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Spatial Data Infrastructures in Iberia-America: State of Play 2006

Joep Crompvoets, Tatiana Delgado-Fernández, Danny Vandenbroucke, Lukasz Grus, and Arnold Bregt

In order to have a better view of the status and development of Spatial Data Infrastructures (SDIs) in Iberia-America, a group of researchers from The Netherlands, Cuba and Belgium launched a study in 2006 using the State of Play method. The study collected information on 11 National SDIs (NSDIs) in Iberia-America (Argentina, Brazil, Chile, Colombia, Cuba, Ecuador, Jamaica, Mexico, Spain, Portugal and Uruguay). In most of these selected countries, many NSDI-building blocks were either in place or being developed. In particular, building blocks which linked organisational aspects, spatial data, metadata, standards, and services were well-developed in the region. Furthermore, the building blocks which linked legal aspects, pricing and funding were weakly developed.

Keywords: Iberia-America, State of Play, Spatial Data Infrastructures.

1 Introduction

A Spatial Data Infrastructure (SDI) consists of many elements and most countries are in the progress of developing or have made plans to develop some of these elements. Most National SDI (NSDI) initiatives can therefore better be described as SDI-like or SDI-supporting initiatives. For example, often the mandate to develop a nation-wide SDI has not been given so that one or more organizations take SDI-like initiatives without a clear strategy or framework in place. Other countries are currently still in the initial stage of developing cadastral services or building core datasets, which often is an important element for the data component of a functional SDI. It is clear that most countries are at different stages in their development of an NSDI. We have opted to describe not only the well-structured ongoing or planned efforts, but also some of the more limited and less structured initiatives in Iberia-America.

It should be noted that the creation of an SDI is an evolutionary process. Even if at one moment in time a full-scale SDI is functioning well, it still has to be maintained and kept up-to-date. The implementation of an SDI is thus definitely not a once-off but a process that sometimes proceeds in unanticipated ways.

Different types of NSDIs or NSDI-like initiatives are possible. Each country has a specific socio-economic, technological and political context. No two countries are alike in the way they handle geographic information. A unique genesis of the nation, an original view of the tasks of the public sector, a decentralized or centralized state structure, the maturity of the national information market... all these elements will influence the final outcome of the NSDI. Moreover, the particular challenges vary for each country which affects the way they tailor their approach to NSDI.

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Because of the uniqueness of each country, the gained benefits and expected bottlenecks for implementation will also be different and hence the best strategies for implementing an NSDI may differ for each country.

2 Objectives of the Study

The general objective of the study is to identify, describe and compare the status of the NSDI in Iberia-America in 2006. This general objective is reflected in two parts:

1. The description of the status of the NSDI and their components.
2. An overall analysis of how the NSDIs are functioning.

Since we have been working with non-homogeneous and non-exhaustive information sources we do not claim to have obtained complete information on all existing NSDI-related initiatives in all countries.

3 Approach

The approach followed is strongly in line with the *State of Play* of SDIs in Europe as performed by the Spatial Applications Division of K.U. Leuven. They describe and monitor the SDI-initiatives in 32 European countries on the basis of relevant elements characterizing one of the five components of the European SDI (Legal Framework and Funding Mechanism, Spatial data, Metadata, Access and other Services, and Standards). These elements were extracted from a compilation of an exhaustive list of items according to which the NSDI could be described.

Most of the information was gathered by literature, Web sites and interviewing key experts of each National Spatial Data Infrastructure. A subset of the information gathered through the *State of Play* is presented in an overview table in this document (Table 1). The presented items relate to a number of organizational issues and to the five generic components of an SDI. They can be considered as the building blocks of the SDI under study. The items or building blocks are expressed as 33 statements and the assessment of the studied SDI-initiative has been made in terms of whether it is (1) in full agreement with the statement, (2) in partial agreement, (3) not in agreement or (4) whether not sufficient information is available for assessing the level of agreement.

