Implementation Overview of the Standarts Framework of the Americas

2013

CP-IDEA

PERMANENT COMMITTEE FOR GEOSPATIAL DATA INFRASTRUCTURE OF THE AMERICAS

PERMANENT COMMITTEE FOR GEOSPATIAL DATA INFRASTRUCTURE OF THE AMERICAS (PC-IDEA)
2009 – 2013

President

Luiz Paulo Souto Fortes

Executive Secretary

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Member Countries

Argentina	Guatemala
Belize	Guyana
Bolívia	Honduras
Brasil	Jamaica
Canadá	México
Chile	Nicaragua
Colômbia	Panamá
Costa Rica	Paraguay
Cuba	Peru
Ecuador	República Dominicana
El Salvador	Uruguay
Estados Unidos	Venezuela

Permanent Comite for Geospatial Data Infrastructure of the Americas
(PC-IDEA)

Implementation Overview of the Standards Framework of the Americas

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This document was done by:

PC-IDEA Working Group on Standards and Technical Specifications (GTnet)

Contents

I. Introduction

1. Objective and description

This document addresses the first activity defined by the Permanent Committee on Geospatial Data Infrastructure of the Americas (PC-IDEA) Working Group on Planning (GTPlan) for the issue of Standards and Technical Specifications, showing an overview for geospatial information integration in the region using standards. Hence, a summary of the PC-IDEA is included, highlighting the importance of geospatial information and the use of regulations at the international and regional levels; also international standardization bodies in the field are mentioned and a theoretical basis for the development and application of a common and consistent standards framework is provided.

2. PC-IDEA overview

The PC-IDEA was established in accordance with Resolution No. 3 of the Sixth United Nations Regional Cartographic Conference for the Americas (UNRCC-Americas) in New York, June 1997. The PC-IDEA will operate under the guidance of the UNRCC-Americas, and will submitt its recommendations and respective activity reports to them (Estatuto CP-IDEA 2011).

With the establishment of PC-IDEA it is intended to promote the importance of using geospatial information at local, national and regional levels in a global environment, to stimulate economic development and social welfare of the Americas. In this way, its goals are defined by the Agenda 21 principles of the UN Conference on Environment and Development 1992, the considerations derived from the Johannesburg Summit in 2003 and the resolution referred to the global geographic information management established at the Regional Cartographic Conference for Asia and the Pacific in October 2009, in order to maximize the economic, social and environmental benefits derived from the use of geospatial information, through knowledge and exchange of experiences and technologies between the countries, based on a common development model which would allow the establishment of the Geospatial Data Infrastructure for the Americas (IDEA) (Estatuto CP-IDEA 2011).

The PC-IDEA shall guarantee the fulfillment of the following objectives:

- To establish and coordinate policies and technical standards for the development of geospatial data infrastructure for the Americas.
- To give priority to promoting the establishment and development of national geospatial data infrastructure in each member country of the Permanent Committee, in accordance with Resolution No. 4 of the Sixth UNRCCA, and seek to integrate them.
- To encourage the sharing of geospatial information among all member countries in the Americas, while respecting their autonomy and their national laws and policies.
- To promote the interoperability of information and systems among member countries, through the use of standards.
- To stimulate cooperation, research, complementation and sharing of experience in areas of knowledge related to geospatial data infrastructure (GDI).

- To advise in the drafting of guidelines and strategies to support PC-IDEA member countries in developing geospatial information, considering the individual needs of each country.

- To set priorities for information sharing, considering the regulatory framework of each member country.

- To promote GDI training activities and technology transfer.

The members of the Permanent Committee shall be countries in the Americas that express their willingness to be part of PC-IDEA, represented by the heads of the official national agencies in charge of geospatial data management or their designated representatives. If such agencies do not exist, representation may be exercised by the directors of the competent agencies or institutions, or the national entities responsible for the environment, sustainable development, land-use planning, territorial administration or their equivalent (Estatuto CP-IDEA 2011).

According to the official website (http://www.cp-idea.org), the PC-IDEA is integrated by:

Country	Institute / Agency
1. Argentina	National Geographical Institute (IGN)
2. Belize	Ministry of Natural Resources and Environment
3. Bolivia	Military Geographical Institute (IGM)
4. Brazil	Brazilian Institute of Geography and Statistics (IBGE)
5. Canada	Natural Resources Canada (NRCan)
6. Chile	Ministry of National Property
7. Colombia	Geographical Institute Agustín Codazzi (IGAC)
8. Costa Rica	National Geographical Institute (IGN)
9. Cuba	Ministry of the Revolutionary Armed Forces
10. Ecuador	Military Geographical Institute (IGM)
11. El Salvador	National Cadastre and Geographical Institute (IGCN)
12. United States of America	Federal Geographic Data Committee (FGDC)
13. Guatemala	National Geographical Institute (IGN)
14. Guyana	Natural Resources Management Project/GINRIS
15. Honduras	Directorate General of Cadastre and Geography
16. Jamaica	National Spatial Data Management Division
17. Mexico	National Institute of Statistics and Geography (INEGI)
18. Nicaragua	Nicaraguan Institute of Territorial Studies (INETER)
19. Panama	National Geographical Institute Tommy Guardia
20. Paraguay	Military Geographical Service (SGM)
21. Peru	National Geographical Institute (IGN)
22. Republica Dominicana	Military Cartographical Institute (IGM)
23. Uruguay	Military Geographical Service (SGM)
24. Venezuela	Geographical Institute of Venezuela Simon Bolivar (IGVSB)

According to the Statute (Estatuto CP-IDEA 2011), the PC-IDEA elects among its members an Executive Board, consisting of:

- A President
- A Vice President
- An Executive Secretary
- Four Vocal members

As part of the main roles and responsibilities of the Executive Board are to:

- Plan, develop and coordinate the work program of the Permanent Committee;
- Monitor the work programs of the Permanent Committee and Working Groups;
- Coordinate and direct the activities which the Permanent Committee must undertake pursuant to decisions of the United Nations Regional Cartographic Conferences for the Americas;
- Submit to the United Nations a report on the achievements;
- Ask the Vocal members for the national reports of member countries, manage and coordinate the production of publications, including directories, news bulletins, training and promotional material, management of the Internet site, and the publications distribution among the member countries;
- Manage and coordinate with regional and international agencies proposals to finance PC-IDEA operations, and the initiatives, programs and projects related to IDEA and the development of national infrastructure in member countries
- Prepare by December a yearly summary with a list of activities and submit it to the Permanent Committee for consideration;
- Take advantage of opportunities to make presentations to related organizations, such as the International Organization for Standardization, Technical Committee 211 (ISO/TC211), International Steering Committee for Global Mapping (ISCGM) and Global Spatial Data Infrastructure (GSDI), and other organizations, and
- Hold related events on the results and progress of IDEA, independently of events presented by members of the Permanent Committee (Estatuto CP-IDEA 2011).

The Executive Board shall ordinarily meet at least once a year, at the date and place determined by a majority of its members. This meeting shall be official and valid if at least fifty percent plus one of its members are present. The meetings held to date are:

- Caracas, Venezuela, November 2005
- Santiago de Chile, Chile, November 2006
- Aguascalientes, Mexico, May 2008
- New York, United States, May 2010

The Permanent Committee shall meet in person at least once a year, for planning and reporting its activities. Every year that a UNRCC- Americas is held, the Committee shall meet concurrently as part of the Agenda. The meetings held to the date are:

- 1st Meeting: Bogota, Colombia, March 2000.
- 2nd Meeting: New York, United States, January 2001(cancelled for lack of quorum)
- 3rd Meeting: Cartagena, Colombia, May 2001
- 4th Meeting: San Jose, Costa Rica, June 2003
- 5th Meeting: Nueva York, United States, June 2005
- 6th Reunión: New York, United States, August 2009
- 7th Reunión: Rio de Janeiro, Brazil, August 2011
- 8th Reunión: Seul, South Korea, October 2011
- 9th Reunión: Rio de Janeiro, Brazil, August 2012

3. PC-IDEA Working Group on Planning

For the development of objective-oriented activities, the Permanent Committee shall approve and establish working groups, that based on the Statute (Secretaría Ejecutiva CP-IDEA 2000) have the following responsabilities: To carry out the projects or tasks entrusted by the Permanent Committee in areas of interest to it; to report at least once a year on the progress of their activities, together with the appropriate recommendations for its consideration; to appoint persons responsible for key activities in their work program; and the rules and procedures set for the Committee shall also apply to the Working Groups.

