

Evaluating the performance of large scale SDIs: two contrasting approaches*

Ian Masser

Public Governance Institute, KU Leuven
(ian.massier@yahoo.co.uk)

Abstract

In the last couple of years there have been two very different attempts to evaluate the performance of large scale spatial data infrastructures (SDIs). The first of these was in the United States of America where the Coalition of Geospatial Organizations (COGO), a consortium of professional organisations, set up an expert panel to produce a report card of the performance of the US NSDI. The second evaluation was in the European Union where the European Commission carried out its own evaluation of its Infrastructure for Spatial Information in Europe (INSPIRE) Directive the requirements of the European Commission. The main features of these two contrasting approaches to evaluation are described in the opening sections of this paper while the final sections consider the similarities and differences between the two outcomes of the two exercises and put forward a simple typology that can be used in other evaluation studies of the implementation of large scale SDIs.

Keywords: SDI, INSPIRE, FGDC, Evaluation, Monitoring

1. INTRODUCTION

The tasks of monitoring and evaluation are normally carried out at two different levels of government. The bottom level involves regularly reporting on the progress of an ongoing project or programme activities that are associated with the process of implementation by the next level of management. The basic objectives of this task are to check whether things are going according to plan so that the necessary steps can be taken if necessary to rectify any problems that may have arisen during the implementation process. In most cases this is enough to meet the project or programme requirements. However, where large scale or complex projects or programmes are involved higher levels of government or independent bodies of experts may carry out their own evaluations to assess whether the implementation process is proceeding smoothly. This task effectively involves monitoring the monitors.

With these considerations in mind this paper discusses two contrasting approaches to evaluate the overall performance of large scale spatial data infrastructures (SDIs). The first of these was in the United States of America where the Coalition of Geospatial Organizations (COGO), a consortium of professional organisations, set up an expert panel to produce a report card of the performance of the US NSDI. The second evaluation was in the European Union where the European Commission has carried out its own evaluation of the performance its Infrastructure for Spatial Information in Europe (INSPIRE) Directive to meet the statutory requirements of the European Commission. The main features of these two

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contrasting approaches to evaluation are described in the opening sections of the paper, while the final sections consider the similarities and differences between the two outcomes of the two exercises and some of their theoretical implications for further research of large scale SDI development and implementation.

2. THE COGO REPORT

On April 11, 1994, President Clinton issued Executive Order 12906 (Executive Office of the President, 1994) that required the Federal Geographic Data Committee (FGDC) to lead and coordinate the development of the National Spatial Data Infrastructure (NSDI). Much of the groundwork for this Order had already been set out in the National Research Council (1993) report entitled 'Toward a Coordinated Spatial Data Infrastructure for the Nation'. The Executive Order stimulated the development of NSDIs throughout the world and began an ongoing debate in America and elsewhere about the nature and role of NSDIs and their implementation in practice. In this way, the Federal government jump-started many of the innovations and collaborations that have created the current geospatial environment (Masser, 2005).

However, during the last twenty years circumstances have changed to such an extent that the National Geospatial Advisory Committee report on 'The Changing Geospatial Landscape,' noted that the Federal government is no longer the dominant data producer. Federal providers of geographic information cannot continue to think of themselves as players separate from the community of private sector, state, local, tribal, and other stakeholders and without a strong Federal infrastructure, the other sectors cannot build the NSDI as it was originally anticipated (National Geospatial Advisory Committee, 2009, p.12).

The Coalition of Geospatial Organizations (COGO) was set up in 2008 to serve as a forum for thirteen non-profit organizations concerned with national geospatial issues. These represent approximately 170,000 individual geospatial practitioners. Table 1 lists its members. In 2014 COGO commissioned an Expert Panel to develop a Report Card for the NSDI. The Expert Panel focused on the NSDI Framework to grade Federal efforts, and points out some of the shortcomings of those efforts. It was chaired by Jim Geringer, a past Governor of Wyoming.

