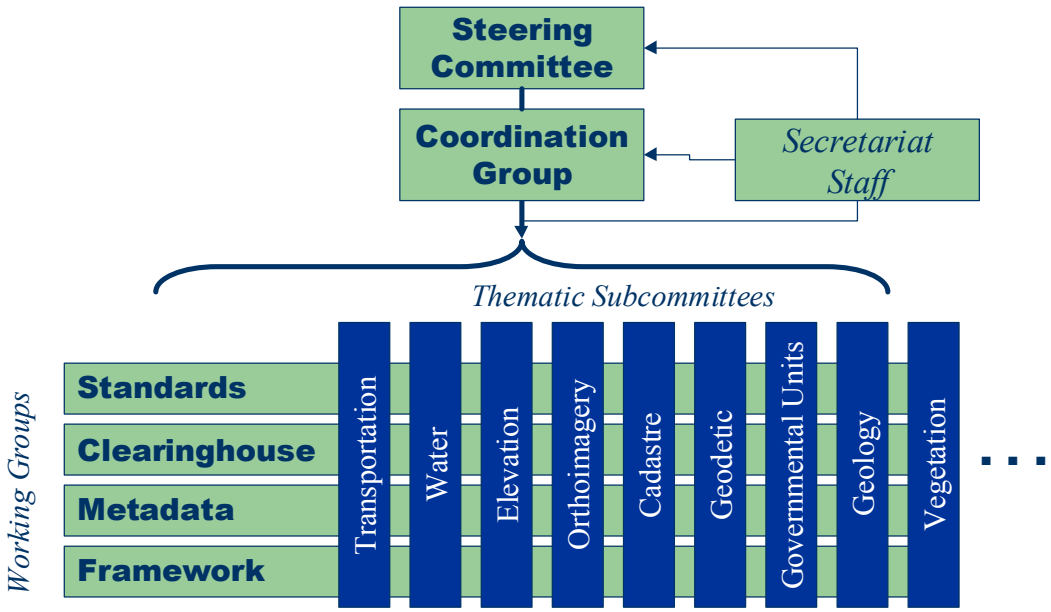


Fig 7: Organisation of the FGDC

Framework data involves federal agencies defining each theme and a standardisation of Framework representation is now being created. Recently, multi-sectoral, ANSI-sponsored standards development teams have been convened for Framework in order to define data content for information exchange for each of the seven themes. This activity is developing in support of Framework data service providers (stakeholders) that will soon be formalised within each community. Other data are encouraged, particularly in terms of documentation, publication, and service for all types of geo-information. The abundant environmental, imagery, and other Framework-like and non-Framework data in the US are documented and available through a distributed

metadata catalogue known as the "Clearinghouse." Data content standards for non-Framework data are also encouraged to promote and aid exchange.

Access to information

There are over 130 government, commercial, and academic data catalogues in the US, with hundreds of thousands of data sets described using the standard developed by the FGDC. Approximately 20% of available domestic metadata entries include links to permit direct data download over the Web. The US will soon be in a transition to adopt ISO 19115 metadata.

The FGDC coordinates a network of six official search Gateways for accessing international content held in Z39.50 (ISO 23950) "GEO" Profile collections (includes non-FGDC metadata) (http://www.fgdc.gov). The issue of semantic interoperability has been in transition in the US.

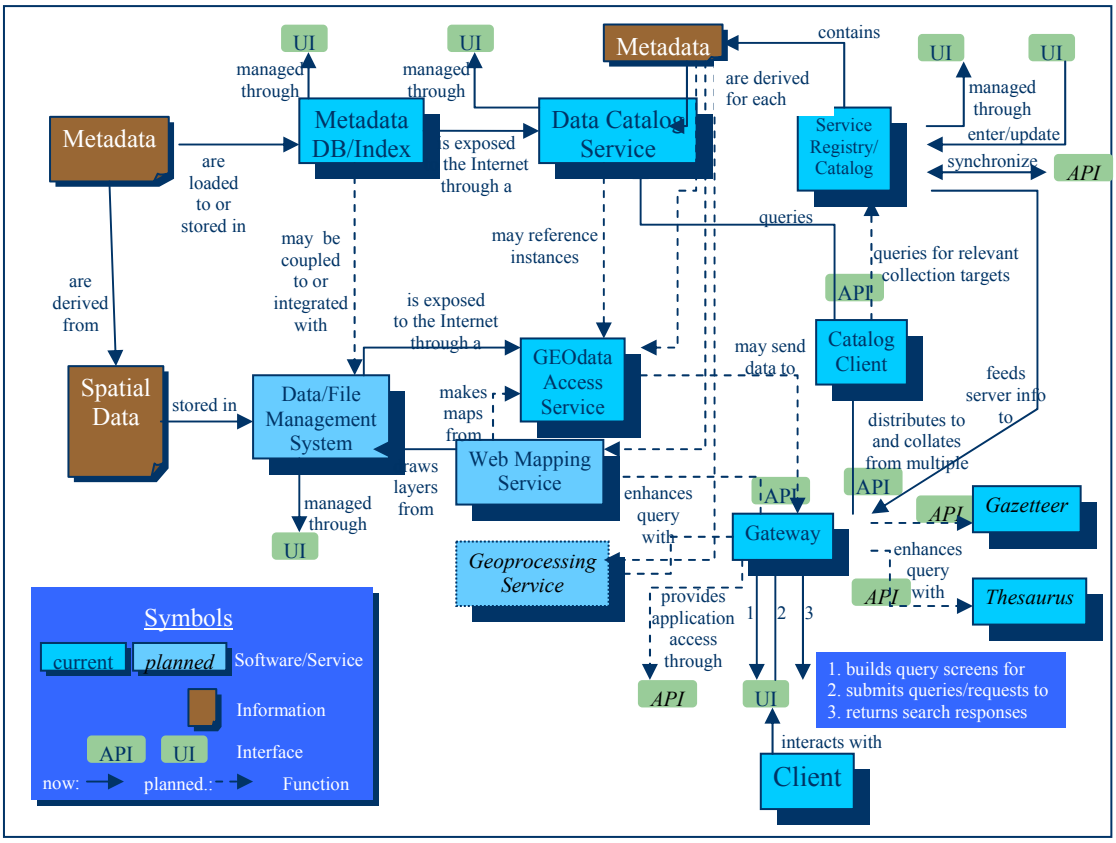


Fig 8: The NSDI architecture

The creation of a Geospatial OneStop is thought to accelerate implementation of the NSDI by:

- the rapid development of Framework schema/standards;
- reiterating asset management in Clearinghouse;
- establishing G2G needs-based access via the Clearinghouse; and
- implementing high-grade federal and other stakeholder map and data services online for Framework themes.