In this sense, the PC-IDEA Working Group on Planning (GTplan) is established, with the participation of representatives from seven countries: Brazil, Cuba, Mexico, Canada, Guatemala, Colombia and Chile. The Group was formalized during the first working session, held in Rio de Janeiro, Brazil, December 2010. The main objective is to plan, implement and monitor a set of activities oriented to comply with the requirements of the 1st, 2nd and 3rd resolutions of the Ninth UNRCC-Americas, held in New York, United States, August 2009 (Grupo de Trabajo de Planificación del CP-IDEA 2010):

- 1st Resolution. PC-IDEA workplan and establishment of working groups

  Recommends that the PC-IDEA develop a workplan for the next four years, by establishing working groups on the following themes:

  a) Institutional strengthening, education and training;
  b) Technical standards and specifications;
  c) Best practices and applications;
  d) Innovations for national mapping agency business models.

- 2nd Resolution. Mechanisms for the building of spatial data infrastructures

  1. *Recommends* that the PC-IDEA set up mechanisms to develop guidelines on geospatial data (creation, management and dissemination), metadata, and geospatial information policies and legal issues relevant to the region, using as a model the various initiatives developed by the INSPIRE Directive;

2. *Also recommends* that the PC-IDEA post on its website available SDI legislative frameworks, management models and national technical standards.

- 3rd Resolution. New study on the status of mapping by country and region

  1. *Recommends* that the United Nations conduct, within available resources, a new study of the status of mapping by country and region throughout the world. The study shall take into consideration official national mapping agencies, other institutions, and the private sector, including both the status of technological and legal issues pertaining to geospatial data;
  2. *Also recommends* that the PC-IDEA provide a forum for national mapping agencies to discuss optimal solutions and/or business cases for reducing the barriers of access to data: such as security, cost recovery, copyright, and different technological access to the data, including timely access to data for disaster prevention, mitigation and management;
  3. *Further recommends* that the Permanent Committee provide a forum for national mapping agencies to discuss and advise Governments on its role in data collection, management and dissemination in the light of changing technologies and societal applications, and that Governments shall be encouraged to make available sufficient resources for them to play a key role in geospatial technology and mapping within their countries, including the collection and dissemination of cadastral information.

Additionally, the specific objectives of the group are defined and structured in the execution of the following four subcomponents:

I. Working plan definition (2010-2013)
II. Questionnaire on relevant themes about SDI
III. SDI and cartography assessment in the Americas
IV. Technological means implementation for SDI theme discussion

Thus, the initial planning is carried out according to the structure of these subcomponents, which work methodology is to establish an understanding for each subcomponent and then complete the proposed activities that confirm the working plan. Subsequently, a responsible country and products for each of the activities are defined:

1. Institutional Strengthening, and education/training activities: Colombia
2. Standards and technical specifications: Mexico
3. Best practices and SDI development guidelines: Canada
4. Innovations in national mapping agencies: Brazil
5. Gathering of knowledge on issues relevant to the SDIs in the region - Guatemala
6. SDIs development assessment in the Americas: Cuba
7. Technological means implementation: Chile

4. Working Group on Standards and Technical Specifications

One of the general objectives of the Committee is to: "Establish and coordinate policies and technical standards for the development of the Geospatial Data Infrastructure for the Americas." As part of the first meeting of the PC-IDEA GTplan, held in Rio de Janeiro, Brazil, December 2010, it was determined that one of the priority issues to address in the region is standards and technical specifications (NET).

In the 9th PC-IDEA Extended Meeting, held in Rio de Janeiro, Brazil, August 2012, the Working Group on Standards and Technical Specifications (GTnet) in collaboration with the Open Geospatial Consortium (OGC) and the participation of six countries: Bolivia, Brazil, Canada, Colombia, Honduras and Mexico is established. Mexico, through the National Institute of Statistics and Geography (INEGI), is assigned as the group coordinator. The group objective is to establish a set of standards and technical specifications that apply in the region within a common regulatory framework.

As part of the PC-IDEA action plan on Standards and Technical Specifications, the agreement is to develop a series of activities to obtain standards and technical specifications applicable to the region as a whole, beyond national specifications. Based on this, the general activities for this theme that are part of the 2010-2013 work program and coordinated by Mexico are:

- Preparation of an overview for the geospatial information integration in the region, through the use of standards
- State-of-the-art questionnaire on the standards development and use, as well as transnational profiles in the region
- Preparation of proposals for core (fundamental) standards for the region
- Coordination of participation in regional standardization organizations and initiatives
- Development of implementation standards manuals for the everyday information managementf

II. Background

1. Geospatial información relevance

All around the world, government and society have in geospatial data a strategic tool with applications in diverse fields such as infrastructure planning, land-use planning, improvement protection and environment, cadastre registry, statistical and election censuses, or aspects related to civil protection and defense, among others (Tebar, 2005). Global technological advances and the fact that much of human activities include a spatial component have led to the availability of a large volume of geospatial data (Capdevila 2004), giving an unquestionable rise to Geographic Information Systems (GIS) and increasing considerably the geospatial information that is generated and maintained inside and outside the government (Cantan, J. Gutierrez, and Lopez 2000); about 80% of the databases used in the public administration contain geographic references (addresses, map coordinates or distribution by municipalities, industries, neighborhoods, census tracts, etc.), so these data may be processed using their location (Bañares, Barnabas, and Gould 2001).

The development of governments and societies that make use of geospatial data requires a wide range of experiences and disciplines, among others, surveying, mapping, land management, geographic information systems, information technology and communications, computer science and legal and public administration (Departmento de Asuntos Económicos y Sociales. Naciones Unidas 2009). Consequently, rapid advances in information technology and geographical information technology have found a valuable geospatial information tool for public policy planning, recognizing that in many sectors of society their use enables to respond more effectively to the global humanitarian, environmental and development problems (Consejo Económico y Social. Naciones Unidas 2010). Geographic information also plays a leading role in activities such as environmental monitoring, management of land and marine resources, real estate transactions, dams, oil fields and mines monitoring, ships and aircraft navigation, oceanography, and tourism, among others. Having complete geospatial information, updated and in one reference system is now extremely important for the economy and social development, in this way remote sensors such as satellites, echo sounders, sensors in airbases and ground-measurement instruments support resources monitoring and effective management, both at sea and on land. The science that integrates this information, derived from a diverse range of disciplines (such as topography, geodesy, photogrammetry, geology, geophysics, mathematics, biology, agronomy, cartography and computing), manages spatial data and represents our world as real as possible has been called: Geomatics (Vasquez 2007).

With the growing applicability of the Geographic information technologies (GIT) in research and studies of territorial planning, siting of infrastructure, environmental condition, business and geolocation, etc., the need to have quality geospatial information organized and standardized, accessible and interoperable comes out (Medina 2010). There is a clear need, at all levels, of being able to access, integrate and use geospatial data from multiple sources, in order to have a basis when making decisions. However, for geospatial data to be available and accessed by specialized users and the general public, it is necessary to have a specific geographic information infrastructure to provide the necessary services for searching and accessing them (Bañares et al. 2001). In this regard, it is essential that the use and query of this type of data can be done over the Internet using interoperability standards, because only then it will be possible to achieve a massive use of this information and encourage interdisciplinary work

required by geographic projects (Sagols, Navarro, and Ulloa 2007), therefore, the ability to make sound decisions, collectively, at local, regional and global levels, depends on the application of what is known as Spatial Data Infrastructure (SDI), which is responsible for compatibility across jurisdictions and promotes access and use of geospatial data (Nebert 2004). A SDI is a new paradigm in the field of geomatics; as broad concept includes everything related to the geospatial data management, it is a collective project involving the government, academia and private sector, providing a large range of open and standardized geoservices, constituting a technological platform for the analysis and monitoring of sustainability and development indicators (Pascual Rodríguez and Abad Power 2008).

All around the world, governments are increasingly understanding the value of geographic or geospatial information and are taking steps to develop and exploit this fact for the following reasons (Red Europea de Información Geográfica 2004a):

- This information is called to play a big role in meeting social demands and taking advantage of opportunities in politics and technology.
- It has itself an economic value as a major component of public sector information, and as a basis for developing new markets and jobs in value-added and location-based industries.
- It has a political and social value because it provides the basis for policies and intervention integration where it is most needed and, therefore, provides benefits to citizens, businesses and governments

2. International standards

Much of the information involved in the States decision-making is georeferenceable. However, when requiring this information, the lack of equipment and software, networking and communications equipment, information standardization and agreements between institutions has created a situation that hinders the possibility of obtaining it (Subgrupo Infraestructura de Datos Espaciales 2006). Geospatial information requires a comprehensive system to ensure its proper collection, processing and flow, constituting an important tool in assessing the state and its surrounding area progress or reversals (Cuzán and Mena 2008). These problems are common to all nations and for some time it has been tried to solve them by developing new integrative tools whose goals are saving time, effort and money in access and responsible use of georeferenced information and, on the other hand to avoid work duplication, harmonizing and standardizing the data required. The answer is the SDI, which elements are the data, a set of policies that define a legal and operational framework and an information center for the infrastructure operation control and maintenance (Subgrupo Infraestructura de Datos Espaciales 2006).