Table 1. COGO Member Organizations

American Society of Civil Engineers (ASCE)
 American Society for Photogrammetry and Remote Sensing (ASPRS)
 Association of American Geographers (AAG)
 Cartography and Geographic Information Society (CAGIS)
 Geographic and Land Information Society (GLIS)
 GIS Certification Institute (GISCI)
 International Association of Assessing Officers (IAAO)
 Management Association for Private Photogrammetric Surveyors (MAPPS)
 National Society of Professional Surveyors (NSPS)
 National States Geographic Information Council (NSGIC)
 University Consortium for Geographic Information Science (UCGIS)
 United States Geospatial Intelligence Foundation (USGIF)
 Urban and Regional Information Systems Association (URISA)

The model for the COGO report is the Report Card approach developed by the American Society of Civil Engineers. Every four years, it carries out a comprehensive assessment of the nation's major infrastructure categories that is published in ASCE's *Report Card for America's Infrastructure* (American Society of Civil Engineers, 2013). Using a simple A to F school report card format, this Report Card assesses current infrastructure conditions and needs, both assigning grades and making recommendations for how to raise the grades.

The report card approach has been used extensively at the US state level as a tool for evaluating infrastructure performance as well as in several other countries.

The NSDI Report Card is 'a qualitative evaluation of the status and condition of the NSDI and its Framework data layers.' (Bossler et al., 2015, p.5) The objective of this evaluation is to draw attention to the need for current and accurate geospatial data for the United States. At the outset, it had to be recognised that a complete assessment of the NSDI assessing the status of the entire NSDI would not be feasible without significant funding and cooperation from all the Federal agencies. Consequently, the data Framework was selected for the focus of the evaluation as it is 'recognized as the data backbone of the NSDI' (p.8).

Table 2. Framework assessment criteria used in COGO report

- A. **Fit for the future:** The data theme is generally in excellent condition and meets the needs for the present and the future. Few geographic areas of the nation require attention. Standards for data and assured public access are met.
- B. **Adequate for now:** The data theme is in good to excellent condition, but some geographic areas of the nation require attention for significant deficiencies. A substantial majority of the theme data that have been designated as Framework follow appropriate standards and are available.
- C. **Requires attention:** The data theme is in fair to good condition, but it requires attention for many geographic areas of the nation. Standards for this data theme exist and are used for most of the data that are designated as Framework.
- D. **At risk:** The data theme is in poor to fair condition and mostly below the goals envisioned for the NSDI. A large portion of the data for this theme has not been developed sufficiently to make them accessible, or are unable to be integrated with other data from this theme.
- E. **Unfit for purpose:** The data for this theme is in an unacceptable condition and provides little to no value to users. Standards for the data theme do not exist or are not being used by most of the users, providers, or data developers.

The Report Card for the NSDI Framework data is based in the five grades shown in Table 2. The NSDI Framework consists of seven designated themes of data that were given the following scores:

1. Cadastral data - Grade: D+ (At Risk)

'The grade is based on the fact that a comprehensive parcel database for cadastral information does not exist...Until the FGDC supports a comprehensive approach to assembling parcel information from local stewards, it should acknowledge that the United States does not have a program to create and support a Cadastral data theme' (p.16).

2. Elevation data - Grade: C+ (Requires Attention)

'Elevation data are generally available across the nation, but they are not suitable for many purposes, and more work needs to be done to better leverage budgets, coordinate data collection efforts, and collaborate across levels of government' (p.31).

3. Geodetic data - Grade: B+ (Adequate for Now)

'The National Geodetic Survey (NGS), a component of the National Oceanic and Atmospheric Administration (NOAA), developed its "Ten Year Strategic Plan 2013-2023," 2013. Goal 3 of that plan is important to this report, because it demonstrates the serious nature of NGS's desire to foster the goals of the NSDI' (p.37).