With this type of rating, reality is of course simplified. For instance, the fact that a particular NSDI is evaluated as being in agreement with the three statements about the metadata component only means that substantial work has been done in relation to metadata. This implies that the practical meaning of these "indicators" to assess the status with respect to metadata production and implementation is limited.

It should be emphasised that this *State of Play* research does not describe the complete picture of what is going on in the Iberian-American countries studied. It is known for example, that the private sector is often very active as data producer or service developer. In addition, the regional (state)

and local level show often a very dynamic Geographical/Geodetic Information (GI) and even SDI scene. It is however impossible within the timeframe and budgetary limits to describe all the details. Nevertheless, it is thought that the *State of Play 2006* study gives the most complete picture of the Iberian-American NSDI scene available.

The country results cannot be taken as the official view of the country concerned. The value in the results reflects our view. At the same time, the results do not aim to evaluate or give an opinion about the NSDI activities or the way these are developed in the respective countries.

It should be also stressed that different opinions and appreciations of the *State of Play* exist in the different countries studied. We tried to integrate the opinions as much as possible without choosing or supporting one of them. Nevertheless, the *State of Play* study does not aim at giving an extensive overview of all the opinions existing but took them into account when making the overall description.

4 Results

Figure 1 contains a summary of the information compiled for the NSDI in eleven Iberian-American countries and valid as at summer/autumn 2006. Grey colours indicate whether the studied NSDI are in large, partial or no agreement with the statements about the building blocks presented in Table 1. This summary table presents a brief description of the status of the NSDI in each country and forms the starting point for the overall analysis of how the NSDIs are operating.

Significant information has been compiled for the following eleven countries: Argentina, Brazil, Chile, Colombia, Cuba, Ecuador, Mexico, Spain, Jamaica, Portugal, and Uruguay.

As can be seen from the table, most of the countries studied are developing a truly national SDI. In many cases, this goes hand in hand with the development of regional initiatives. This happens almost exclusively in the public sector sphere of every studied Iberian-American country. Driving forces are modernization of government, modernization of National Mapping Agencies (NMAs) or similar institutions, modernisation of cadastres, programmes related to the promotion of e-government and information society, shortcomings in disaster prevention/management, and the need to enhance administrations and make them more cost-efficient.

From the wealth of collected information we can conclude that operational NSDIs made up of the integrated components as identified in the Geographical/Geodetic Spatial Data Infrastructure (GSDI) Cookbook, do not yet exist in Iberia-America. In many countries, the tasks for building and maintaining the NSDI are not very well defined and divided amongst the different stakeholders. However, various components of NSDIs are definitely in place or being developed. Furthermore, it is clear that most legal, pricing and funding issues are underdeveloped. The main reason is likely that the legal status of the SDI has not been clarified yet in the most countries. On the other hand, organisational