It is necessary to ensure that the SDI be consistently built, so as to maximize its impact, however, many initiatives are working in isolation, without the harmonious development and consequently unable to reap the benefits of working together. Globally, the most prominent examples of formal SDI programs are at national level, most conducted by the federal government (NSDI in the U.S., SNIG in Portugal, ASDI in Australia or ICDE in Colombia) and in their majority, the SDI usefulness and the benefits to the public, private and academic sectors, non-profit organizations and individuals are recognized (Nebert 2004). Meanwhile, regional initiatives such as that of the European Union aimed at creating the Infrastructure for

Spatial Information in Europe (INSPIRE), the Permanent Committee on GIS Infrastructure for Asia and the Pacific (PCGIAP) and the PC-IDEA, denote the value of cooperation. An increased international cooperation in this area would contribute to the full exploitation of the potential of geospatial information and underlying technology and would make them more useful and accessible to a wide range of users and policy makers. This poses both technical and regulatory difficulties in terms of access and data sharing, interoperability, privacy, confidentiality, national security, licenses for the use of datasets, partnerships between public and private sectors, and defintion of the respective roles of public participation, private sector and governments in the formulation and implementation of geospatial information management strategies. When considering all these issues it is important to compare various global perspectives (Consejo Económico y Social. Naciones Unidas 2010).

In November 1994, the ISO created the Technical Committee 211 (ISO/TC211) in charge of Geographic Information/Geomatics, which deals with the definition of a comprehensive set of standards that considers all aspects of geospatial information. It is the main initiative on the standardization of geospatial information, applying the Vienna agreements and acting together with the CEN/TC 287 (European Committee for Standardization) and the OGC through the Joint Advisory Group ISO/TC211 – OGC (Ramírez and Pérlite 2009).

The fact of having rules and standards suggests, somehow, the institutional maturity degree existent in the organizations to establish either by creation, adaptation or adoption, the use of standards required in the geospatial information handling processes. Also, beginning to manage metadata will enable to implement different services and not only for organizations, but for the whole society, such as automated catalog and search services of geospatial information, in that way you will not need to turn to different public offices (Subgrupo Infraestructura de Datos Espaciales 2006). The importance of standardization in any sector of productive human activity is crucial, since it is inevitably associated with the maturity of the technologies involved. The rules make the difference between craft production and industrial mass production, thus allowing the process to be repeatable and easier to control, which makes that the development, production and supply of goods and services be optimized, and become more efficient, safer and cleaner. (Ramírez and Pérlite 2009).

All technological and industrial sectors have gone through different stages of development, particularly process and product standardization involves to reach a degree of maturity qualitatively essential. Until recent years, geospatial information was available in different proprietary formats for different conceptual models and operating in very particular applications who could not handle data in different format or platform. Disseminating geospatial information in these conditions to a client that works with different format to the supplier's, is a very expensive work, which can not always be automated and that virtually involves some kind of loss of information. In these conditions, boundaries between different data producers assumed impassable walls that require a large amount of resources to be eliminated. Moreover, non standards-based processes, but specific solution-based ones are defined for very concrete and particular needs, in consequence they can not meet the objective of sharing and reusing information by a third party or the general public. So the real solution is to establish the widest possible scope regulation that enables to materialize exchange, interoperability and dissemination mechanisms for digital geographic information (García and Federico Rodríguez 2008).

3. Regional standards

One of the main problems faced by different agencies of the Latin America and the Caribbean countries and that affects geospatial data and information producers and users is that many systems are islands of information that do not communicate with each other and there is no way to easily exchange data or to implement higher-level intelligence (Secretaría de la Función Pública 2010). Agency systems are product of a heterogeneous development and when two of these agencies need to share information to provide a service, they shall make arrangements to establish what data shall flow from one to another, how they shall be represented and interpreted and on what security schemes must operate; so when n number of agencies require information exchange, multiple regulating agreements governing the relationships among them must be created (Escobar, Santanna, and Mejia 2007). This problem can also be extrapolated to the interaction between countries in the region, where it is "natural" to use a heterogeneous model in which to develop relationships between two (with their definitions and rules), which would be inappropriate because "couples" of computer islands would begin to emerge difficult to be communicated with other islands or couples of islands. Therefore, if the relationship between n agencies and n countries is based on interoperable standards and on a homogeneous pattern of technical specifications and processes the cost and complexity of n problems will be reduced to one, establishing a technology platform that will ensure information security and efficient resource investment (Escobar et al. 2007).

Furthermore, due to the diversity of languages used in Latin America and the Caribbean and the options to describe data (syntax) in the government agency information systems, as well as their interpretation by the countries (semantics), it is necessary to agree an exchange language, that is, to precisely define the standard language to be used for the exchange and the proper interpretation of data and documents (Escobar et al. 2007). Thus, the agencies shall adopt a common language for the information exchange in order to enable the construction of a semantic-knowledge basis, which will require the development of information and knowledge classification systems using common data model relationships (Secretaría de la Función Pública 2010). Only through common conventions and technical agreements it will be possible for local communities, nations and regional decision makers to discover, acquire, exploit and share geographic information vital for the decision making process (Nebert 2004). The adoption and establishment of geospatial data standards and specifications, to which these data and their sharing must conform, as well as the interoperation of systems that manages the data constitute the standards framework for geospatial data production and maintainance of the common denominator: compatibility, comparability, shareability, reliability, consistency and completeness (Instituto Nacional de Estadística y Geografía 2009).

Under the above scenario and the constant changes in the social, political, economic and academic fields present in our society and considering the growing demands of geospatial data and information in the region, as well as information and communication technologies in accordance with reality, it is necessary to define and adopt a **consistent standards framework** as a requisite to achieve greater efficiency in responding to these demands and as a basis for establishing an interoperable collaborative scheme that contributes to the development of the IDEA defined as "*the set of fundamental geospatial data, standards for its integration, mechanisms that facilitate access and use, policies, and principles that ensure compatibility between the member countries of the PC-IDEA*" (Secretaría Ejecutiva CP-IDEA n.d.).

In this context, existing standards shall be broadly taken into account, particularly those used by the countries participating in SDI strategies, and by leaders in technology, structure and semantics of information, publication and dissemination of services (Escobar et al. 2007). It is advisable to follow the guidelines of international organizations seeking the highest level of standardization in terms of components and recommendations for interoperability, specifically in relation to standards, protocols and open standards (Secretaría de la Función Pública 2010). An important aspect according to Nebert (2004) is to examine the SDI experience of other countries and regions, in order to help to identify best practices and technologies as a means to increase availability, access and use of geospatial information. Also, an agreement must be achieved in order to encourage use of standards in the community, facilitate implementation and spread their use, so that the set of rules applicable to the objects and phenomena that are directly or indirectly associated with geospatial location constitutes a reality in the region and provides the framework for the development of multiple applications and sectors that require structured geographic data. The use of these standards is not an easy task and involves changes in the culture of organizations, but it is definitely much greater the economic and social cost of not using the standards and maintaining an isolated production, with serious difficulties in fulfilling their purpose (IPGH-Comité ISO/TC 211 2010).

The magnitude of the task to have a homogeneous standards framework that supports the IDEA is considerable, it must be remembered that the task of integration has been difficult and will remain so. It requires a great boost, as it is complex to agree a regional framework. The cooperation possibilities that the Information and Communication Technology (ITC) can offer our countries are related to make less difficult trade transactions, joint learning, coordinated work on issues of supranational interest and political dialogue improvement. To achieve these objectives it is necessary to have interoperable information systems, that is systems sharing technical, semantic and organizational standards in an environment of dialog and governance agreed and followed by all participants. This is only possible through the collaboration of governments decided to voluntarily participate in the pursuit of common goals and the support of international organizations to coordinate and support these joint efforts (Escobar et al. 2007).

4. Geographic technical standards development: The Mexican experience

The development of regulations is the foundation to give coherence and promote the operation and functioning of the National System of Statistical and Geographical Information (SNIEG). For this, the Law of the SNIEG confers the National Institute of Statistics and Geography (Instituto Nacional de Estadística y Geografía 2009) as Central Coordinating Unit, the function of regulating and coordinating the SNIEG.

For the standards dissemination, the Law of the SNIEG provides the implementation of a Regulatory Compilation System aimed to conserve and publish the Regulatory Provisions developed by the Units of the State, issued or authorized by the INEGI through the Governing Board.

Thus, establishing the regulations requires close coordination between the Institute and the other Units of the State to fully comply with their responsibilities as members of the System.

