

Towards the Mexican National Spatial Data Infrastructure

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An infrastructure is considered as the underlying basic frame of any system or organization, the skeleton or primary and fundamental support over which such system or organization rests and is sustained. On its part, spatial data are related to a location in the physical space with respect to a certain reference system. In general, data can be geographic, as well as economic, demographic, social, or of any sort. Accordingly, a spatial data infrastructure (SDI) constitutes the fundamental basic frame of a system integrated by geospatial data.

Within the geographic information medium, an accepted definition is that a SDI is a set of policies, technologies, standards and necessary human resources for the effective compilation, handling, access, distribution and use of geospatial data within a certain community.

Under these considerations the SDI concept becomes more extensive and goes beyond the commonly accepted idea of integration of an infrastructure on the basis of just physical components, to become a highly comprehensive one in terms of constituent elements of an order that includes all involved aspects besides physical. In fact, the consideration of a national SDI has changed from being a purely technical subject to one which is essential as an aid for the economic and social development.

Factors affecting the emergency of the SDI's are related to the present globalization phenomenon so much commented and spoken at the present times in the economic and financial world, as well as the Agenda 21 for the Sustainable Development as derived from the 1992 Rio Summit on Environment and Economic Development.

The globalization is understood as a set of phenomena occurring without any regard to administrative or political borders. It is possible to mention in this context, in addition to the globalization of the economies, the globalization of the communications and connected to it, the globalization of the information, affecting both geographic and cartographic institutions in a world of increasing competition, as much national as international, reason why the production and administration of geospatial information also globalizes.

We are going at the present times through deep changes in the technological order, since at least from the fifties we have seen, in addition to a continuous advance in computer systems, the emergency of remote sensing, global positioning systems, new developments and concepts about geographic reference systems, computer assisted cartography, data bases development and their management systems, GIS in its ample and diverse modalities, and the information superhighway represented by Internet as part of the information and communications technologies.

Geographic information is becoming more open and accessible in our days than it was before through the use of more powerful and friendly computer resources which put it within reach of all sectors in an atmosphere where new terms and concepts are of everyday usage; dataware, liveware, digital terrain models, clearinghouse, metadata, are just some examples of the new terminology. To this we add the concept of SDI, the central subject of this paper.

Accordingly, geographic information and cartography are going through a democratizing process; powerful and more friendly computer systems allow people without much knowledge and abilities to generate their own maps. To this we can add the increasing role that is playing the private sector, among other aspects, by providing communication infrastructures, added value to geographic information services and free software services.

Globalization of the information has to do with subjects and problems in our developing countries, such as water availability, soils degradation, environment deterioration, increasing population growth, natural disasters, climatic change, integration of transportation systems through frontiers and the location of trans bordering energy sources, all of them phenomena for which as said before, there are not administrative or political borders.

It is convenient to recall that Agenda 21 is oriented to revert the negative effects of the environmental deterioration and to the creation of the necessary conditions to foster the economic and social development of the present generations without jeopardizing the future and well-being of the coming generations; that is, towards sustainable development. Schemes such as those of ecological and territorial planning and management, which are so much spoken and commented at the present time, are part of an associated general scheme aimed to sustainable development.

At the present time we can notice both in the world-wide, as in the national level, an increasing influence of the geospatial information in decision making processes, centered mostly in the solution to problems derived from the demographic explosion and the environmental deterioration. Recent studies reveal that 40 % of the Gross Internal Product of developing countries is located in sectors that depend on geospatial information; the forecast is that in the next 50 years 80% of the economic sectors will depend on this kind of information.

To exert their functions governments need geospatial data referenced and defined in the national context. This has to deal with the formulation of policies, allocation of resources, management of natural resources, in matters of defense and public security, and to support a wide variety of regulatory activities and national planning, so it is required from the government to promote the development and understanding of a deep knowledge of the physical, economic and human geography of the country and its relationships in a space analysis environment.