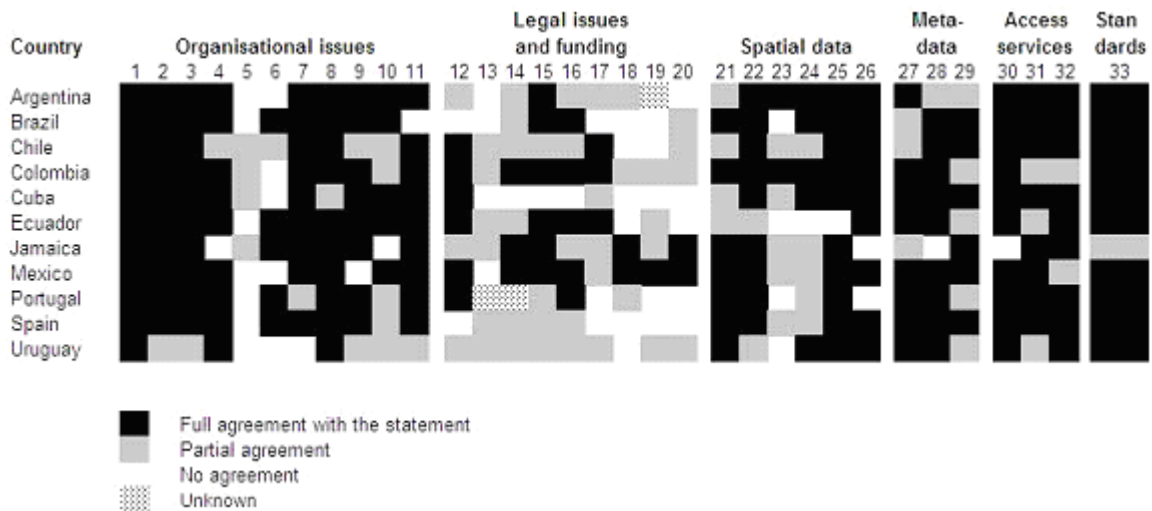


Figure 1: Assessment of the Building Blocks of NSDI, Summer/Autumn 2006.

(and educational) issues, spatial data, metadata, standards, and services are quite well developed.

Some countries are paying more attention to the development of GI-projects and applications. Although these projects are important and valuable, they are not to be confused with the development of the SDI as such. Sometimes the development of an integrated SDI is confused with a simple sum of all the activities of the most important stakeholders.

In most countries, a "National Data Producer" (NDP), i.e. the NMA or a similar agency (Cadastre or Land Survey Agency) is taking the (strong) lead to (1) coordinate its traditional geodetic and mapping activities with other data producers and (2) interact with the major user groups of spatial data in order to better meet their needs. In this way, the agency fulfills an existing, traditional mandate of coordination or takes up a more recent formal mandate. In both cases, the awareness raising by international initiatives such as GSDI and the Permanent Committee on Spatial Data Infrastructure for the Americas (CPIDEA) [1] [2] have had great influence although the term "SDI" is not always used. Along the other hand, few organizations other than traditional data producers are also driving the development of an NSDI. Those participants are often partnerships of public sector users of spatial data aiming at overcoming financial, procedural and other barriers against sharing and re-using each other's data and external data. With respect to the traditional data providers, these partnerships initially tend to act as clients. In later stages, some of the data providers may join the partnership and/or the partnership may turn to data production activities.

Whereas NDP-led NSDIs mostly benefit from more or less guaranteed although often decreasing basic public funding, this not the case for the user-driven NSDI. Only in a very few exceptional cases has legislation been drafted which devotes to these initiatives formal mandates and sub-

stantial funding.

The status of the construction of some core spatial datasets is mature for most countries studied. Moreover, there are many activities going on which are related to the improvement of these core datasets. The main weakness regarding the current situation of core spatial datasets in Iberia-America is that the data quality control procedures applied at the level of the national SDIs are frequently missing. This could have a negative consequence on the data quality and so its use.

The status of spatial data production and repositories is such that a workable basis is provided to start gap-filling, harmonisation and integration to cover the national territory. Most of these data have been documented by metadata. Most of these metadata records are maintained in operational metadata catalogues of which many can be accessed through a Web-based service. Harmonisation and standardisation of data production within one data producing organisation is rather common practice. This is not the case among producing agencies. ISO and OGC are often mentioned as providing the guidelines for standardisation efforts. For example, ISO19915 is almost becoming the standard for metadata description, and OGC specifications such as WMS and to a lesser extent WFS are very frequently used. There is interest in the use of Open Source software and it has been applied in several countries, at least in a test environment. Most work in the field of standardisation and interoperability happens through projects.

There are a large number of Web services already in place. Most of them deal with discovery of metadata, catalogue or view services. Many services are accessible through Web portals. Access is sometimes limited to a particular target public. Sometimes it also targets the broader public. Many countries have currently established national on-line services for metadata and Web mapping services for core data in order to target the broad public.