To contribute to this purpose the INEGI Governing Board issued the Rules to Develop the Regulations of the SNIEG made up of those provisions issued by the Governing Board and grouped in terms of:

A. Regulations for the System Coordination.- *The Regulations for the Coordination shall be proposed and developed by the Institute pursuant to its powers. They are comprised of provisions ruling the participation of the Units of the State on the following activities:*

I. Operation of collegiate bodies as instances of participation and consultation
II. Development of programmatical documents, monitoring their implementation, evaluation, review and update;
III. Determination of the Information of National Interest;
IV. Integration and operation of the National Information Network;
V. Provision of the Public Information Service;
VI. Conservation, protection and configuration of the Information Archive;
VII. Training, updating and research on production and analysis of the Information of National Interest;
VIII. Configuration of the National Registry of Geographical Information and the National Statistical Registry;
IX. Integration, management and dissemination of the National Indicator Catalog;
X. Standardization for the Regulations development and updating;
XI. Authorization, regulations dissemination and implementation monitoring, and
XII. Other regulations involving joint operations that must be performed by the Institute as the System Coordinator

The general regulations and procedures for the provision of the Public Information Service shall cover aspects on how the Information of National Interest is managed, shared, published, marketed, updated and protected. Access and dissemination conditions are included in terms of the stipulations of the Law of the SNIEG.

B. Technical Regulations.- The Technical Regulations comprise standards issued or authorized by the Governing Board to regulate the design, acquisition, production, updating, organization, processing, integration and compilation of statistical information on: demography, economy; government, public safety and justice, as well as geographic and environmental information, to ensure the application of principles to help to improve the quality of information produced by the Units of the State, which is of national interest or may be determined as such.

In order to provide quality, relevant, accurate and timely information, generated by the System, it is required to regulate the entire information process. Then, INEGI will regulate, by issuing general rules, the set of standards and guidelines that ensure coherence and technical consistency, using the following general procedure:

a. INEGI and the Units of the State (producers of Information of National Interest) develop the technical standards,

b. Through the SNIEG Subsystems and by the Technical Specialized Committees proposal,
c. With the Executive Committees decision,
d. For approval by the Governing Board and its publication in the Official Journal of the Federation

As part of the technical regulations, INEGI, as information producer and according to the powers conferred by the Law of the SNIEG, strives to offer the Geographic Information of National Interest that will be integrated into the System supported by the development of regulations and guidelines on methodological, technical and conceptual standards related to gathering, processing and publication of the following data groups:

- Geodetic reference frame
- Coastal, international, state and municipality boundaries
- Continental, insular and submarine relief
- Topography
- Cadastre
- Geographical names
- Natural resources and climate

Thus, in order to have organized, structured and approved geographic data, INEGI has integrated into its Standards Development Program the following technical standards:

Technical standard	Status
▪ Geographic addresses ▪ National Geodetic System ▪ Positional Accuracy Standards ▪ Geographic Metadata Generation ▪ Generation, Capture and Integration of Cadastre and Register Data for statistical and geographic purposes ▪ Use of the Catalog of Undersea Feature Generic Terms (Accord)	**Published in the Official Journal of the Federation**

Technical standard	Status
▪ Unique Code for the Territory Register ▪ Unique Catalog of Geostatistical Codes for States, Municipalities and Localities (Accord) ▪ Continental and Insular Geographical Names ▪ Digital Elevation Models ▪ Use of the Catalog of Mexico Natural and Induced Vegetation Types for statistical and geographic purposes (Accord) ▪ Interoperability for Geographic Information	**In publication process**

Technical standard	Status
▪ Cadastre and Register Information Exchange	**In preparation**

Technical standard	Status
▪ Orthoimage Generation ▪ Aerial Photography Surveys with Analog Metric Camera ▪ Aerial Photography Surveys with Digital Metric Camera for statistical and geographic purposes ▪ Aerial Photography Scanning ▪ Bathymetric data ▪ Data for Soil Classification and Spatial Representation ▪ Sample Survey, Classification and Spatial Representation of Lithological Units ▪ Classification of Water for Irrigation Purposes ▪ Hydrographic Division ▪ Temperature and Precipitation Mean Data for Climate Classification ▪ Climatic Data for Spatial Representation at Scale 1:1,000,000	**In technical revision**

In the case of technical standards that have been published in the Official Journal of the Federation, training programs are established to facilitate the understanding and interpretation of the technical specifications contained in the standards and to expedite its implementation and monitoring by the Units of the State that make up the SNIEG.

III. Standardization International Bodies/Geospatial Information Standardization

1. ISO – International Organization for Standardization

The ISO is a non-governmental organization, which is a network of national standards institutes of about 160 countries (one member per country, representing social and economic interests internationally), supported by a Central Secretariat in Geneva, Switzerland, that coordinates the system (ISO, International Organization for Standardization n.d.).

The ISO is the leading organization for the development and publication of international standards, which purpose is to facilitate the exchange of products and services by removing technical barriers to trade through the essential principles of global openness and transparency, consensus and technical coherence. The formulation of these principles is safeguarded by an ISO Technical Committee (ISO/TC) representing all stakeholders and is based on a public feedback phase (the ISO Technical Enquiry) (IPGH-Comité ISO/TC 211 2010).

Through the ISO TC/211, Technical Committee on Geographic Information/Geomatics, ISO develops a comprehensive set of standards for geographic information. The scope of the ISO/TC 211 is the standardization of digital geographic information, so that their work is focused on the establishment of a structured set of standards for information concerning objects or phenomena that are directly or indirectly associated with a location relative to the earth. These standards may specify, for the case of geographic information, methods, tools and services for data management (including definition and description), and the acquisition, processing, analysis, access, representation and transference of such data in digital/electronic format between different users, systems and locations (ISO/TC 211 n.d.).

Hence the general objectives of the ISO/TC 211 are to (IPGH-Comité ISO/TC 211 2010):

- Increase the geographic information understanding and use
- Increase the geographic information availability, access, integration and dissemination
- Promote the efficient, effective and non-expensive use of digital geographic information and the related hardware and software systems
- Contribute to a unified approach for solving global environmental and humanitarian issues

The ISO/TC 211 standards are becoming a standardized framework for technical domains of geospatial information communities and are essential to establish and support the accelerated development of national, regional and global SDIs (IPGH-Comité ISO/TC 211 2010).

The international standards and technical specifications already published and developed by the ISO/TC 211 are listed and summarized on the offical web site (http://www.isotc211.org), and according to the IPGH-ISO/TC (IPGH-Comité ISO/TC 2010) are classified as follows.

- Standards that specify the infrastructure for geospatial standardization

ISO 19101 Geographic Information – Reference Model
ISO/TS 19103 Geographic Information – Conceptual Schema Language
ISO/TS 19104 Geographic Information – Terminology
ISO 19105 Geographic Information – Conformance and testing
ISO 19106 Geographic Information – Profiles

- Standards that describe data models for geographic information
  ISO 19109 Geographic information – Rules for application schema
  ISO 19107 Geographic information – Spatial Schema
  ISO 19123 Geographic information – Schema for coverage geometry and functions
  ISO 19108 Geographic information – Temporal schema
  ISO 19141 Geographic information – Schema for moving features
  ISO 19137 Geographic information – Core profile of the spatial schema
  ISO 19111 Geographic information – Spatial referencing by coordinates
  ISO 19112 Geographic information – Spatial referencing by geographic identifiers

- Standards for geographic information management
  ISO 19110 Geographic information – Methodology for feature cataloguing
  ISO 19113 Geographic information – Quality principles
  ISO 19114 Geographic information – Quality evaluation procedures
  ISO 19115 Geographic information – Metadata
  ISO 19131 Geographic information – Data product specifications
  ISO 19135 Geographic information – Procedures for item registration
  ISO/TS 19127 Geographic information – Geodetic codes and Parameters
  ISO/TS 19138 Geographic information – Data quality measures

- Standards for Geographic information services
  ISO 19119 Geographic information – Services
  ISO 19116 Geographic information – Positioning services
  ISO 19117 Geographic information – Portrayal
  ISO 19125-1 Geographic information – Simple feature access – Part 1: Common architecture
  ISO 19125-2 Geographic information – Simple feature access – Part 2: SQL option
  ISO 19128 Geographic information – Web map service interface
  ISO 19132 Geographic information – Location based services – Reference model
  ISO 19133 Geographic information – Location bases services – Tracking and navigation
  ISO 19134 Geographic information – Location based services – Multimodal routing and navigation

- Standards for encoding of geographic information
  ISO 19118 Geographic information – Encoding
  ISO 6709 Standard representation of geographic location by coordinates
  ISO 19136 Geographic information – Geography Markup Language (GML)
  ISO/TS 19139 Geographic information – Metadata – XML schema implementation

- Standards for specific thematic areas
  ISO/TS 19101-2 Geographic information – Reference model – Part 2: Imagery
  ISO/TS 19115-2:2008 Geographic information – Metadata – Part 2: Extensions for imagery and gridded data

2. OGC – Open Geospatial Consortium

The OGC is a nonprofit organization that brings together more than 400 public and private organizations dedicated to standards consensus and promotion for open and interoperable geoprocessing in geographic information systems and the World Wide Web. The OGC pursues agreements between different companies that enable the interoperation of geoprocessing systems and facilitate the geographic information exchange for the users benefit (The Open Geospatial Consortium, Inc. n.d.).