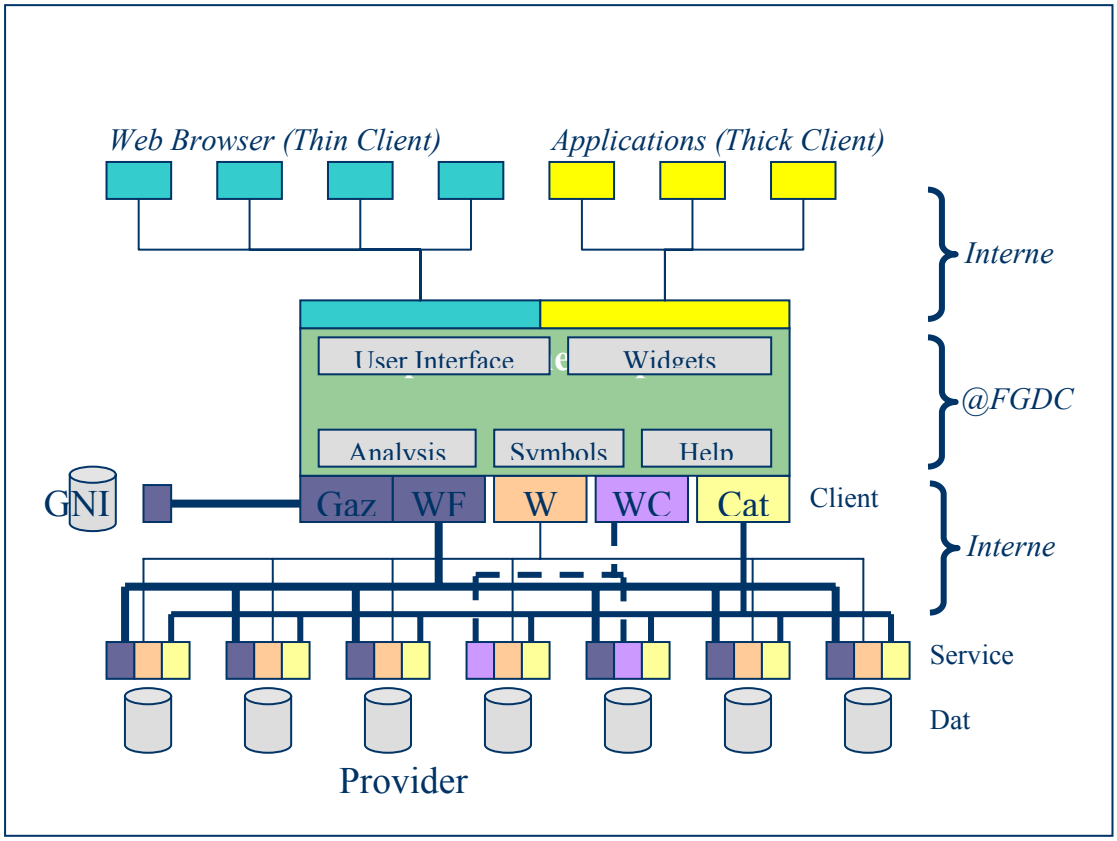


Figure 9: The Portal concept

Standards

OMB Circular 119 requires governmental bodies to work first through international and national standards bodies before developing government-specific standards. FGDC participates in US National Standards for geomatics (ANSI INCITS-L1) and as part of US delegation to ISO TC 211. Data content standards and the Metadata Standard were developed through FGDC – will be migrating this process under ANSI. The FGDC Content Standard for Digital Geospatial Metadata (CSDGM) was published in 1994 and revised in 1998 and will soon be adapted in support of ISO 19115 metadata.

The FGDC Data Content Standards for specific data themes have not been created using consistent modelling and implementation guidance. At their best they only provided semantic guidance on content. Framework Data Content Standards are now under development through an ANSI-facilitated process and will include common core UML models and documentation. This will utilise a feature cataloguing methodology and identifier systems, and define a single reference application schema for each theme to promote data exchange.

As geographic data is so diverse, in terms of the disciplines who use it and the nature of the subject itself, the development of a common set of theme keywords for all disciplines has been difficult. ISO 19115 Categories provide one high level classification of generic data but international co-operation is sought to identify and endorse a single set of thematic keywords that has codes for common use.

User expectations and benefits

The main objectives of the NSDI are:

- to promote use and re-use of spatial data for multiple purposes by government and citizens;
- to encourage participation of self-disciplined providers of data and services; and
- to establish baseline services that support community discovery and access to geo-information (including a directory of services, semantic registry, search gateways, a gazetteer and reference software implementation).

The lessons learned from the US experience are important. It has been suggested that it would have been better to have promoted a consistent modelling approach and encoding guidance for specific data themes (and in particular Framework) earlier in its development. The establishment of an internationally consistent theme keyword classification for use in all metadata (for search and browse purposes) was also seen as desirable. Equally, standards were seen as something that cannot operate alone and guidance documents could have been useful to both implementers and adopters. One key area that was under-developed was the way in which NSDI project implementation monitoring took place. The progress of all FGDC-supported projects would have benefited from closer examination and it would have been useful to provide follow-up assessments on a regular basis. In relation to project funding, the experience was that there is not a direct correlation between the amount of funding provided and the success of a given project. In practice, many small grants have been more successful (with vested local involvement) than having fewer large grants. Finally, the US context would have benefited from more creative and pervasive ways of promoting the SDI particularly at state and local level so that the current predominantly federal SDI can really become a national one.

Part II:

Comparison, Evaluation, and Recommendations

General Comparison

The previous Section has provided a profile of each of the countries considered in respect to their progress in developing national (or regional) geographic information infrastructures. This Section compares these results and draws conclusions able to inform the policy process, share experience, and act as benchmark for further studies. Before analysing the key features emerging from the previous Section, it is worth noting that the fifteen countries considered vary a great deal in size, and population.

Table 1 below summarizes some of the key statistical indicators presented in the previous Section, with two additions: the ratio of Gross Domestic Product per capita of each country in respect of the EU average, and an indication of the proportion of the population having Internet access.