While every country must exert proper actions to reach the objectives of Agenda 21, in the global context international cooperation is required, where as time goes by it is becoming increasingly evident that geospatial information is an important part of the schemes of development and a fundamental patrimony of society. The necessity is quite clear then to count on reliable geospatial information in schemes of maximum advantage and rationalization, a premise which contributed to the development of ideas about SDI's. Geographic information is now oriented to the recognition of its importance in the definition of policies and strategies of action related to basic problems affecting all sectors.

A brief situation analysis as far as the status of geospatial information is concerned, reveals that throughout the time, geographic activity in Mexico has been characterized by the production of a high volume of data in analogical formats through several official organizations. It is not but until lately that the digital approach is acquiring overwhelming force; a good proportion of present activities is oriented towards the conversion of information and cartography from analogical to digital format, as a necessary step for the development and operation of geographic databases.

In most of the cases, integration of geographic data in proper schemes of utilization does not exist; that is, there is not a formal body of geospatial information for the knowledge within the data-information-knowledge scheme, nor an effective integration with the statistical information, which we think is necessary. What is directly apparent is a deficiency of geographic information management systems. In most of the cases, the information is hardly known, is not shared, has access difficulties, is of unknown quality, not standardized and is very much dispersed among several organizations.

The above was caused by the emergency, about 400 years ago, but mainly in the first part of the XXth. century of national cartographic organizations, which without greater competition exerted a monopoly in the technical and industrial organization of the geographic and cartographic activities. These monopolies began to be questioned from the sixties, when surveys and cartographic production activities were increasingly influenced by the explosive advance in computer science resources and other technologies, so that now they are becoming accessible to the non specialist within the community of users, and tend, as already mentioned, to the democratization of geographic and cartographic activities. At the present time, official organizations are increasingly subjected to constant budgetary reductions and government demands to generate income derived from geographic activities and products.

Considering these circumstances now more attention is being paid to geospatial information management within the frame of a greater rationalization and efficiency, without neglecting the productive aspects, which on the other hand, are now more diversified and include new sceneries. To this we can add the notion to share existing information through the SDI, which so rises as an invaluable tool for the efficiency and rationalization of the information. SDI's represent a modern resource associated to the management and distribution of geospatial information, within an approach adapted to the design and implementation of now necessary administrative schemes.

In this context, a set of necessities associated to the dynamics characterizing geospatial information has been detected and must be analyzed:

- To know where the information is,
- To define and standardize it,
- To share it,
- To facilitate transference and access
- To establish an effective understanding between producers and users,
- To rationalize the production, and
- To handle it with the greatest possible efficiency.

Within this highly inclusive idea, the next SDI's components are considered:

- Producers as well as users of geospatial information,
- Sources of the data,
- Data catalogues and fundamental data sets,
- Clearinghouses
- Data bases and data networks,
- Metadata,

- Technologies for compilation, access, handling, transference and representation,
- Interinstitutional relationships and agreements,
- Development of basic and specific policies,
- Standards and specifications,
- Associated legal aspects,
- Restrictions to access and dissemination of data,
- Administrative and financial aspects involved,
- Organization schemes.

SDI's, as they are conceived at the present time, include a set of characteristics that in first instance have to do with the standardization of its own content, with the conduit or communication network through which the information can flow, and with the procedures adopted to control such flow.

A consideration of primary importance is the necessary inclusion of the concept of SDI in the e-Mexico project, currently in process of development as an initiative of the Federal Government.

The Government has a strong interest in developing the information society, where the e-Mexico project is part of the definition of public policies in matter of technology, with a strong social tendency. E-México includes e-Government, e-Science and Technology, e-Training, e-Public Health and e-Commerce components, with the vision of being an agent of change in the country by integrating the efforts to eliminate the digital breach.

The e-Mexico system will try to provide digital services of telecommunication to 60 million inhabitants who do not count on facilities for this purpose, as well as to offer services on health, education and administrative government transactions, among others, through Internet.