The OGC strategic objectives expressed in its official website (http://www.opengeospatial.org) are to:

- Provide free and openly available standards to the market, tangible value to Members, and measurable benefits to users.
- Lead worldwide in the creation and establishment of standards that allow geospatial content and services to be seamlessly integrated into business and civic processes, the spatial web and enterprise computing.
- Facilitate the adoption of open, spatially enabled reference architectures in enterprise environments worldwide.
- Advance standards in support of the formation of new and innovative markets and applications for geospatial technologies.
- Accelerate market assimilation of interoperability research through collaborative consortium processes.

The OGC has agreed several families of interfaces, and some of these have been implemented in off-the-shelf software. All interface specifications agreed in the OGC carry a commercial application or commitment to community by their promoting teams (Nebert 2004). Along with the ISO/TC 211, the OGC has formed a coordinating group to take advantage of mutual development and minimize technique duplication. The OGC, as an industrial consortium, presents its specifications to ISO to be standardize through the ISO/TC 211. It also has a conformity test suite for its own specifications, as well as an interoperability program to develop specifications by using a quick test software. This practical bottom-to-top scope by the industry and suppliers generates the specifications resulting from the implementation and interoperability scenarios.

The OGC standards are technical documents that detail interfaces or encodings, that software developers use to build open interfaces and codify them as part of their products and services. These standards and supporting documents are the main OGC "product", which have been developed by the OGC members as an answer to specific challenges of interoperability and are available at no cost for any person or organization (The Open Geospatial Constortium, Inc. n.d.).

The standards promoted by the OGC are listed, summarized and available on its official website (http://www.opengeospatial.org), here are some examples included:

- Standards for objects and geographic information access and processing
  OpenGIS Geographic Objects Implementation Specification

OpenGIS Implementation specification for geographic information – Simple feature access – Part 1: Common architecture
OpenGIS Implementation Specification for Geographic Information – Simple feature access - Part 2: SQL option
OpenGIS Simple Features Implementation Specification for OLE/COM
OpenGIS Implementation Specification for coordinates transformation service

- Standards for Web Services Implementation
  OpenGIS Catalogue Service Implementation Specification
  OpenGIS Web Map Service (WMS) Implementation Specification
  OpenGIS Web Feature Service (WFS) Implementation Specification
  OpenGIS Web Coverage Service (WCS) Implementation Specification
  OpenGIS Web Coverage Processing Service (WCPS) Implementation Standard
  OpenGIS Web Processing Service (WPS)

- Standards for Geographic Objects Encoding
  OpenGIS Geography Markup Language Encoding Standard (GML)
  OpenGIS KML
  OpenGIS GeoXACML Implementation Specification

IV. Conceptual Basis for Standards Framework

1. Basic Concepts

The definition of a standards framework as part of the IDEA aims to propose a set of standards and technical specifications related to the geospatial data and information acquisition, representation, organization, storage, documentation and sharing to contribute to a good management and provide coordination, administration and access mechanisms.

However, it is necessary to begin with the rudiments that shall support the conceptual basis for the standards framework definition.

a) Standard

According to the Royal Academy of the Spanish Language, the term standard (*norma in spanish*) (Latin norma 'rule'), refers to: "Rule to be followed or to which behaviors, tasks, activities must be adjusted".

The standard (*norma in spanish*) of the Latin word "normun" etymologically means "rule to follow in order to reach a particular purpose." This concept was more specifically defined by the German Committee for Standardization in 1940, as: "The rules that unify and logically order series of phenomena" (Navarro Frómeta 2008).

For the INEGI, a standard, in general, refers to "a provision that determines or directs the overall performance of those obliged to comply with the provision, which, is mandatory, comprehensive and strict in its application" (Instituto Nacional de Estadística y Geografía 2010).

b) Technical standard

According to Navarro (2008), a technical standard is a rule or minimum requirement. It is usually a formal document that establishes uniform technical criteria, methods, processes and practices. In general, it to tune or coordinate the technical work of an organization or group of professionals who make some trade."

For the INEGI, a technical standard, in general, refers to "a set of scientific and/or technological mandatory rules, issued by an authority where the requirements, specifications, parameters and allowable limits to be observed in the development of activities are established". For the SNIEG, a technical standard is defined as a “provision developed and/or proposed by the Units of the State issued by the Governing Board concerning the collection, processing, production, integration and conservation of information" (Instituto Nacional de Estadística y Geografía 2010).

c) Standardization

According to the Royal Academy of the Spanish Language, the term Standardization refers to " action and effect of standardize " where standardize means "to regulate or put in order what was not so".

According to the ISO, standardization is "the activity that establishes, before real or potential problems, the provisions for common and repeated use in order to obtain an optimal level of order in a technological, political or economic context" (Instituto Ecuatoriano de Normalización 2006).

d) Specification

According to the Royal Academy of the Spanish Language, the term specification refers to the "action and effect of specify." Where specify concerns to: "explain, individuality declare something" and as to "fix or determine precisely."

e) Technical specification

A technical specification "sets the characteristics of the goods or processes and production methods related, or of the services or their related operating methods, including the applicable administrative provisions. It may also include requirements for terminology and symbols applicable to a good, production or operation process or method, or deals exclusively with the mere characteristics" (Secretaría de Relaciones Exteriores 1995).

f) Interoperability

According to the European Commission, interoperability is "the ability of ICT systems and business processes ICT supported to exchange data and to enable information and knowledge sharing." In European studies, the analysis of the interoperability phenomenon is developed based on a typology that considers four aspects: semantics, organization, technique and governance (Escobar et al. 2007):

- **Semantic interoperability**: It is responsible for ensuring that the precise meaning of exchanged information be understandable without ambiguity by all the applications involved in a transaction and enables systems to combine received information with other information resources and process them appropriately.

- **Organizational Interoperability**: It deals with the definition of business goals, process modeling and the collaboration between administrations facilitation that wish to exchange information even with different organizational structures and internal processes, guiding also, based on the requirements of the user community, the services that must be available, easily identifiable, accessible and user-oriented.

- **Technical interoperability**: It covers technical issues (hardware, software, telecommunications), necessary to interconnect computer systems and services, including key aspects such as open interfaces, interconnection services, data

integration and middleware, data presentation and exchange, accessibility and security services.

- **Interoperability Governance**: It refers to agreements between governments and actors involved in the interoperability processes and how to achieve them. It also refers to the definition of dialogue spaces where agreements are defined. With governance, it is intended that the public authorities have the necessary institutional basis to establish interoperability standards, ensure their adoption, and provide agencies with organizational and technical capacity required to implement them.

In an organizational approach, interoperability refers to "the ability of diverse organizations and systems to interact following common and agreed objectives and to achieve mutual benefits." The interaction implies that the organizations involved share information and knowledge through their business processes, by means of the exchange of data between their respective information and communications technology systems (Secretaría de la Función Pública 2010).

2. Types of standards

There are different classifications for technical standards, proposed by diverse organizations and based on the following properties, as shown in Figure 1:

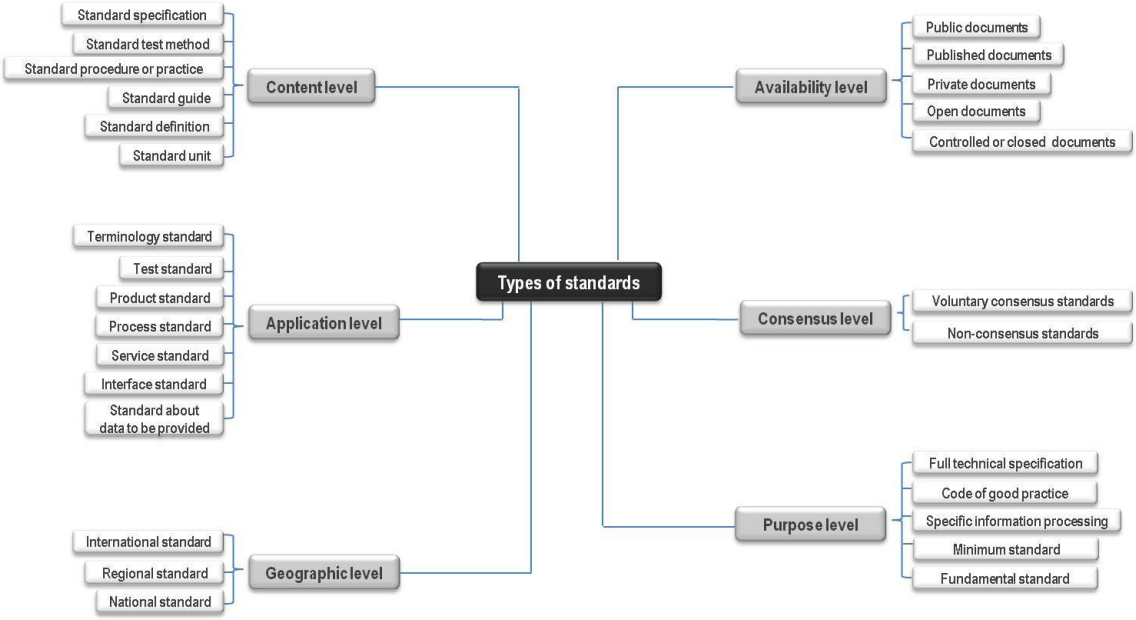

Figure 1. Types of Standards

- ***Content level:*** Standards may be classified by their level of technical content in the following types (Arteaga n.d.):