Table X: Key indicators of countries considered

COUNTRY	Area 1000 km.sq	Population Millions	GDP 2002 PPS/inh EU=100	On-line[3] % of pop
Austria	84	8	112	43
Catalunya	32	6.3	100	23[4]
Czech R.	79	10.3	61	26
Finland	338	5.2	103	44
Flanders	13	6	105	33[5]
France	550	60	101	26
Germany	357	81	104	36
Greece	131	10.5	69	12
Italy	301	56	105	33
Norway	324	4.5	138	54
Poland	313	38.5	39	16
Portugal	92	9.8	74	34
Sweden	450	8.8	100	65
Switzerland	41	7.3	130	47
UK	244	59	101	55
US	9800	278	140	59

Sources: GDP: Eurostat Structural Indicators (forecast for 2002) except for Flanders and Catalunya where source is EC Cohesion Report 2001, and Switzerland where data has been derived from World Bank for 2000. http://www.worldbank.org/data/icp/pppdata.htm

Flanders and Catalunya in *Italics* as data for population and area refers to region and not country

[3] Source: www.nua.com variable data sources 2001-02
[4] Data for Spain
[5] Data for Belgium

Area: the difference in size between the countries (and regions) considered is very large. The US stands out in particular for being 3 times the size of all other countries (and regions) combined. Within Europe, there are also large differences and we can divide the group into three classes: small (Flanders, Catalunya, Switzerland, Czech R., Austria, Portugal and Greece), medium (UK, Italy, Poland, Norway, Finland, and Germany), and large (Sweden, and France).

Population: The US again stands out but not as much as it did in area terms, as the combined population of the other countries and regions considered is 1.3 times that of the US. Again for simplicity we can divide the table into three categories: small (less than 10 million inhabitants) with 8 countries, medium (10-30 million) with 2 countries, and large (greater than 30 million) with 5 countries.

GDP per capita: the figures in the table represent per capita Gross Domestic Product in Purchasing Power Standard, with the EU 15 taken as reference point at 100. As shown most countries considered are around the EU average, with the exception of the US at 143 and four less endowed countries, Portugal, Poland, the Czech Republic, and Greece. To be noted however, that the two regions considered, Flanders and Catalunya are clearly at or above the EU average, confirming their central place in the economy of the EU.

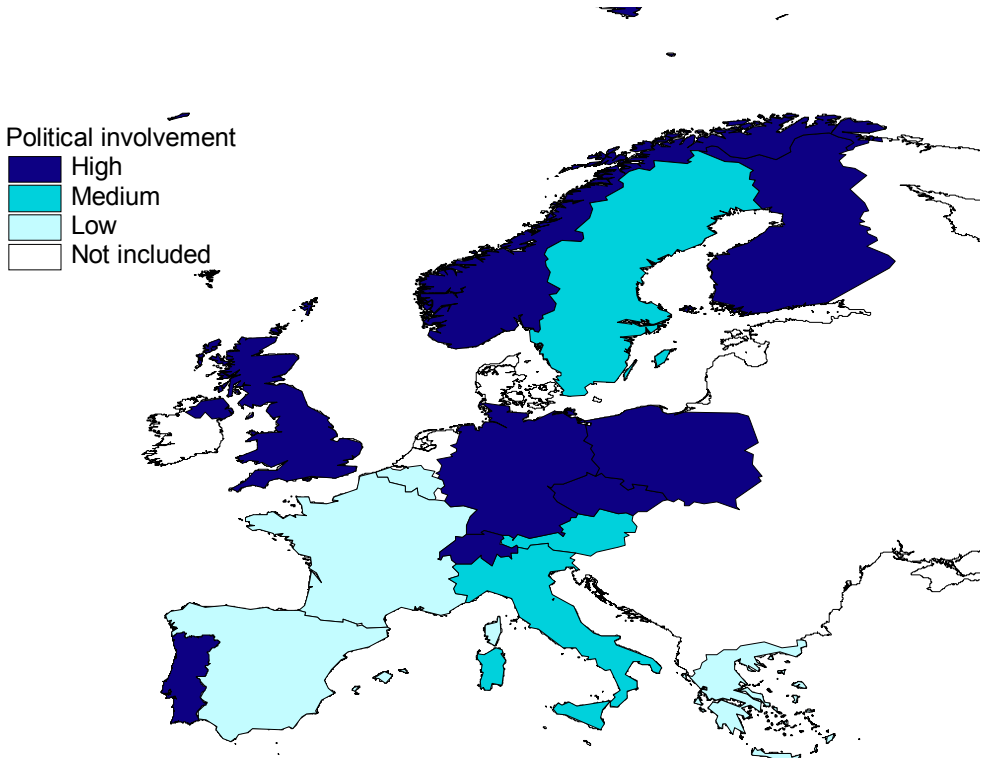
Proportion of population online: these figures are indicative only as the data sources are varied in time of reference and robustness of methodology. We can see however three groups again, with Poland and Greece at less than 20% (but Greece data is 1999), France, Czech Republic, Catalunya, Italy, Portugal, Flanders and Germany at 25-40 % and 8 countries at over 40%. The US is not significantly different in this category from the more advanced European group. It also worth noting that the Czech Republic and Poland are the countries that have made more rapid progress since 2000, when their percentage of internet access was reported being 3% and 7 % respectively.

Systems of Government: although formally there are only two categories among the countries considered (federal or centralised), in reality there are possibly three distinctive groups: those countries with a federal system of government (US, Germany, Switzerland, Belgium, and Austria), those with a significant degree of autonomy at the local regional level (Spain and Italy, and to some extent the UK), and those more centralised.

From the dimensions considered above, it is clear that the group of countries and regions considered in this report is as varied as it can be in terms of physical size, population, wealth, system of government, and level of access to the Internet. Yet they have all considered the development of a National (regional) SDI as important enough to devote effort, time, and resources. From this perspective they have more similarities than differences. The following section compares their experiences.