4. Governmental units data - Grade: C (Requires Attention)

'The Expert Panel's grade of C reflects positively on the ease of access to nationally consistent, digital representations of numerous governmental units. The "C" grade reflects the challenges in obtaining the most current reliable information, as well as uncertain methods for integrating governmental boundaries with other Framework data' (p.41).

5. Hydrography data - Grade: C (Requires Attention)

'There has been good coordination among the Federal agencies that require these data for their program and mission needs and with non-federal entities. However, as with other types of Framework data, more work needs to be done to better leverage budgets, coordinate data collection efforts, and collaborate across levels of government' (p.48).

6. Orthoimagery data - Grade: C+ (Requires Attention)

'The "leaf-on" orthoimagery layer warrants a grade of A-, given coverage, standards, and collaboration among supporting agencies. However, "leaf-off" orthoimagery, a documented requirement, lacks coverage. As a result, the grade for the combined layers is a C+' (p.52).

7. Transportation data - Grade: D (At Risk)

'The grade reflects poor stewardship in the past as reflected by the multiple sources of road centreline data (e.g. TIGER, ARNOLD, and privately produced) in use by Federal agencies' (p.57).

These scores are summarised in a Report Card (Figure 1) which gives an overall score to the Framework data of C. It also includes scores in relation to seven overall criteria: capacity, condition, funding, future need, operation and maintenance, public use, and resilience. The scores for each of these categories are shown below.

Figure 1. The COGO Report Card (Bossler et al., 2015, p.4)

GRADE REPORT OF: National Spatial Data Infrastructure (NSDI)			SEMESTER: Fall 2014		
Subject	Dept.	Grade	Subject	Dept.	Grade
CADASTRAL DATA	DOI	D+	CAPACITY	FGDC	C
GEODETIC CONTROL	DOC	B+	CONDITION	FGDC	D
ELEVATION DATA	DOI	C+	FUNDING	Various	D
HYDROGRAPHY DATA	DOI	C	FUTURE NEED	FGDC	D
ORTHOIMAGERY DATA	DOI & USDA	C+	OPERATION & MAINTENANCE	FGDC	C
GOVERNMENT UNITS DATA	DOC	C	PUBLIC USE	FGDC	C
TRANSPORTATION DATA	DOT	D	RESILIENCE	FGDC	C
OVERALL DATA GRADE		C	COMPREHENSIVE GRADE		C-

TO: Federal Geographic Data Committee
590 National Center
Reston, Virginia 20192

FROM: Coalition of Geospatial Organizations (COGO)
<http://www.cogo.pro>
See the full report for an explanation of each grade.

3. Capacity - Grade: C (Requires Attention)

'The Framework's capacity to meet demands is quite strong from the perspective of individual themes of data.... However, the ability to effectively use this current and increasing amount of data is not certain. The Framework data resources are currently difficult to identify and integrate. As new or updated data are added across the nation, the ability of users to determine what data are integrated Framework data will likely be even more difficult than at present' (p.68-9).

2. Condition - Grade: D (At Risk)

'Individual themes of data for Framework categories are generally in good shape.... However, the Framework has significant shortcomings as an integrated whole...[and] it is very difficult to identify which of the potentially numerous datasets is actually Framework data for a specific theme, or for a given geographic area' (p.69).

3. Funding - Grade: D (At Risk)

'The development of an integrated NSDI Framework is a collaborative effort that requires participation from the entire geospatial community. Funds for this type of Framework theme data - including activities around standardization, documentation, dissemination, and integration - are lacking. In addition, we haven't effectively architected an integrated system for the NSDI Framework to enable the full exploitation of data, including location and delivery of the data that are most suitable for individual purposes' (p.70).

4. Future Need - Grade: D (At Risk)

The NSDI Framework was envisioned to be an integrated resource of seven common data themes most often needed by users.... In addition to funding Framework data projects, there is a critical need to fund the infrastructure that supports data coordination, management, maintenance, and distribution functions (p.70).

