Towards a European Spatial Data Infrastructure: Recommendations for Action from the GINIE project

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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 whether it can be 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

[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

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:

- Data should be collected once and maintained 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.
- Geographic information needed for good governance at all levels should exist and be available widely 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 be easy to understand and interpret within the appropriate context and selected in a user-friendly way through the use of visualization tools.

Whilst INSPIRE aims at developing a legal framework to underpin the creation of an 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 addressing 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. A report evaluating the experiences of the individual countries represented at the meeting is available from the GINIE Web site (www.ec-gis.org/ginie). Below is a summary of the key findings and recommendations.

[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.

Summary of Findings

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 at the meeting showed 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 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.

Summary of Recommendations

To contribute to the development and implementation of a European Spatial Data Infrastructure (SDI), 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 content and encoding, 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 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 SME's in the value-chain of services needed to guarantee the implementation at the local level, and on local government.

BIOS:

Alessandro Annoni obtained the degree in Physics from the University of Milan in 1979. He has been working on various national and regional remote-sensing and GIS projects funded by Member States and by the European Commission. In 1988 he was one of the founders of Remote-Sensing Data Engineering S.r.l. (RSDE) in Milan, with which he was until 1996. At present Dr. Annoni is head of the Geographic Information and Spatial Applications sector of the Land Management Unit at the Institute for Environment and Sustainability (IES) of the European Commission's Joint Research Centre (JRC) in Ispra, Italy. He is the Leader of the JRC Project "GI&GIS: harmonisation and interoperability". This project within the 5th

Framework Programme has fostered the links between various networks and has played and still plays an important role in preparing the ground for the establishment of a European Spatial Information Infrastructure. Dr. Annoni is also participating in several projects relevant for ESDI development (GINIE, NATURE-GIS) and the recently finished (ETEMII, PANEL-GI, GIPSIE). He is also the technical responsible of GIS activities for JRC that includes his participation in COGI. Dr. Annoni is author and co-author of more than 60 papers and books related to GIS and remote-sensing.

Max Craglia is a Senior Lecturer at the Department of Town & Regional Planning, University of Sheffield. His research interests focus on two sets of issues: the first, relates to the development of spatial data policies and infrastructures to support integrated spatial and environmental planning at the European, national, and local level. The second, relates to the application of Geographic Information Systems (GIS) for policy analysis, needs assessment, resources deployment, and impact evaluation in policy relevant fields such as spatial planning, neighbourhood renewal, and crime reduction. Max Craglia is the coordinator of the Geographic Information Network in Europe (GINIE) project funded by the European Union' Information Society Technology programme. He has published extensively in the field of GI, and details can be found on http://www.shef.ac.uk/trp/staff/cragl/index.html