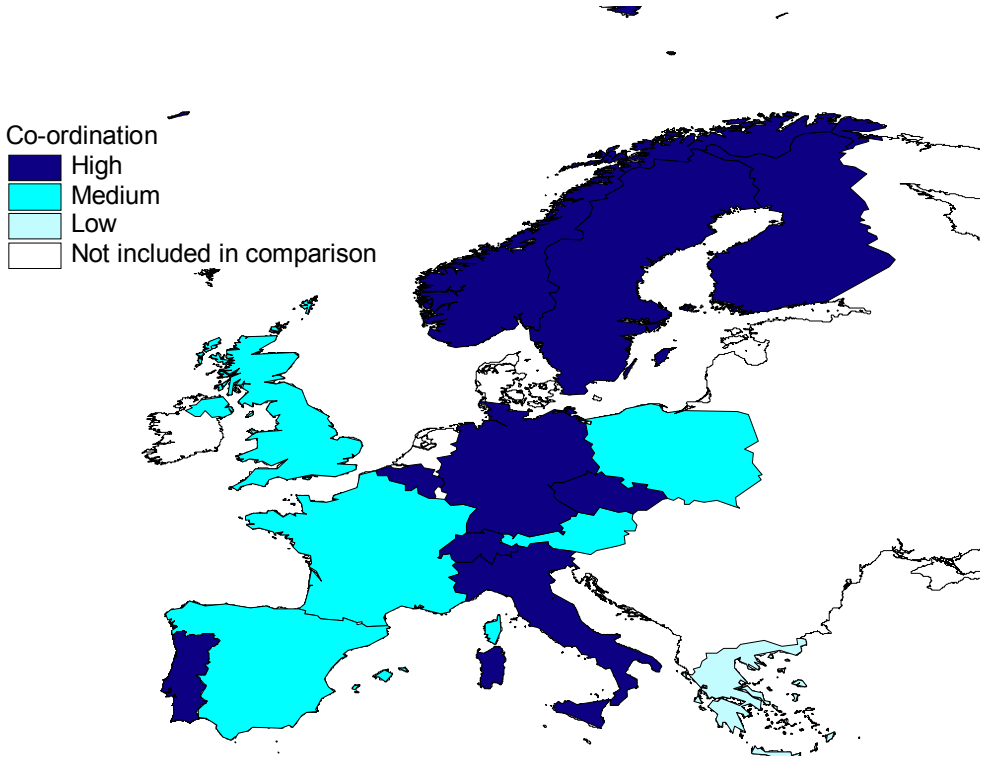
Political Involvement

Country	Comments
AT	Moderate at federal level. High in some provinces. E-government initiatives developing
Cat.(ES)	Low nationally. Variable regionally. Pilot in Catalonia 2000-02 funded by e-government budget.
CZ	High. Linked to accession and modernization of public administration
FI	Generally high. Strong link to Information Society policies since 1996
Fla(B)	Low at federal level. High in Flanders and closely linked to e-government initiatives
FR	Low on NSDI, not perceived as strategic issue per se, but many e-government initiatives, and focus on Large Scale Reference (RGE), which is broadly similar to NSDI concept.
DE	High at federal level. Variable at state, but increasing.
GR	Low on NSDI. New cadastre is key project. National security considerations affect policies for access and dissemination of PSI
IT	Moderate but growing with linkages to e-government initiatives
NO	High and strongly linked to e-government.
PL	High and part of accession policies + modernization of public administration
PT	High at national level
SE	High for e-government in general. NSDI seen as part of it but specific political support not as high
CH	High federal level. Variable at canton and local level. Increasing link to e-government.
UK	High for e-government; GI is now recognized in government as an essential part of the infrastructure.
US	High at federal level. Variable across states and local level. Link to e-government in progress.



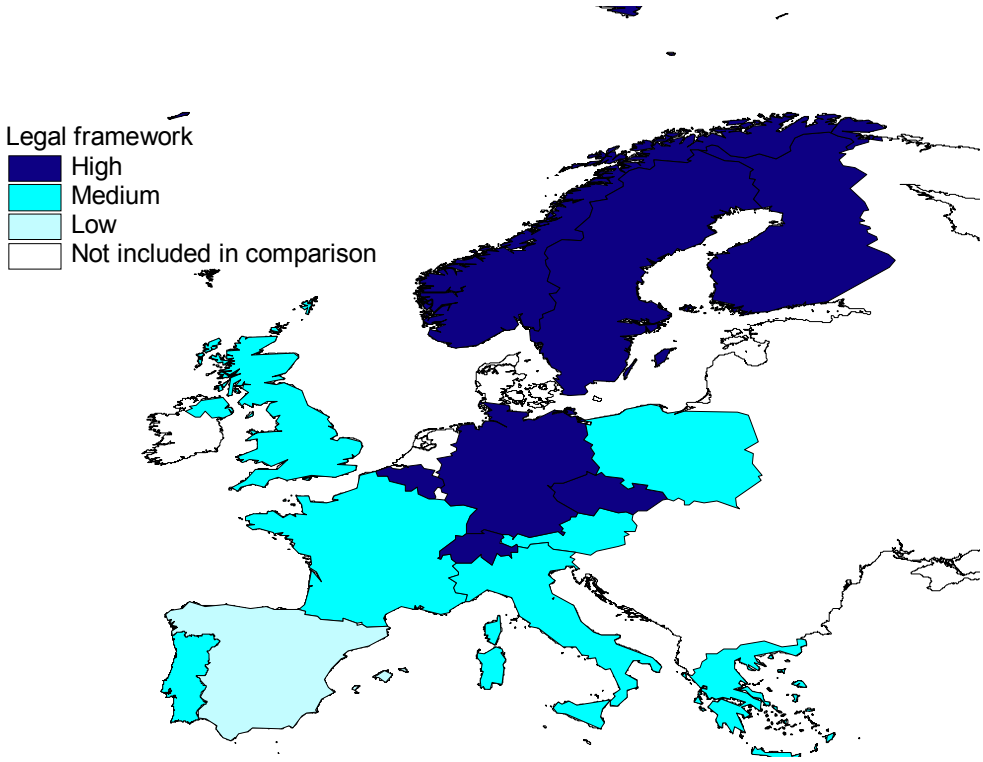
Coordination

Country	Comments
AT	Limited. Difficulty to keep all stakeholders on board without specific organisation to coordinate
Cat.(ES)	Government of Catalunya, but if project develops may need strengthening
CZ	Good, multi-agency and multi-actors. Office for Surveying, Mapping, and Cadastre + CAGI + NEMOFORUM
FI	Good. NLS was lead in the past, now supported by establishment of multi-agency Finnish Council for GI in 2001
Fla(B)	Strong and multi-agency
FR	CNIG + AFIGEO. Relatively weak given low political engagement
DE	Interministerial committee (IMAGI) + federal agency BKG linking with Länder and their framework agreement AdV.
GR	Low. HellasGI is raising awareness but major initiative needed
IT	Significantly strengthened since 2000-01 with lead of Ministry of Environment, and Technical Committee working on common specs
NO	Good. Lead by Norwegian Mapping Authority + framework for multi-sector cooperation (Geovekst)
PL	In progress. Series of projects identified to develop multi-level system local/regional/central by 2006.
PT	Portuguese Government through IGP
SE	Very extensive and well linked to administrative processes for updating
CH	Good. KOGIS specifically set up in 2001.
UK	Traditionally very fragmented, Ordnance Survey now taking a stronger lead in joining up several agencies through collaboration and in conjunction with the Office of Deputy Prime Minister.
US	Very strong multi-agency at federal level. Link to state and local needs strengthening.