The project aims to extend the digital culture up to the most forgotten corners of the country. The general objective of the project is to obtain a significant progress in the integral development of the society through the integration of a technological system that contributes to eliminate the access barriers to the information and services, and to reduce the digital breach of the Mexicans, among themselves and with the rest of the world. In this context, the recently promulgated Law of Access to the Information is a tool of utmost importance.

In the general context, one has to consider that the national economic growth must come along with the technologies of the information and communication, where the e-Mexico initiative will permit an accelerated adoption of the Internet in the country.

One of the particular objectives of e-Mexico consists on accelerating the historical tendencies in the penetration of services of telecommunications and information, in order to guarantee that the services and contents of the National e-Mexico System are present in all the national territory and within reach of all the population. In this way, the adherence of the Mexican SDI to the e-Mexico project opens interesting perspectives as far as its scope, dissemination and future operation is concerned, by taking advantage and use of the technological resources to be implanted for the project.

Another characteristic for the SDIs is the necessary interconnection of data sources and data users, in a functional and sufficiently effective mode to facilitate access to the data.

An additional one is that SDIs comprise different actors, where everyone is in charge and responsible for its own information, without visible heads, which implies, from the point of view of implementation and service, the existence of a set of distributed databases, although it is yet required to count on a body for interinstitutional coordination. For Mexico, this is a responsibility, according to law, of the National Institute of Statistics, Geography and Informatics (INEGI).

We all know that SDIs can occur with different geographic coverages, from institutional and local infrastructures, to those of national, regional and global extent. In the first case, we are adding a new category in reference to infrastructures which can be integrated in the level of great producing organizations handling significant and diversified geospatial information. The second case refers to SDI's applied to local complex urban coverages which count with diverse spatial geoinformation in charge of different local offices of urban planning, services, utilities, transportation, cadastre, etc. Our addition of institutional SDI's comes from the idea that before a local or national SDI could be integrated it is necessary to define and organize the different actors under the same principles of any SDI. In other words, institutional SDI's should be in the first place oriented to higher SDI's.

We also know that National infrastructures are integrated in the level of countries by bringing together national geospatial information producing institutions, whereas regional infrastructures are conceived at the level of whole continents, integrated by the national infrastructures of the included countries; for example, the Asia-Pacific region, Europe and the region of the American Continent. Under this same concept, the global IDE is conceptually considered as the result of integrating regional SDI's.

The above establishes a conceptual organization scheme by which it would be required to develop national SDI's in the first place to be able to integrate them in the regional context and with these conform the global SDI. The practical scheme now seems to consist of an integration of the global infrastructure and at the same time to promote the national SDI's development, without neglecting the simultaneous implementation of the regional ones. This is probably the circumstance of the Global Map initiative as a part of the global SDI, which is being developed and has already important advances at the worldwide level. Mexico has already contributed with its share by developing the required several digital layers covering the Mexican territory.

Here is where the From Global to Local idea takes significance

It is interesting to note that significant progress have been attained through concepts of SDIs as developed in the global context by setting most of the practical issues for national SDIs conception and development. In this context both global and regional SDIs share a position as holders of basic concepts and implementation issues for lower level SDIs, both national and local, where this last level is mostly concerned with municipal bodies engaged in continuous services and decision making.

It is in the global realm where an integration of ideas concerning national infrastructures takes place by establishing strategic concepts useful for the development of SDIs in the national level where the interest lies in the establishment and operation of national bodies concerned with the management of their own national geospatial data and information. Examples of the above are the ideas about data framework and fundamental data sets, the need to develop metadata, the establishment of clearinghouses or data discovery places and also the establishment of common data and information standards, all along with the necessary access and dissemination means through available information and communications technologies. This seems also true of regional SDIs where most of the integration effort has taken place so far.