a. Standard specification.– It is an explicit set of requirements for an item, material, component, system or service often used to formalize the technical aspects of an agreement or procurement contract
b. Standard test method.– It describes a definitive procedure that produces a test result, it may involve a careful observation or a high technology measurement.
c. Standard procedure or practice.– It defines a set of instructions to execute operations or functions.
d. Standard guide.– It includes general information or suggestions that do not require specific activity or activities.
e. Standard definition.– It is the way to provide a formal terminology.
f. Standard unit.- In physics and applied mathematics, it refers to the commonly used units for measuring physical quantities.

- ***Application level***: It is based on the subject or field on which the rule is applied, it can be divided into the following modalities (Instituto Ecuatoriano de Normalización 2006):
-

a. Terminology standard.- It sets the terms, usually with definitions, and sometimes with explanatory notes, illustrations, examples, etc.
b. Test standard.– It establishes the test methods, usually including other provisions concerning the test, such as sampling, statistical methods and sequence of tests.
c. Product standard.- It specifies the requirements that must be met by a product or group of products to determine its suitability for use.
d. Process standard.- It specifies the requirements to be met by a process to ensure its suitability for use.
e. Service standard.- It specifies the requirements that must fulfill a service to ensure its suitability for use.
f. Interface Standard.- It specifies the requirements related to the products or systems compatibility at their interconnection points.
g. Standard about data to be provided.- It contains a list of properties in which values or other data shall be set to specify a product, process or service.

- ***Geographic level***: When a geographically defined community needs to solve a problem that requires the coordination of the whole community, an existing standard can adopted, or a new one can be produced, which according to the geographical, political and economic coverage included in the standardization can be (Instituto Ecuatoriano de Normalización 2006):

a. International Standard.- In which relevant agencies of all countries or main industry or field-related representatives can participate. It shall be promoted by a globally recognized standardization body.
b. Regional standard.- In which relevant agencies from a geographic, political or economic area or region of the world can participate. This modality is developed by the national standardization bodies, within a continental scope.
c. National Standard.- Which takes place in a specific country and is promoted by a recognized standardization body within a country or a country territorial division. The standardization can also be done on a sector basis at a local, association, company and individual offices level.

- ***Availability level***: The distribution and access to technical standards can be given as follows (Arteaga n.d.):
-

  a. Public documents, available for free and open consultation.
  b. Published documents available for purchase.
  c. Private documents or property of an organization or corporation, that are used and circulated at someone's convenience.
  d. Open documents for public use, but with intellectual property rights.
  e. Controlled or closed documents, which contain secret or classified information.

- ***Consensus level***: It defines the degree of participation of different agencies representatives to increase the probability that the standards they develop meet the needs of the public and private sectors. They may be (Oficina de Administración y Presupuesto – Asociación de la Promoción de Infraestructura Nacional de Datos Espaciales n.d.):

  a. Voluntary consensus standards.- They are developed or adopted by voluntary consensus standardization bodies, both national and international. These standards include provisions by which the standard owners have agreed to make that intellectual property be available on a non-discriminatory, open access or reasonable rights to all stakeholders manner.
  b. Non-consensus standards.- They are distinct from voluntary consensus ones and correspond to industry standards, company standards or de facto standards, which are developed in the private sector, but not in the full consensus process; unique standards developed by the government for its own use; and standards required by law.

- ***Purpose level***: Standards can also be classified according to the purpose they are intended:

  a. Full technical specification.- It includes all technical aspects of the standard, describing a particular technological element and how other technologies and standards shall use it. Examples: TIFF (Adobe), JPEG (ISO), JSR (Sun Corp.), C + + (ISO), SQL 99 (ISO), XML Group (W3C), etc.
  b. Code of Good Practice.- Set of methodological and organizational recommendations oriented to a specific activity. Examples: ISO 17799. Information systems Security; ISO 15489. Document Management; DLM FORUM Digital information processing; UNE standards, etc.
  c. Specific information processing.- It establishes unambiguous criteria regarding a specific data and information processing (documentation, serialization, date, etc.) in all possible aspects (description, storage, preservation, etc.). Examples: ISAD (G) multilevel documents description, ISO 3297 ISSN International Standard Serial Number, etc.
  d. Minimum standard.- Specification of a mandatory implementation core in data structures in order to ensure interoperability criteria between systems for setting the minimum quality required. Example: R (95) 3 Architecture description.

e. Fundamental Standard.- It deals with aspects such as terminology, measurement, conventions, signs, symbols, etc. Examples: ISO 8601 Storage date format in databases; ISO 3166 Codes for countries; ISO/DIS 15511 library identifiers for related organizations.

3. Technical standards characteristics

The standards are technical documents with the following characteristics (Navarro Frómeta 2008):

- They contain technical specifications.
- They are developed by consensus of stakeholders: manufacturers, administrations, users and consumers, research centers and laboratories. professional associations, social agents, etc.
- They are based on the results of experience and technological development.
- They are approved by a national, regional or international recognized standardizaton body.
- They are available to the public.

The standards have the following characteristics (Diego 2004):

- They are the meeting point of methodologies which, from a homogeneous processing, allow comparison of results.
- They cover all technical aspects related to information, as well as production and management.
- They are coherent and consistent. They were developed by technical committees under the supervision of a specialized body.
- They are based on the joint work of all parties involved: producers, professionals, users, public administration, etc.
- They are based on real experiences and tested in practice.
- They are continually evolving because of a periodic review.
- They represent a commitment between the most advanced technology and economic constraints.
- They are internationally acknowledged.
- They enable universal accessibility.
- They represent the basic reference procedure (knowhow) in a specific activity, which requires an adaptation indispensable to meet some requirements.

Open standards, according to the National Interoperability Framework, shall have at least the following characteristics (Secretaría de la Función Pública 2000):

- Availability
- No copyright
- Maturity
- Internationally accepted
- Easy distribution
- Industry and market support

The technical standards are intended to provide quality, relevant, accurate and timely information, and meet, among others, the following conditions (Proyecto FOMIN/BID Mercosur n.d.):

- Having been established with the participation of all stakeholders (producers, consumers, technological and control bodies, etc.)
- Having been approved by consensus
- Having the benefit of the community as a goal
- Being available to all stakeholders
- Being developed and published by a recognized standardization body

The characteristics of the standards can also be associated with the basic principles of the standardization process referred to:

- Representativeness.- In the standard development the participation of different stakeholders, such as farmers, industrialists, traders, consumers, government agencies, academic and research institutions, etc., shall be sought.
- Consensus.- It is related to the participants' general agreement, characterized by the absence of sustained opposition to substantial issues by any important part of the stakeholders involved and through a process that includes taking into account all stakeholders' points of view and reconciling any conflicting arguments. Consensus does not necessarily imply unanimity.
- Public consultation.- Period prior to the entry into force of the standard, when the standard is made known to the general public, so that any individual or entity may send to the agency responsible for its production opinions and comments, which will be attended by the agency.
- Modification and updating.– It allows for provisions in force, consistent with the present needs and technologies.

Three scientific principles for standardization are described, they can also be oriented to the standards characteristics or properties (SCRIBD 2010):

- Homogeneity.- When a standard is developed or adopted, it must be perfectly integrated to the existing standards dealing with the same standardized object, taking into account the evolutionary trend in order to avoid impending future standardizations.
- Balance.- Standardization shall be a practical task and the results, the standards shall be agile instruments, immediately implemented and modifiable at any time, when technical advances, economic possibilities or both so may required. Standardization shall achieve a state of balance between global technological progress and economic possibilities of the country.
- Cooperation.– The standardization is a joint work and shall establish standards along with really committed and cooperative stakeholders.