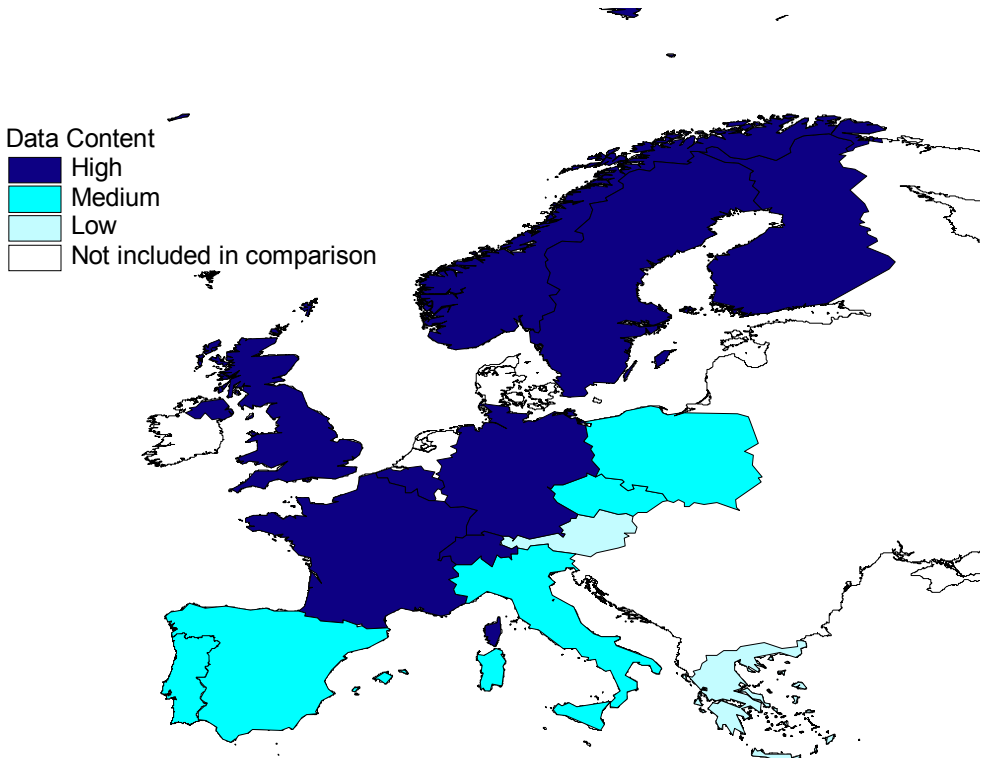
SDI Legal framework

Country	Comments
AT	Yes for cadastre, no for SDI
Cat.(ES)	To be developed. IDEC project aims to explore issue and initiate change in public administration
CZ	Yes, explicit link to Action Plan for State Information Policy. Broader framework policies for access to PSI being developed
FI	Yes explicit + clear framework for PSI access and dissemination
Fla(B)	Yes, NSDI specific in 2000
FR	Partial. Further progress needed in clarifying issues of funding/access/competition in PSI and GI
DE	Yes explicit and increasing since 1998 with major support given in Parliament in 2001
GR	Cadastre and mapping have framework. Broader issues of access/dissemination + IPR and pricing need addressing
IT	Yes, major development in 2000 with multiagency, multi-level agreement. Some broader policies on PSI to be finalised
NO	Yes around Land Division Act and Land Registration Act. Pricing models need further clarification
PL	NLIS established in 2001. Additional legislation required to complete framework. Focus at present on data access for public administration.
PT	Yes, since 1990
SE	Well developed for access and dissemination of PSI. Some adjustment needed to policies for pricing and competition in GI.
CH	Yes. Federal Geodata Strategy launched in 2001. IPR & pricing need clarifying and harmonising
UK	In rapid development linked to e-government. Move towards greater transparency and consistency will affect GI sector as well.
US	Yes since 1994



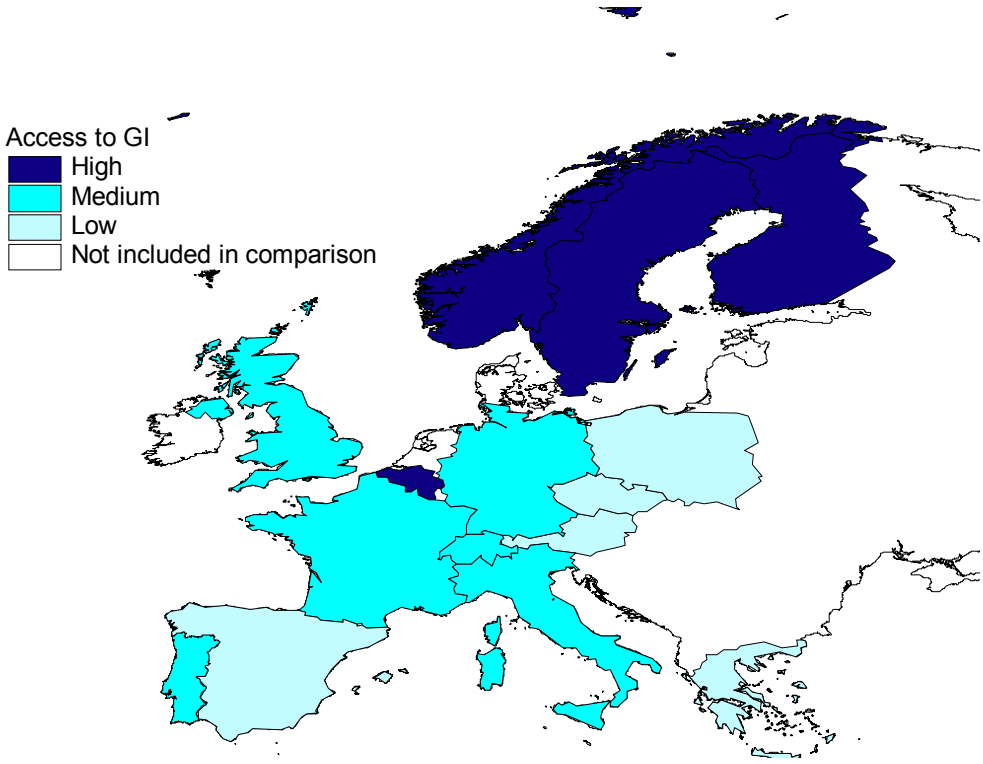
Data content

Country	Comments
AT	Several layers developed including topography, cadastre, addresses, and environmental data. Coverage variable.
Cat.(ES)	Some available. Priority is linking and increase use
CZ	In progress. Priority to topographic, cadastre, orthophotos. Good environmental coverage
FI	Very extensive in all areas and well integrated to local administrative processes for updating
Fla(B)	Good coverage topographic, orthophotos, cadastre, land-use, DEM
FR	Good coverage socio-economic and environmental. Major effort to develop RGE given size of the country, linking topo-cadastre-address.
DE	Extensive including topographic, cadastre, addresses, and environmental. Some variability across states
GR	In progress. Patchy coverage of topo and cadastre. Good orthophotos
IT	In progress, some basic layers already available. Large scale variable at regional level. Timetable to complete by 2006.
NO	Very well developed and strongly linked to administrative processes at local level for updating.
PL	In progress. Series of projects identified to develop multi-level system local/regional/central by 2006.
PT	Some available. Needs reinforcement
SE	Very extensive and well linked to administrative processes for updating
CH	Being developed. Slow process but major strengths of model-driven approach for interoperability and future extension.
UK	Very extensive. More work to do, e.g. need to link the National Land & Property Gazetteer and link to the primary reference base ~ OS MasterMap.
US	Very good at federal level. Variable at state/local.