5. Operation and Maintenance - Grade: C (Requires Attention)

'The FGDC and lead agencies for Framework themes generally have the capability to maintain the current condition of the Framework and to operate it in much the same way as in the past several years... While these efforts should keep a status quo, it does not promise significant steps forward for the Framework component of the NSDI' (p.70-1).

6. Public Use Grade: C (Requires Attention)

'Framework theme data resources are readily available to the public through a variety of data portals and clearinghouses that are part of the NSDI... However, there is no definitive designation that identifies specific data as the Framework data that are 'authoritative'' (p.70-1).

7. Resilience Grade: C (Requires Attention)

'The NSDI was envisioned as a national effort with leadership by the Federal government and with active partnerships, participation, and contributions from other levels of government and non-government sectors.... The basic leadership, responsibility, and authority for the NSDI are with the Federal government. Neither the other levels of government, nor the private sector, are positioned to provide national leadership' (p.71).

The Report Card in Figure 1 gives an overall grade for the US NSDI of C- with a recommendation that this requires attention. In the eyes of the expert panel 'The NSDI Framework exists and provides substantial value to users through the large amounts of publicly available thematic data. The vision of the NSDI Framework, however, has not yet been fulfilled. While there are many datasets for the Framework themes, definitive sets of reliable and certified Framework data are not available. The Framework is not an integrated whole, but remains mostly as seven separate themes' (p.68). It is important to note that that,

while the findings of analysis are the work of the Expert Panel, they have been fully endorsed by the COGO Member Organizations. (Bossler et al., 2015, p.1).

3. EVALUATING THE IMPLEMENTATION OF THE INSPIRE DIRECTIVE

The publication of President Clinton's Executive Order in 1994 prompted the Information Society Directorate in the European Commission to publish a series of consultation documents outlining its own ideas for a European SDI. Social matters rather than environmental considerations were the driving forces behind this initiative. These drafts, collectively known as GI 2000, were the subject of extensive consultations with the European geographic information community between 1995 and 1999 and helped to create a climate of opinion favourable to the idea of a European SDI.

The development of the INSPIRE (Infrastructure for Spatial Information in Europe) initiative has been a complex process involving many groups of people since its inception in September 2001 (Masser and Crompvoets, 2015). An important driver behind the INSPIRE initiative was the Sixth Environment Action Programme of the EC for the period 2002 to 2012 which was approved in July 2002 (CEC, 2002).

After a public consultation in 2003 and an extended impact assessment the Commission published its proposal for an INSPIRE Directive in 2004. Following its publication, the draft directive entered a co-decision process whereby it required approval by the European Commission (the EU's executive arm of government), the European Parliament (directly elected legislators from EU member states), and the Council of Ministers (heads of ministries from EU member states) before it could become law. After three years of discussions the amended INSPIRE Directive was formally approved by the European Parliament and the Council on March 14th 2007 (CEC, 2007). The next stage of the formal implementation process was for the Member States to transpose the terms of the Directive into their own national legislation within two years of it becoming law.

From the outset, the Commission recognised that the development of Implementing Rules for the Directive would require the participation of large numbers of stakeholders from the member states. These Implementing Rules spell out in some detail the technical requirements for each of the main components of the Directive. Each of them went through various stages of public consultation prior to their approval by the INSPIRE Committee. Once approved, these Decisions and Regulations are legally binding on each of the Member States. Table 3 contains details of these Decisions and Regulations.

Article 23 of the Directive also requires the Commission to present a report on its implementation to the European Council and the Parliament by May 2014 and every six years thereafter. To meet this requirement the Commission and the European Environment Agency - EEA (2014) duly submitted its mid-term evaluation report.