4. The Spatial Data Infrastructures Standards

Most SDI initiatives include the component of standards, as in the case of the Colombian Spatial Data Infrastructure (ICDE), which is based on fundamental geographic data with a country-wide coverage, supported by a policy and regulatory framework that makes access and use easier. The Colombian Institute for Technical Standards and Certification (ICONTEC) leads the geographic information standardization through the Technical Committee for Standardization of Geographic Information-CTN 028, which conducts voluntary agreements among the various producers and users, on issues relevant to the IG community: methods, tools and services for geographic data management, as well as the acquisition, processing, analysis, access, precision, and transfers in different forms and between different users, systems and locations. This committee is composed of the main companies that produce and use geographic information and the advances achieved are focused on the Colombian Technical Standards approval relating to the geographic themes, as of the adoption of the Technical Committee ISO/TC 211 standards (Centro de Investigación y Desarrollo de Información Geográfica-IGAC n.d.).

For its part, the Spatial Data Infrastructure of Mexico, also called IDEMex, in the context of the provisions of the Law of the SNIEG, it is restricted to the indicated datasets for the geographic component of the National Subsystem of Geography and Environment (SNIGMA), but like every SDI initiative it is also necessary to include, besides data, other components that allow to coordinate, organize and standardize the geospatial information produced in the country and thus be able to offer it and share it between different producers and users. Thus, as part of the regulatory framework, the regulations are the basis required to give coherence and promote the operation and functioning of the SNIEG and the IDEMex itself, hence, to regulate geographic activity with respect to production, integration, preservation and dissemination of geospatial information it is necessary to establish by consensus and based on the powers of each participant, policies, standards and specifications based on international standards, recommendations and best practices, to allow that data and information produced are uniform and consistent at all levels (Instituto Nacional de Estadística y Geografía 2009).

In the Argentinian model, a SDI is defined as the creation of services subject to standards that enable the analysis, visualization, query and downloading geospatial information posted on the Internet. Thus, to facilitate reuse of spatial data by different applications and share information between agencies without adaptations or conversions, interoperability standards are implemented for creating an environment where data exchange is consistent and safe, enabling integration of geospatial information in that region, where ISO standards and OGC specifications are the main reference for the achievement of this objective (Equipo Coordinador de IDERA n.d.).

The Spatial Data Infrastructure of the Republic of Cuba (IDERC) is defined as the set of policies, technologies, standards and human resources necessary for the effective collection, management, access, delivery and utilization of national spatial data depending on economic, political and social decision making, and on sustainable development. The standardization work within the IDERC has been developed through the Standardization Technical Committee 113 on Geomatics (CTN 113), mirror of the Technical Committee ISO/TC 211, which has worked on a ISO 19100 set of standards that must derive on similar Cuban standards to regulate: spatial reference, metadata, conceptual schema language, terminology, application

schema rules, quality principles and interface of web map server, among other themes (Delgado 2009).

In the United States, the National Spatial Data Infrastructure (NSDI) is defined as the set of technologies, policies, criteria, standards and people necessary to promote geospatial data sharing. The FGDC is set up to coordinate this initiative and to promote the coordinated development, use, sharing and dissemination of geospatial data; to achieve this, it develops geospatial data standards for the NSDI implementation, in consultation and coordination with federal, state and local govenments, the private sector and the academic community, and as far as possible with the international community. The FGDC develops geospatial data standards only when there are no voluntary consensus standards, highlighting the Content Standard for Geospatial Metadata, which was the basis for developing the ISO 19115 Geographic Information – Metadata (Federal Geographic Data Committee n.d.).

For its part, the Infrastructure for Spatial Information in the European Community (INSPIRE) is an important global reference for a SDI design and implementation, whose directive (Parlamento Europeo y del Consejo 2007) identifies various important aspects related to the regulatory framework development:

- INSPIRE shall be based on the spatial information infrastructures established by the Member States making them compatible through a set of common implementation standards and complemented with measures at a community level.
- The implementing standards shall be based, where possible, on relevant international standards and standards adopted by the European bodies and shall not result in excessive costs for Member States.
- Promote the adoption of the implementing standards for laying down the technical arrangements for the interoperability and harmonization of the spatial datasets and services, and standards governing the conditions of access to such sets and services.
- In developing the implementing rules, relevant user requirements, existing initiatives and international standards for the harmonization of spatial datasets, and the feasibility and profitability shall be taken into account.
- Members States shall create metadata for the spatial datasets and services in conformity with the implementing standards and corresponding procedure.
- The implementing standards shall address the following spatial data aspects: a) A common framework for the unique identification of spatial objects, as a reference for the identifiers location under the national systems to ensure interoperability among them; b) The relationship between spatial objects; c) The main attributes and the corresponding multilingual dictionary generally required for policies which may have consequences on the environment; d) Information on the temporal dimension of the data and e) Data updating.

- The implementing rules shall cover the definition and classification of spatial objects relevant for spatial datasets on the following themes:

Reference data

a. Coordinate reference systems
b. Geographical names
c. Statistical units
d. Administrative units
e. Orthoimagery
f. Buildings
g. Addresses and postal codes
h. Cadastre parcel
i. Transport network
j. Elevation
k. Hydrography
l. Protected sites
m. Land cover

Fundamental thematic data

a. Geology
b. Soil
c. Land use
d. Natural risk zones
e. Oceanographic geographical features
f. Sea regions
g. Bio-geographical regions
h. Species distribution
i. Energy resources
j. Mineral resources
k. Agricultural and aquaculture facilities
l. Environmental monitoring facilities
m. Meteorological geographical features
n. Population distribution

Therefore, based on some of the different initiatives and their meanings, in its most basic definition, an SDI can be understood as: "A set of technologies, policies, standards and human resources necessary to acquire, process, store, distribute and improve the use of geographic information" (Sánchez y Torrecillas 2003) and in the component of standards is where the standards and tools common framework is established and supported by these tools. The standards, and therefore the corresponding agreements, are an essential substrate that enables consistency, compatibility and interoperability necessary for SDI data, services and resources to be used, combined and shared (Consejo Superior Geográfico IDEE n.d.).

5. Standards relevance on spatial information production

One benefit is that standards have been developed through a consultative process (with other "experts") and provide a basis for developing national profiles or oriented to a discipline. Just as the standards are being adopted within a larger community, software programs will be developed to help the industry with the standard implementation (Nebert 2004). The national, regional or international standards development is one way to cope with the technical barriers caused by differences of judgment or regulations independently developed (Arteaga n.d.).

According to the (Asociación Española de Normalización y Certificación-AENOR 2007), international standards are widely adopted at a regional or national level and are used by all stakeholders (manufacturers, trade organizations, users, consumers, certification bodies, testing laboratories and authorities), reflecting the industry best experience -in this case on geospatial information- because they:

- Support the technical aspects of social and environmental policies, contributing to a sustainable development.

- Offer one usability level, whether applied in a mature or emerging economy.
- Reflect the technique status and serve as a vehicle for the new technologies dissemination.
- May become national standards after a public consultation or consensus process.
- May serve as a basis for national technical regulations without creating unnecessary technical barriers for regional or global exchanges.
- Are used for the conformity assessment as a means for improving products, systems, processes, services or people.

The importance of standards use and standardization activity may also be reflected through the statements of (Asociación Española de Normalización y Certificación-AENOR 2009):

- Dynamic and profuse standardization is capable of accelerating the access to national, regional and global innovation, becoming one of the pillars for the economic development and competitivity promotion.
- Standards use (application or implementation), both in the continuous quality management and project quality management, represents a process significant improvement and development.
- Standardization can help to create the necessary order to generate confidence in users and benefit the area of application growth. Through the development of standards in key moments of technological development, the management of technological change is promoted in a controlled manner.
- Standardization can encourage collective knowledge sharing by developing collaborative solutions.
- Standards about the technique state of the art offer an equal footing for innovators, facilitating interoperability and competition among new and existing products, services and processes.
- Standards serve as a reference for security, performance and reliable quality levels. For regulated products and services, standards conformance may provide a simple and cost effective means to demonstrate compliance with the obligations regulated.
- Active participation in provisions development represents a unique opportunity to build contact networks and access to information resulting from research in new fields, new applications, new products and new ways for providing a service, that provide a medium and long term view of the state of the art and technological evolution of the organization.

According to (Diego 2004), the benefit of standards is a function of the standardization objectives in general, which may be focused on the geospatial information field:

- Rationalization of work.- Standards are the rationalization core of information generation and management, providing a useful guide regarding how to approach work and production processes.
- Quality Assurance.– It is necessary to assess the product and service quality, therefore it is required a recognized quality system. The standards represent an essential reference in regard to methodologies, techniques and practices, as they are defined by the professional and scientific community.