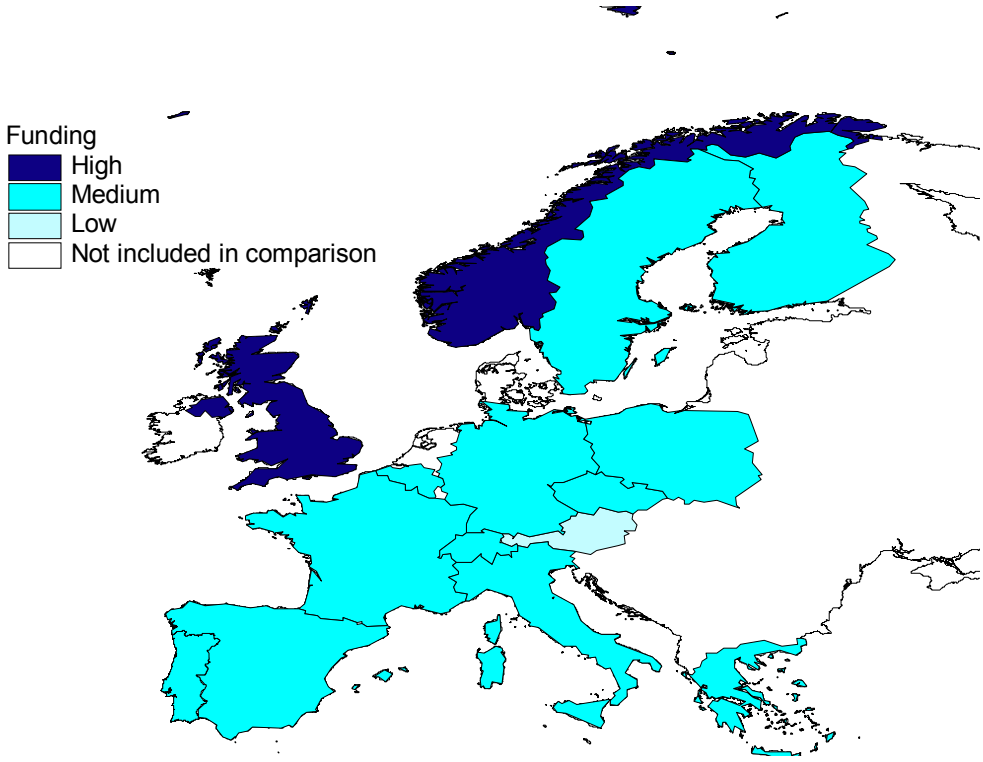
Access to information

Country	Comments
AT	Partial. Needs developing further with greater integration and extension of existing services.
Cat.(ES)	Key focus of the project. OGC specifications to facilitate interoperability and new e-services
CZ	Partially available, based on CEN. Need to update to ISO and extend service.
FI	Catalogue on-line since 1992. Difficulty in the past to keep up-to-date. Needs some modernising but good level of service.
Fla(B)	Yes but needing further extension to the service, which is in progress
FR	Catalogues for e-government services developing. GI-specific services still fragmented.
DE	Several independent services. Pilot to integrate into GeoPortal
GR	Pilot stage only.
IT	In progress. Service from Ministry of Environment to be opened soon.
NO	Yes based on national standards. Migration to ISO in progress.
PL	Limited as yet but recognised as key project. Need to move from CEN to ISO as well.
PT	Partially available. SNIG and GEOCID portal. Needs developing further with greater integration and extension of existing services
SE	Good basis but needs developing further and harmonising across agencies + ensure updates.
CH	Several services at canton/local level. Federal geoportal in progress.
UK	In rapid progress for reference data (Ordnance Survey and OSNI and some UKHO, BGS) but the thematic data in government remains patchy (some available, others not). Some commercial sector data available but others eg utilities less so.
US	Good services. Migration to ISO in progress.



Funding

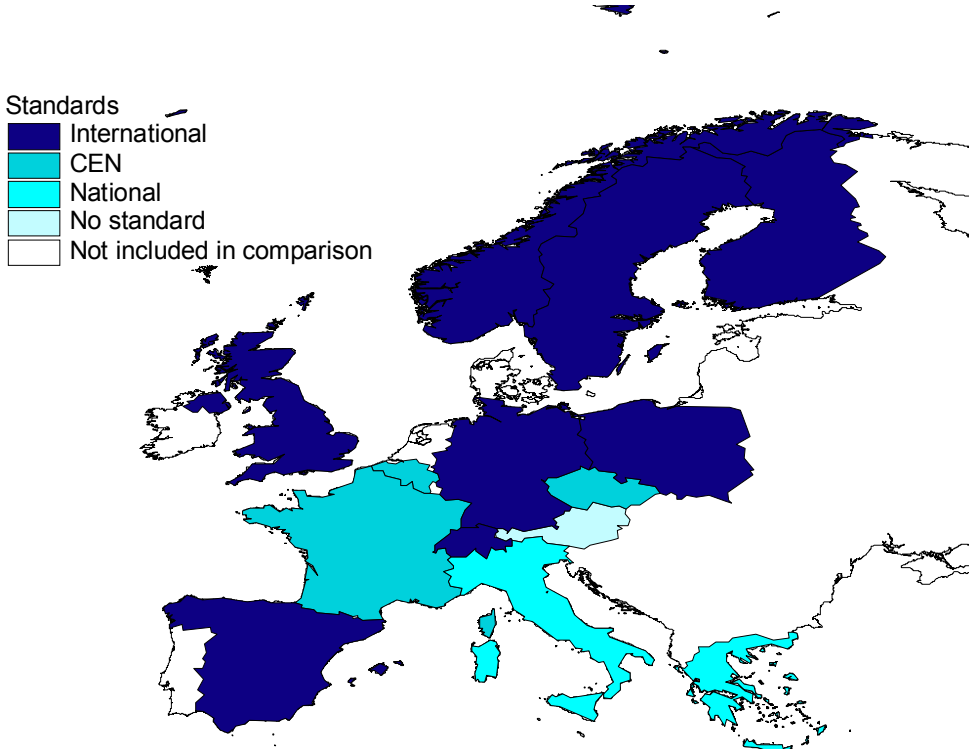
Country	Comments
AT	public funding favoured at present but this depends on political decisions on pricing policy
Cat.(ES)	IDEC project funded by the e-government
CZ	Funding by projects plus a central fund established for the Action Plan of Implementation of the State Information Policy.
FI	Funding are mainly provided by the Government
Fla(B)	Funding comes from a government base
FR	Most of the core activities to develop the RGE are centrally funded by government.
DE	Funding of NSDI is considered responsibility of the Government. Some private partnership at regional level
GR	Funding of SDI is provided by EU Structural Funds
IT	Government National funding and some European funds for Objective 1 regions
NO	Funding comes from government, user charges, and 'joint ventures' with public organisations. Discussions are taking place about PPP
PL	Funding is mainly provided by the Government
PT	Funding is mainly provided by the Government
SE	funding is partly governmental funds, partly cost recovery
CH	Funding of the Official survey and KOGIS is through the federal level, the development of standards is based on a mixed approach.
UK	Combination of public funding and user charges. Note "user charges" does not necessarily mean that the end user (ie citizen) pays. The citizen already has access to reference data and thematic data combinations, free of charge on the internet where the service is provided by local or central government as a "public" service.
US	Funding comes from a government base