The mid-term evaluation report on INSPIRE implementation (European Environmental Agency, 2014) was written by a team of officials from the EEA and the Joint Research Centre (JRC) who have been closely involved in its development. It was based largely on the country reports on implementation from each EU member state; an independent assessment by KU Leuven; and a public consultation that had some 700 responses.

The report marks the halfway stage of the implementation process and, as such, is aimed at the European Parliament and Council. It evaluates progress towards achieving the original

objectives and considers the need for policy action to align existing approaches better to changing circumstances.

Chapter 4, on the state of implementation, is the heart of the report. It considers the legal transposition by Member States (MSs) and the coordinating structures that have emerged within each country. It also discusses the development of the implementing rules, the use of the emerging infrastructure, and the estimated costs and benefits of its implementation.

The first section of chapter 4 shows that the Directive has been successfully transposed into the legislation of all 27 states which formed the EU in 2007. Croatia, which became a full member in July 2013, had already enacted the necessary legislation in May of that year. However, it should be noted that only one state met the original transposition deadline, and the European Commission had to threaten 'infringement' procedures against the others.

Table 3. INSPIRE Implementing Rules legislation
(source: <http://inspire.ec.europa.eu>)

Metadata

Commission Regulation (EC) No 1205/2008 of 3 December 2008 implementing Directive 2007/2/EC of the European Parliament and of the Council as regards metadata.
Corrigendum to INSPIRE Metadata Regulation 15.12.2009

Interoperability of spatial data sets and services

- Commission Regulation (EU) No 1089/2010 of 23 November 2010 implementing Directive 2007/2/EC of the European Parliament and of the Council as regards interoperability of spatial data sets and services.
- Commission Regulation (EU) No 1312/2014 of 10 December 2014 amending Regulation (EU) No 1089/2010 implementing Directive 2007/2/EC of the European Parliament and of the Council as regards interoperability of spatial data services.*

Network Services

- Commission Regulation (EC) No 976/2009 of 19 October 2009 implementing Directive 2007/2/EC of the European Parliament and of the Council as regards the Network Services.
- Commission Regulation amending Regulation (EC) No 976/2009 as regards download services and transformation service 08.12.2010.
- Commission Regulation (EU) No 1311/2014 of 10 December 2014 amending Regulation (EC) No 976/2009 as regards the definition of an INSPIRE metadata element.

Data and Service Sharing

- Commission Regulation (EU) No 268/2010 of 29 March 2010 implementing Directive 2007/2/EC of the European Parliament and of the Council as regards the access to spatial data sets and services of the Member States by Community institutions and bodies under harmonised conditions.

Monitoring and Reporting

- Commission Decision of 5 June 2009 implementing Directive 2007/2/EC of the European Parliament and of the Council as regards monitoring and reporting.

*: The text of this regulation is a consolidated text of three earlier regulations

The report concludes that the participatory model that was first developed for the general coordination of INSPIRE activities, and the formulation of implementing rules, are successes

that need to be maintained and further developed. At the same time, it suggests that more effort is needed to embed INSPIRE fully into other related environmental activities.

Coordination at the national level is discussed with respect to the advantages of centralised and decentralised coordination structures, the role of the lead organisation, the stakeholder board membership and the effectiveness of coordination.

An important factor is the role of the lead organisation - usually the national mapping and cadastral organisation or the environment ministry. These large organisations have the necessary human, financial and technical resources to shape the form and nature of national implementation. Typical stakeholder boards for coordination contain only the main stakeholders and, in many cases, the freedom of action of these bodies is constrained by a national spatial data infrastructure (NSDI), open data requirements and/or eGovernment policy.