Geographic Information Systems

Access to metadata is generally free of charge. Data are provided on partial to substantial cost recovery basis and often with strict restrictions for use. Acquisition of spatial data, even by governmental bodies often requires heavy pro-

cedures, partly due to the fact that a pricing framework for trading, using and/or commercialising spatial data is mostly missing. Only a few datasets can be downloaded or obtained otherwise free of charge.

<i>Topic</i>	<i>Statement</i>
Organizational issues	
SDI-initiation	1. Initiatives have been undertaken in your country to launch the development of a National Spatial Data Infrastructure (NSDI)
Level of SDI	2. The initiative and territorial coverage of the SDI is truly national
Vision	3. The NSDI-initiative has a long-term and clear vision about the national SDI
Coordination	4. The officially recognized or de facto coordinating body of the national SDI is a national data producer, i.e. a national mapping agency or a comparable organization (cadastral or land survey agency, i.e. a major GI-producer)
	5. The officially recognized or de facto coordinating body for the national SDI is an organization controlled by data users
	6. An organization of the type "National GI-association" is involved in the coordination of the national SDI
Participants	7. Producers and users of spatial data are participating in the national SDI
	8. Only public sector participants are taking part in the national SDI
Leadership	9. The national SDI-initiative is supported by someone with strong leadership
Qualified staff	10. The national SDI-initiative can be implemented by enough qualified staff capable of leading work in the national SDI-initiatives
Capacity building	11. The national SDI-initiative takes into consideration capacity building issues in order to perform appropriate tasks within the broad set of principles relating to an NSDI
Legal issues and Funding	
Legal framework	12. There is a legal instrument or framework determining the national SDI-strategy or development
Public-private partnerships	13. There are true Public-Private Partnerships or other co-financing mechanisms between public and private sector bodies with respect to the development and operation of the (national) SDI-related projects
Policy and legislation on access to public sector	14. There is freedom of information (FOI) act which contains specific FOI legislation for the GI-sector
Legal protection of GI by Intellectual property rights	15. Geo-information can specifically be protected by copyright
Restricted access to GI further to the legal protection of privacy	16. Privacy laws are actively being taken into account by the holders of geo-information
Institutional framework	17. There is an institutional framework or policy for sharing geo-information between public institutions
Data licensing	18. There are simplified and standardized licenses for personal use
Funding model for the SDI and pricing policy	19. The long-term financial security of the national SDI-initiative is secured
	20. There is a pricing framework for trading, using and/or commercializing geo-information
Spatial data	
Spatial data availability	21. Most spatial datasets are available in digital format that provide a basis for contributing to the national SDI-initiative
Geodetic reference systems and projections	22. The geodetic reference system and projection systems are standardized, documented and interconvertable
Quality	23. There is a documented data quality control procedure applied at the level of the national SDI
Interoperability	24. Concern for interoperability goes beyond conversion between data formats (e.g. hardware/software/data definitions)
Language	25. The national language is the operational language of the national SDI
	26. Spanish is used as primary or secondary language
Metadata	
Availability of metadata	27. Metadata are produced for a significant proportion of spatial datasets
Metadata catalogue availability + standard	28. One or more standardized metadata catalogues are available covering more than one data producing agency
Metadata implementation	29. There is a coordinating authority for metadata implementation at the level of the national SDI
Access and other services	
Metadata	30. There are one or more on-line access services for metadata
Data	31. There are one or more on-line access services for core spatial data
Web mapping	32. There are one or more Web mapping services available for core spatial data
Standards	
Standards	33. The national SDI-initiatives are devoting significant attention to standardization issues

Table 1: Selected Building Blocks.

The role of the private sector in the described initiatives is limited to the development of sub-components and the provision of supporting services as contractors to the public sector. The only initiatives deployed independently by the private sector pertain to Web mapping or rather Web advertising of spatial data they hold and to some limited services.