Standards

In only few countries standards were not defined and/or adopted. The tradition was to adopt some existing pre-standards (e.g. CEN) or to develop specific national standards to create metadata and data discovery services. It could be observed now a general tendency to move to the ISO 19100 family to replace part of the national standards. OGC specifications are instead mainly considered by countries interested to develop immediately new geo-processing services.

Country	Comments
AT	market as determining force for the present, with no real standards applied
Cat.(ES)	ISO standards and OGC specifications adopted
CZ	CEN pre standard is in use for metadata
FI	well established national standards. In preparations to adopt the ISO 19100 family
Fla(B)	The spatial information directory is based on CEN pre-standard.
FR	CEN pre standard adopted as national standard
DE	ALKIS/ATKIS data model done according to international standards (ISO/OGC)
GR	Unique reference system GGRS'87 mandatory since 1990. Other standards on project base.
IT	Common rules and standards recently defined
NO	The SOSI (national standard for data exchange) implemented 100% The ISO 19100 series is planned to replace SOSI
PL	National standards exist and the CEN TC287 pre-standard
PT	Based on CEN, but migrating to ISO 19100 family.
SE	Swedish standards (SS-series) concerning roads, addresses, etc plus ISO
CH	Several national standards defined. Transition to ISO and OGC on going
UK	Euref, National, ISO, Industry, DNF, OGC, Hydrographic (eg SH57)
US	FGDC standards + ISO + OGC



Lessons learned and implications for a European SDI.

What are the features of a successful SDI? An SDI is successful:

- When it is developed, used, and maintained by several agencies responsible of key data resources including socio-economic, environmental, land and property, and reference data (e.g. addresses, administrative boundaries, physical infrastructure, and topographic features).
- When it is ready to answer to real needs, particularly at times of emergency such as natural or man-made disasters,
- When its framework data conform to common specifications, are maintained up-to-date, and are easy to find and access
- When it is multi-level from local to regional and national levels,
- When there is functional homogeneity in the framework across levels of jurisdiction.
- When there is clear authority in managing the framework
- When it supports sufficient economy to justify itself.

Political Support

If the characteristics highlighted above are those of a fully functional SDI, the experiences of SDIs reviewed in this report show that the more successful SDI, i.e. those coming closest to these characteristics, also enjoyed the highest and most consistent level of political support throughout their development. Conversely, the experiences that are more patchy in geographical coverage, and more mono-thematic in content tend to have developed in a climate of more limited political support.

This of course does not come as a surprise but it is important to have it confirmed by a wide range of national and international experiences, some of which have more than 10 years of development behind them. Two aspects are worth underlining:

1. **Political support at the highest level is crucial**.
   This is because:
   - Most geographic information is collected, maintained, and used by public sector organisations, which are dependent on the policies set by government in respect to organisational priorities, funding, and regulatory mechanisms;
   - Geographic information is an expensive commodity as well as underpinning a large number of government services to the citizen. It is therefore an area of tension between policies aimed at maximizing government revenue, and those such as e-government aimed at maximizing benefits to citizens. Political support is therefore needed to resolve these conflicts.

- SDIs are not primarily about technology, but about developing a clear framework of agreements among government agencies, and between government, the private sector, and citizens on the terms through which the use of public sector information, including geographic information, can be maximized for the benefits of all. These agreements often require attention and political support at the highest levels.
- Governments therefore play an absolutely crucial role in the development of SDIs and of the Information Society because they are at the same time data producers, users, policy setters, and regulators who provide guidance to major public sector organizations.

2. **Political support needs to be sustained over time**.
   For their very nature political priorities may change due to external circumstances, change of administration, or even only change of key individuals. The experience of some of the most well developed SDIs in the world indicates that even after many years of successful development they remain sensitive to changes in organisational priorities and political leadership.

With these considerations in mind, it is clear that one of the absolute priorities for the development of an SDI is persistent action to gather and maintain support among political decision makers at all levels. Political support is needed to endorse and propagate the vision, establish the legal framework, and allocate resources to get results. This requires selling the benefits of SDIs throughout their development, without ever taking support for granted.

Selling the Benefits

An SDI can and should be developed at local, regional, national, European, and global levels. Therefore, there is a need to address politicians and decision-makers at each of these levels and demonstrate the benefits of having an SDI.

The benefits have to address areas of high political priority such as crime reduction, health, education, spatial planning, environmental protection and disaster management. One must demonstrate how to support e-government and general economic development, reduce duplication and waste of resources, and increase competitiveness through the development of new industries in the location-based services.

To demonstrate such benefits it is possible at the beginning to use examples and cases from other parts of the world, suitably adapted to address local concerns, and as the local SDI develops it is important to focus on applications that can deliver *quick wins*, rather than spending a long time before showing any payback. At the European level, there are a number of key policy areas that can provide good case-studies for the benefits of having an SDI, or conversely the costs of not having one. These include disaster management (for example the Toulouse explosion or Chernobyl), environmental management (water framework directive, floods in Italy and along the Rhine basin), and transport (impact of blocked tunnels across the Alps).

One of the important messages from the more successful SDI experiences is the need to manage expectations. The development of an SDI also requires education, and the change of organisational cultures. These are often lengthy processes for many public sector organisations that have difficulty in adapting quickly to change. Some of challenges that need facing include the need to work more horizontally across departments and agencies, having greater sensitivity to customer needs and requirements, and using information more effectively, as well as the ability to "let go" to "my" information. Selling the benefits has to be realistic and not based on hype.

Coordination

Coordination is one of the most important aspects in the development of an SDI, as the experience of all the countries analysed indicates. The countries with the most developed national SDIs such as the US, and the Nordic states are all characterized by strong multi-agency coordinating frameworks. Countries with the least developed national SDI, such as Spain, Belgium, and Austria, also have the weakest co-ordination at the national level. These countries have on the other hand excellent examples of regional SDIs because it is at that level that good coordinating mechanisms have developed. Coordination is therefore crucial.