Table 4. The 34 INSPIRE data themes
(source: <http://inspire.ec.europa.eu>)

Annex 1

Addresses
Administrative Units
Cadastral parcels
Coordinate reference systems
Geographical grid systems
Geographical names
Hydrography
Protected sites
Transport networks

Annex 2

Elevation
Geology
Land cover
Orthoimagery

Annex 3

Agriculture and aquaculture facilities
Area management/restriction/regulation zones and reporting units
Atmospheric conditions
Bio-geographical regions
Buildings
Energy resources
Environmental monitoring facilities
Habitats and biotopes
Human health and safety
Land use
Meteorological geographical features
Mineral resources
Natural risk zones
Oceanographic geographical features
Population distribution and demography
Production and industrial facilities
Sea regions
Soil
Species distribution
Statistical units

Utility and government services

The section on implementing rules considers their impacts on six key components of the Directive: metadata, network services, the INSPIRE geo-portal, interoperability, sharing of spatial data/ services, and monitoring/reporting.

1. *Metadata*: The report shows that considerable progress has been made with the creation of Annex I and II metadata which is similar to the US data Framework (Table 4), although not all of the metadata is INSPIRE compliant. A third of countries reported more than 90 per cent compliant metadata but some of the others lagged far behind frequently citing lack of resources and complexity of specifications as reasons for the delay.

2. *Network services*: There are clear parallels with metadata and, on average, 63 % of the required metadata spatial datasets and services are available through discovery services and 27 % of the data is available to view and download. Again, there are marked variations between countries.

3. *The INSPIRE geo-portal*: Usage of the pilot INSPIRE geo-portal mirrors the content of the national discovery services. Only Bulgaria, Cyprus, Hungary, Italy, Lithuania and Malta had not connected at least one discovery service to the geo-portal. The public consultation suggests that relatively few respondents used the EU wide geo-portal: national and regional geo-portals were much more popular because most users were only looking for national data.

4. *Data interoperability for Annex I*: The current timetable requires MS to comply with the implementing rules for data interoperability only for newly collected and extensively restructured Annex I spatial data sets which deal with similar matters to those considered in the COGO report. So far, the implementation of INSPIRE is not consistent across all MS due to differences in the effectiveness and communication of the national coordinating organisations. Nevertheless, implementation in several countries has enabled stocktaking of who is responsible for what data, and has created opportunities for reorganising data holdings to reduce duplication.

5. *Spatial data and service sharing*: Agreements for sharing, access and use are among the main components of an infrastructure for spatial information and the Member States are adopting a variety of measures for spatial data and service sharing between public authorities. The focus has been on sharing and providing access to the basic (reference) spatial data sets such as topographic maps, geographical names, addresses, and orthoimagery. The findings of the public consultation suggest that INSPIRE has contributed to a more open policy for the public sector but that there are still a lot of organisational, technical and legal barriers to sharing.

6. *Monitoring and reporting*: Annual quantitative monitoring and the three yearly country reports are the main sources for evaluating the progress of INSPIRE. However, there are concerns about the relevance and reliability of some indicators and the country reports vary considerably in quality. There is also a tendency to focus on technical implementation at the expense of issues such as data sharing and the extent to which INSPIRE is supporting national environmental policies.

The last two sections of chapter 4 deal with the use of the infrastructure and the costs and benefits. With respect to the use of the infrastructure, the report concludes that this is particularly difficult to measure and that further work on this topic is needed. The key finding of the 2013 country reports is that costs are so far in line with initial expectations but that

most of the benefits in terms of improved data access, better cooperation in the public sector, and better services to citizens and business, have yet to be fully realised.

The final section of the report describes the results of the assessment. These suggest that implementation has reached its half way stage with generally positive outcomes. Three of the five original objectives have undergone a positive evolution. Increased availability of metadata has led to improved documentation, and considerable progress has also been made with establishing internet based network services. Interoperability is improving, even though most of the measures required have yet to be implemented. Organisational, legal and cultural barriers still restrict data sharing and the arrangements that have already been made for coordination need strengthening at the EU, national and local levels.

In July 2016, a 13-page report of the European Council and the European Parliament on the implementation of the INSPIRE Directive was published in response to the mid-term evaluation (European Commission, 2016a). This was accompanied by a substantial staff working document (European Commission, 2016b). The main Commission report contained the following recommendations.