- Technical and professional capacity.- They facilitate and accelerate the implementation of projects, since many of the necessary methodologies and functions are included in the very standards.
- Interoperability.- Interoperability or integration can be approached at the process, professional, product and service levles.
- Technical and communication development.- The benefits of the standards use come from the acceptance of standards as a set of rules that rationalize our work, forcing the producer to be in communication with the technical community (issuing bodies, working groups, forums).

Standardization is essential to technological maturity of any production process, such as maps, cartography or other goods or service; increases the activity of the sector in which it appears; can make profitable investments in innovation, and that the forces generated by demand and users requirements may act without hindrance, i.e. always opens new horizons (IGN, Centro Nacional de Información Geográfica n.d.). The overall benefits of standardization are based on the use of voluntary international standards widely recognized and internationally accepted, that have been developed at the highest technical level through open consensus process involving all those affected (Diego 2004).

V. General considerations on the standards framework definition

In the definition of the common standards framework in the region for the integration of geospatial information it is pertinent to analyze the following general considerations:

- The standards and models for a common SDI do not have to be reinvented in each country. Common model and standards would improve the effectiveness of SDIs at national and regional level. This would cause a powerful exchange of experiences and results, coordination and division of labor within the national institutions in the region, including effective engagement with a non-permanent joint steering committee as coordinator (Nebert 2004).

- Many of the global geographic communities are familiar with the ISO/TC 211 Standards, however, not all user communities adopt them. The ISO/TC 211 benefits can be fullfilled only when they are implemented for different forms of human endeavor that use geographic information. As a strategic investment to ensure the viability of the ISO/TC 211 in the long term, it is necessary to establish agreements between ISO/TC 211 and global organizations that recognize and institutionalize these standards, as a basis for the geographic information standardization (IPGH-Comité ISO/TC 211 2010).

- To support the development of national and regional SDIs, and their interoperability, there is a need to support the organizational and institutional capacity, to promote international standards and best practices, and provide coordination and technical support. The two latter should include the development of regional data content specifications based on existing ones, keeping the least possible impact on the national databases (Red Europea de Información Geográfica 2004c).

- Europe is, by the advances in the integration process, a basic reference to feed our own reflection, the European experience offers valuable lessons, which must be analyzed to determine which can be adapted to the Latin American reality, given our structural and institutional specificities. In the field of interoperability, the European Union offers studies, practices and understandings that can be taken into account in the dialogues undertaken by the Latin America and the Caribbean countries in this area (Escobar et al. 2007). Aware of the critical social, environmental and economic issues shared regionally and often globally, it is also extremely important the security of a Global Spatial Data Infrastructure to allow nations and organizations to collaborate with the themes and solutions (Nebert 2004).

- The catalogs and standards for identity and semantic structure are fundamental and should not only be created, reused and maintained but also spread to serve as a model and general application. Data models, metadata and term lists must conform to semantic interoperability standards defined by the Standards Framework (Secretaría de la Función Pública 2010). A common conceptual frame must be agreed which contain the definitions that will help to establish dialogs and solutions to organizational, semantic and technical problems to enable a secure and efficient exchange of information among countries. And with these definitions an interoperability architecture and a standards framework will be proposed for the region (Escobar et al. 2007).

- A high interoperability level is essential for any SDI to be effective. This includes technical interoperability aspects, such as the ability to communicate several spatial processing systems in real time by shared interfases, like semantic interoperability such as, the ability to understand data content, quality and meaning; nevertheless the local authorities approach related to interoperability is quite different. In most cases, there are interoperability information flows within the bureaucracy vertical data storage, where the central administration sets the standards and proceedures, and later it demands the local jurisdictions to observe them, recollect the relevant information and send it to the following link in the chain.This type of interoperability only works fine within its own channel, but it is totally inefficacious when sharing information among several channels or communities with diverse information (Red Europea de Información Geográfica 2004b).

- A published technical standard not always is useful or correct. That is, if an element of a dataset complies with a standard there is not necessarily a certainty that it is going to fit to a particular use. People using this element or service (engineers, commercial groups, etc.) have the responsibility of considering available standards, specify the correct use, respect its compliance and use the element appropriately. However, the suitable use and applicability of the element of the dataset and the standards must be validated (Arteaga, n.d.).

- It is advisable to take up an evolutionary perspective of a continued study which determines the recommendation, adoption, study or non-adoption of existing standards, based on their level of maturity, features, service, obsolescence and extent (Secretaría de la Función Pública 2010). Standardization evolves according to technological development and innovation, then a commitment of active participation in the standards elaboration and modification must be made, which offers the posibility of knowing and setting the pace of geographic innovation for the region, allowing to measure, evaluate and compare efforts (Asociación Española de Normalización y Certificación-AENOR 2009).

- It should be acknowledged that standardization contributes increasing availability, accesibility, integration, dissemination, understanding and use of geospatial information, and it also enables geographic systems interoperability, adds unified approximations for solving global issues and simplifies the establishment of SDIs. Therefore, it introduces essential qualitative and quantitative advantages to the geographic sector that benefit significantly to its maturity (García y Federico Rodríguez 2008).

- Taking the Geographic Information Network in Europe as a reference, the planning frame for the IDEA should establish a national spatial data committee in each country to be responsible for the national SDI standards-based implementation, with the following duties:

    a. To bring coherence within the standardas framework. Clear agreements should be establish on standards and specifications to regulate spatial datasets collection, processing and publication.
    b. To reinforce regulations in collaboration with the existent organizations.

c. To help to develop trust, transparency and fair play. It is recommended that national organizations work in close cooperation to solve problems so as to provide the maximum benefit to a regional level.
d. To ensure that the standards framework benefits all users, without discriminating any sector.

- All management areas of the participating institutions should consider developing standards a priority. Technical working groups should be monitored and ensure that the desired results will be obtained; issues such as data standardization and harmonization of classification schemes can not be left only to technicians because they involve political and administrative decisions (Nebert 2004).

- For the adoption of international standards, profiles can be used or adapted to the needs of the region or member of the committee considering removing language barriers or harmonizing the terminology used in the PC-IDEA standards framework.

VI. Conclusions

- The relevance of geographic information is widely recognized, as well as the need to undertake a national SDI initiative in order to promote geospatial data access and use. Nevertheless, there is little coordination for the development of regional initiatives that enable exchange, integration and continuity of datasets beyond national border, based on geospatial standardization, harmonius development and inter-institutional agreements.

- It is necessary to define and adopt a compatible standards framework for the region, which establishes common conventions and technical agreements required for achieving a higher efficiency to attend geospatial information demands, where data are produced and keep the common denominator: compatibility, comparability, shareability, reliability, consistency and completeness, being the basis for the establishment of an collaboration interoperable schema, contributing to the development of the IDEA.

- As a starting point and in order to facilitate dialogue and exchange and the proper interpretation of the documents, it is necessary to use a standard language that allows the homogenization in handling concepts and definitions from a common conceptual basis. In this sense, the paper integrates a group of basic definitions and standards classification proposals, which shall be revised, agreed, and established for collective use within the PC-IDEA.

- In establishing the standards framework for the region, do not start from zero, it is advisable to examine and promote the adoption and use of existing standards and recommendations, that internationally recognized bodies -such as ISO, through the ISO/TC211, and the OGC- promote in the area of geographic standardization, as well as best practices resulting from the experience of countries or regions which SDI initiatives have achieved a bigger momentum and maturity.

- Because the participation in the standardization work allows access to information resulting from research in new fields and provide insight in the medium and long term in the state of the art and technological development trends, more participation and representation in international bodies such as ISO and OGC by the Member States of the PC-IDEA should be sought, together with the participation that countries like the U.S. and Canada may have.

- The geographical standardization should focus its early efforts towards obtaining a regional standards diagnosis, which analysis marks the guideline for the adoption of international standards and best practices applicable to the economic and technological realities of the region that along with the development and the implementation of other regional standards constitute the "core" or fundamental standards framework on which the development and strengthening of the IDEA underpin, thus contributing to meeting the objectives set for the PC-IDEA.

- A second phase in the process of the geographic standardization for the region is the realization of a coordinated effort to develop guidelines for the implementation of "core" or fundamental standards group, allowing their adoption and use in alignment with national initiatives and standards.

- We must not forget that in the definition of the standards framework for the region, according to the "2nd Resolution: *Mechanisms for the building of spatial data infrastructures*" of the 9th UNRCC-Americas, we propose to use as a model the various initiatives developed by the INSPIRE Directive therefore it is worthy to look into as regards to the definition and establishment of the so-called "implementation standards" which constitute the Directive standards framework.

- With the development of this proposal Mexico -as coordinator of the Gtnet- is answering to the first activity, concerning "Preparation of an overview for geospatial information integration in the region using standards ", it was reviewed by GTnet members for consensus and refinement.

- The final version was approved at the 10th Plenary Meeting of PC-IDEA.

VII. References

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