The roles of the coordinating body are manifold and include:

- leadership,
- mediating inter-agency conflicts,
- sustaining political support,
- selling the benefits to multiple audiences,
- providing technical guidance and enforcement of common standards,
- raising awareness and disseminating the results.
-

In addition coordination can also play a very useful role in identifying gaps or inconsistencies in the legal and organisational framework, and suggesting remedial action to the government. Whether all of these activities are performed by a single organisation or more than one, for example one focusing on operational implementation, and one more on strategic and legal issues, will depend on the circumstances. There is no question however that all of these activities are essential.

This central activity for the life of an SDI does not need to be expensive or imply large bureaucracies. Using the US as an example, the Federal Geographic Data Committee (FGDC) which coordinates the National SDI performs all of the functions above with a staff of 15 and a budget of $ 3.6 million per year, of which approximately half is spent as seed money to support the development of metadata and related services and portals at federal, state and local level. This is therefore not a large structure or budget, but a very successful model, providing a high return on the investment made.

There are three other lessons from the US experience that are of particular relevance to Europe:

- Even if political support comes from the highest possible level, without firm coordination the centripetal forces of each agency pulling in its own

direction would undermine the SDI. Never underestimate "departmentalism"!

- Coordination needs its own budget to be effective.
- Like in any complex project, you need to think big and act small, i.e. keep and promote the vision, but phase implementation.

Phased Implementation

The experiences of implementing SDIs in Europe clearly show that different models and approaches emerge as a result of the different cultural and institutional circumstances. Some countries spend longer time in the planning stage, developing a coherent conceptual model of the SDI and its components before starting implementation, others are more pragmatic and start with whatever is already available and develop as they go along. One model does not fit all.

Focusing on the endeavour of developing a European SDI, a phased implementation that builds and supports the existing national and regional SDIs is crucial. Collaboration and complementarity are key principles. At the same time, it is clear that national SDIs do not exist in every country. Therefore some legal backing requiring Member states of the EU to develop a base-line SDI seems necessary, whilst leaving the details of how this is undertaken to national responsibility.

To support the development of national and regional SDIs, and their interoperability at the European level, there is a need to support organisational and institutional capacity, promote international standards and best practice, and provide technical coordination and support. Coordination and support should include the development of European specifications for data content based on what already exists, whilst keeping the impacts on national databases to a minimum.

In addition to this foundation work there is also a need to harmonize the data layers and achieve seamless coherent information. The amount of work needed will vary on the layers and the level of agreement reached across the production chain on common definitions and standards. However, the existing experiences in Europe in relation to developing seamless data bases on soils, land cover, meteorological information, topography, and administrative boundaries indicates that significant harmonization work is needed, and that for each theme specific organisations need to be charged with the task of undertaking this work.

Implementing an ESDI needs therefore to consider a series of issues including:

- Identification and selection of who will be in charge of harmonizing the data layers,
- Coordination of these organisations vis-à-vis the technical coordinators of the ESDI and existing European agencies,
- How this work will be funded,
- The relationships between original and harmonized data, issues of IPR and access.

When building national, and European, SDIs phased implementation is needed both from the top down (policy frameworks, coordination), and from the bottom up,

integrating what already exists. It is crucial that the services implemented work together at each layer of achievement, i.e. be interoperable.

In the European context (but this is equally valid at other levels) a GeoPortal is important for demonstration purposes but also to allow visualisation, processing and access to data. This service must be based on clear user needs, be multi-lingual to act as an European entry point to available services, and provide links to national portals (possibly based on service registers). To achieve this, existing catalogues in different countries need to be extended by building software interfaces.

The value of such GeoPortal is to demonstrate what can already be achieved by making public sector data more visible and accessible, provide services that respond to user needs, and identify priority areas for improvements and gaps to be filled. It also has the announcement value that something *is* happening, and a measure of progress of SDI development through indicators such as the number of services and catalogues available over time, and measures of user feedback.

With these considerations in mind, the following recommendations are made.

Summary of Recommendations

To contribute to the development and implementation of an ESDI, and support the INSPIRE initiative aimed at developing the legal framework for a ESDI, the expert group convened by GINIE makes the following recommendations:

1. Political sustainability

It is recommended that politicians be encouraged to take an active role in all committees involved in establishing and steering the development of the SDI, at regional, national, and European levels.

2. Financial sustainability

To kick-start the establishment of a European SDI, it is recommended that the financial support come initially from national governments through general taxation. These investments must be regarded as an integral part of the e-Europe and e-Government agendas because the SDI underpins the modernisation of government, and increased access to Public Sector Information. Once the initial infrastructure is in place, its long term financial stability must be ensured. This may require a combination of public and private investment, and user charges congruent with the objective of maximising its use.

3. Legal Framework

It is recommended that a common legal framework be set in place to support the development of an ESDI. This framework should require:

- of the EC that ESDI principles should be followed in all EU-funded projects, i.e. the development of data and technology specifications should be considered in parallel to enable delivery of a specific service,
- of Member States that a base-line SDI on agreed priority services (e.g. Catalogue Services) be constructed building on existing services or creating them where not available.

4. Coordination

It is recommended that a coordinating framework at the European level be established to ensure that the ESDI becomes a reality. Such framework should include:

Operational coordination:

- To define European specifications for common data models and encoding methods, and provide technical advice, support, and technology watch.
- To promote international standards for interoperability.
- To coordinate the activities of the organisations charged with thematic data model harmonization.
- To manage a European GeoPortal.

Strategic Coordination

- To support the development of National SDIs through institutional capacity building, and comparative studies with common methodologies of national experiences and legal frameworks that relate to GI and SDI.
- To ensure that policies and actions at the European level are consistent with the development of the ESDI (policy watch).
- To liase with national organisations in raising awareness at the political level through the dissemination of use-cases and pilot projects that have a direct relation to political top priorities such as environment and e-government.

It is further recommended that each of these two coordinating functions be supported by a clearly earmarked multi-annual budget.

5. Phased implementation

It is recommended that a phased implementation for the development of an ESDI is adopted based on subsidiarity, i.e. on the national and regional efforts already undertaken. To deliver the global vision in a sustainable and phased approach the following is specifically recommended:

- That a multilingual GeoPortal be established for demonstration purposes, and to measure the success of ESDI development. Such portal must integrate with e-government services underpinned by location rather than providing GI services isolation.
- That candidate services and capabilities should be identified early in order to construct a baseline ESDI.
- That a core technical committee should be established at the European level at an early stage to define European specifications, and provide technical coordination of the ESDI.
- That the organisational and financial framework for the harmonization of data layers be established in consultation with existing European Agencies and organisations, and the core technical committee of the ESDI.
- That capacity building measure focus on SMEs (Small and Middle-sized Enterprises) in the value-chain of services needed to guarantee the implementation at the local level, and on local government.

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