The most important of these is that:

‘As a prerequisite, all Member States need to step up their efforts in implementing (e.g. on their coordination activities) and critically reviewing the effectiveness of their data policies. This applies in particular to those Member States lagging behind the most if they are to meet future implementation deadlines’ (p.12).

This means that Member States should give priority to environmental datasets and improving coordination between national INSPIRE implementation efforts and eGovernment, open data and other related activities.

To complement these national efforts, it is recommended that the Commission carry out four tasks:

A. ‘evaluate the shortcomings of the national data policies in relation to Article 17 of the Directive in more detail and explore synergies with the ‘free flow of data’ initiative under the Digital Single Market with the view to resolving these issues through that;

B. review, and possibly revise, the INSPIRE rules, in particular on spatial data harmonisation, to take into account the implementing risks and complexities with a view to reducing them (simplifying requirements);

C. assist the Member States in applying and implementing the INSPIRE Directive (simplification of use), e.g. by the use of common tools, and promote priority setting together with the Member States;

D. work closely with Member States to explore opportunities arising from the use of existing EU-level funding programmes to help capacity building and close the INSPIRE implementation gaps (e.g. through the Interoperability Solutions Administrations)’ (pp. 12-3).

4. DISCUSSION

At first sight it looks as if comparing the COGO report with the INSPIRE review is rather like trying to compare chalk and cheese because there are so many striking differences between them. But it must be borne in mind that the objective of both is to examine the progress of the national SDI in the US and multinational SDI implementation in Europe. The big difference between them is that the COGO report was prepared by an expert panel of independent professionals with the objective of raising overall awareness of the issues involved whereas the INSPIRE report is essentially the outcome of a self-evaluation carried out by staff involved in the SDI implementation process to meet the regulatory requirements of the Commission.

Once these differences are considered there are some interesting features about the two documents. The COGO report deals essentially with the data Framework to draw attention to the need for current and accurate geospatial data for the United States. The authors also point out that a complete assessment of the NSDI would not be feasible without significant funding and cooperation from all Federal agencies. In contrast, there is almost no mention of the data issues involved in the INSPIRE review report even though a much wider range of data is involved. INSPIRE is an environmental Directive and its 34 data themes also include large quantities of environmental data (Table 4). For this reason, it presents a much greater challenge for data providers than the US NSDI Framework. Nevertheless, this issue is almost entirely passed over in the review report which focuses mainly on the problems associated with development of data networks and services. This is something that might have been considered in the COGO report had the resources been available for a full assessment. As it stands the few references to data networks and services in the COGO report seem to take it for granted that they will be created during SDI implementation.

Another noteworthy feature is the apparent weakness of the FGDC that is noted in the conclusion of the COGO report and the relative strength of the INSPIRE implementation process. It should be noted that the development and implementation of the INSPIRE Directive is the outcome of an unusual account of interagency collaboration in the European Commission. At an early stage in its development a Memorandum of Understanding (MoU) was agreed between the three European Commissioners responsible for the Environment, Economic and Monetary Affairs (including Eurostat), and Research (including the JRC). The original lead services of the European Commission for the implementation of the INSPIRE Directive were Directorate General (DG) Environment, Eurostat, and the JRC. DG Environment is the overall legislative and policy co-ordinator for INSPIRE and the JRC acts as the overall technical co-ordinator of INSPIRE. Eurostat was the overall implementation co-ordinator until 2013. When Eurostat resigned to concentrate on its core business (statistics) the JRC became the implementation coordinator and the European Environment Agency increased its involvement in the EU level coordination by taking over tasks previously carried out by Eurostat while also strengthening the integration of INSPIRE with other EU environmental activities.