The results presented are still in line with the outcomes of a survey conducted in 2000 [3]. On the basis of this survey, Masser et al. [1] described the following situation for this region:

- SDI issues led by national mapping agencies, but challenged by other types of geographic information providers.
- Absence of policy concerning development of national spatial data infrastructures.
- Private sector not involved in the development of SDI initiatives.
- Information layers most frequently considered as fundamental data: topographic mapping, roads, land cover, and land use, administrative borders, and hydrography.
- A tendency towards cost recovery, as the main factor for pricing data.
- Legal issues, lack of standards for geodata, pricing and data access as major constraints for the consolidation of NSDI initiatives.

In 2006, we still see that the main SDI issues are led by national mapping agencies, not many policies concerning development of national spatial data infrastructures are implemented, private sector is slightly involved in the initiatives, cost recovery is the main factor for pricing data, and legal issues, funding and pricing are considered as major constraints for the consolidation of NSDI initiatives. On the other hand, positive developments are the application of numerous standards, the increase of spatial data production, the increase of data access (partly due to the many Web services developed), and the investment in capacity building.

5 Conclusions

Through the use of the *State of Play* method, it was possible to describe the status of the Iberian-American NSDIs and their components, and to analyse generally how the NSDIs are functioning.

Most of the selected countries are developing a National SDI (Argentina, Brazil, Chile, Colombia, Cuba, Ecuador, Jamaica, Mexico, Spain, Portugal and Uruguay). In most of these countries, many NSDI-building blocks are definitely in place or being developed. In particular, building blocks relating organisational (and educational) aspects, spatial data, metadata, standards, and services are quite well-developed in the region. Furthermore, the building blocks relating legal aspects, pricing and funding are weakly developed. The main reason is likely that the legal status of the SDI has not been clarified yet in the majority of countries (a lot of legislation exists, but it is not directly related to the NSDI).

From an inventory and analysis of factors for success and failure of the NSDI in these countries, we conclude that there is no single solution or uniform approach for setting up a successful NSDI, i.e. an infrastructure which succeeds in delivering to the user spatial data and services subject to conditions which do not restrain their application. Customisation to national ways of organisation is imperative.

6 Recommendations Regarding Future NSDI Implementations

- The status of the NSDI-development in the different countries studied shows the importance of collaboration among the different authorities, horizontally, as well as (maybe even more important) vertically (national, regional, and local). Successful implementation of the NSDI will largely depend on this successful collaboration. In addition, the regional and local level is becoming more important as a data producer (basic reference data, updates) and data user. It is recommended to put in place coordination procedures or enhance these when they already exist between different levels of authority.

- There are diverse (but all of them rich) experiences in implementing components of NSDI. Besides the already existing initiatives like the CPIDEA and the Urban and Regional Information Systems Association (URISA) international workshops where experiences are shared and discussed, there should be a maximum of exchange among the different countries and their regions in order not to re-invent the wheel. We can learn from the bilateral collaboration between countries (and regions) about a more formalized forum for exchanging experiences.

- Although many countries and regions have developed, or are developing coordination mechanisms, there is still a lot of fuzziness about the roles and mandates for building the NSDI. This should probably be enhanced, whether it be through (modified) legislation or more informal procedures for collaboration and division of tasks.

- There have been a lot of new initiatives for developing technical parts of the NSDI: geoportals, data catalogues, data, catalogue and mapping services, etc. Some of them are or could/should be similar in the respective countries and regions. Sharing these resources is advisable in order to gain some time for those countries that are slightly behind in the development of their components. This is especially feasible where Open Source software is used (although in other cases it should also be envisaged).

- Collection of information on what is going on in the NSDI, Regional Spatial Data Infrastructure (RSDI), etc. at the national, regional and local level remains a key element for evaluating NSDIs. Therefore, it is recommended not to stop this process. Collection of information should be enhanced however in the sense that stakeholders involved in legislation, data, metadata production, service development, etc., can upload new information (reference, documents, etc.) themselves and that this information can be processed in new versions of *State of Play* reports.

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