If the formal INSPIRE reporting arrangements were to be put into practice in the United States, the FGDC would be required to submit regular reports on the NSDI to the US House of Representatives and the Senate. This is clearly not the case. In contrast, the Federal Geographic Data Committee (FGDC) is situated within the large Department of the Interior which also houses the Office of Management and Budget and the US Geological Survey. In accordance with Office of Management and Budget (OMB) Circular A-16, the FGDC is chaired by the Secretary of the Interior with the Deputy Director for Management, OMB as Vice-Chair. It is made up exclusively of representatives from the main federal bodies that are responsible for the provision of geographic data. Its immediate links with non-federal agencies come largely through the National Geospatial Advisory Council which was created in 2008 under the Federal Advisory Committee Act. Its members include representatives from state and county agencies but it functions solely as an advisory body.

The outcomes of this investigation of two contrasting approaches to SDI evaluation in the US and Europe provide some interesting insights into the issues involved in the implementation of large scale SDIs. They also suggest two needs for SDI future research in the US and Europe. In the US, there is obviously a need for a more extensive investigation of the aspects SDI implementation than was possible in the COGO report. Of special interest, would be the whole area of network services from metadata to invoke (chaining) services covered by INSPIRE. In the case of INSPIRE there is equally a need for further research on the implementation of the data specifications that are needed to make INSPIRE operational throughout the whole of Europe. In this respect, attention should be given to the annex 3

mainly environmental data themes that come from quite different sources to those of the other two Annexes.

5. GENERAL CONCLUSIONS

The findings of this analysis also raise some general questions about the approaches to SDI implementation evaluation in both theory and practice. Three of the most interesting questions are discussed below:

- **who** is carrying out the evaluation,
- **what** they are evaluating, and
- **why** they are doing the evaluation.

The question as to **who** is carrying out the evaluation highlights the distinction between internal and external approaches to the evaluation of SDIs that is discussed in Masser and Crompvoets (2016). The COGO report was produced by a group of external experts. It essentially reflects the users' perspective on the underlying the US data Framework with all its accompanying difficulties. In contrast, the INSPIRE evaluation is essentially a self-evaluation by those agencies who have been directly involved in some part of SDI implementation. It is also worth noting that, in their paper on the definitions of SDIs, Hendriks et al. (2012) argue that it is very important to view SDIs not from the perspective of their own objectives but from the reversed perspective of the users' objectives. This is essentially the approach adopted by the authors of the COGO report.

In this case the question as to **what** is being evaluated draws attention to the classic philosophical distinction between form and content. This distinction was originally recognised by the classic Greek philosophers and now underlies a lot of social science research. The subject matter of the COGO report deals essentially with the content of the data Framework that has been developed for the US NSDI by different groups of data producers. In contrast, the INSPIRE evaluation is concerned primarily with the form of the INSPIRE implementation process and the progress that has been made by the participants towards realising their objectives.

Finally, the **why** question focuses on the intended audiences of the evaluation and their objectives. The COGO report was commissioned by the Coalition of Geospatial Organisations on behalf of its members to draw attention to the current state of the data Framework in the US. Its primary objective was to highlight some of its weaknesses in the hope that action will be taken to improve the current state of affairs. On the other hand, the primary audience for the findings of the INSPIRE evaluation is the elected members of the European Parliament and their technical advisors. Its primary purpose is to inform them about the progress that has been made by the officials who have been charged with the implementation of the INSPIRE legislation that was passed by them in 2007. For this reason, the mid-term evaluation must also be regarded as part of the whole apparatus that the European Commission has developed for evaluating the progress of its various programmes.

It can be also argued that these general questions can be asked in relation to any material that is published regarding the implementation of any SDI. The 'who', 'what' and 'why' questions highlight some of the fundamental differences in the approaches that can be adopted to the task of evaluation: i.e.. the distinction between the internal and external nature of the evaluation, the degree to which its principal focus is on form or content, and the nature of the intended audience for the outcomes of the evaluation. For this reason, these questions suggest a useful typology that can be used and further developed in future SDI research.

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