The above seems to be general for all sorts of SDIs, but does not take care of some issues as applied to top level infrastructures, for example when dealing with the need for concert and to come to agreements among several independent actors, which is not so pressing in the case of local SDIs. Perhaps it will be necessary to establish a sort of ladder where needs and components are placed on one side, paired with SDIs levels on the other side, from global to local, and also to clearly establish the flow direction along the hierarchy of SDIs. At the present time, the strategic practical direction seems to go from global to local, but it is also true that due global and regional integration depends on formal integration in the lower levels, so this is perhaps a matter of feedback.

Initiatives for the implementation of SDIs throughout the world are under way in the present time, in an effort dating from 1986 with the first Australian SDI. Several countries worldwide are planning or implementing their infrastructures. The majority of American nations are conceiving, or in the design process and implantation of SDIs and most of them already count with Clearinghouse nodes or Metadata Distributing Centers as a part of the GSDI and for their own SDI. In Mexico, the INEGI has already established a node, which is being populated with metadata developed according to Federal Geographic Data Committee (FGDC) standards. Other national institutions dealing with geospatial information have established similar centers.

In our Continent, the United States of America is in the process of developing the NSDI, with quite significant advances since 1994. Several developing countries are trying to follow the institutional approach of the US, mainly due to the willingness to keep an up to date scheme of free information regarding experiences and achievements in the matter by issuing bulletins, publications and other documents from the FGDC and other organizations like the USGS. Another important contribution is that from Canada through the Canadian Geospatial Data Infrastructure (CGDI).

Colombia is making significant efforts to develop the Colombian Infrastructure of Spatial Data (ICDE), Venezuela is beginning to work with its National Infrastructure of Geospatial Data (INDG); other countries as Cuba, Chile, El Salvador, Guyana, the Dominican Republic and Paraguay are also working on the subject, and in Mexico, particularly in the National Institute of Statistic, Geography and Informatics (INEGI), the necessary initial steps are under way to conceive and develop the Mexican Spatial data Infrastructure. (IDEMEX) with the primary aim to make all national geospatial information available for all users in all levels and sectors by using the modern communications technologies at hand.

Other countries in the area are looking for implementation forms through the acquisition of experiences, the collaboration, development of agreements and the establishment of conceptual organization schemes related to the subject.

There is a set of conditions which have to be considered in connection with the implementation of the IDEMEX, which are centered in the total recognition of its importance and necessity, as well as on the existence of a decided political will to come with the planning and implantation and to assume the commitments of the case, particularly the recognition on the necessity to also make a strong effort to come to terms of agreement between the different actors, as well as trying to pay careful attention to all involved technical aspects, and to those of legal, administrative and financial character, including the necessary prevision for continuous development and maintenance.

An important premise is the necessary participation of a coordinating body, which given the scope of the IDEMEX and its characteristics of national interest in the field of the geospatial information, is centered in the INEGI, to which by its character as the official national coordinating and normative institution in the field of geographic information, corresponds such function within the concept of the IDEMEX.

A second course of action consists of an in depth knowledge to what each institution is doing in matter of production and administration of geospatial information, reason why it will be necessary to apply and administer a questionnaire on existing information and its characteristics, as well as on those details which are of interest within the concept associated to a SDI. This questionnaire is conceived to be applied to a selected group of institutions (the actors), which by the nature of their functions and attributions are considered as suitable candidates to be part of the IDEMEX. This must be necessarily an initiative of the INEGI. In fact, the questionnaire is already formulated and ready to be applied once some aspects of administrative order are solved within a carefully formulated sequence of work.

Other aspects are associated to the development of informative documentation directed to the interested ones, the call for an initial approach with the selected actors, and to work hardly to achieve conviction and motivation. Next to it there will be the organization of discussion and agreement meetings, formation of work groups, subscription of agreements and commitments, tabling and solution of technical, legal and administrative problems, including the development and implantation of norms and standards, all of it oriented to integrate the basic components of the IDEMEX in terms of the set of policies, technologies, standards and resources as given by the definition pointed at the beginning of this paper.

The SDI concept is not totally new in Mexico if the National Geographic Information System (NGIS) of Mexico is considered, which according to our Statistical and Geographic Information Law is defined as the "Data set produced by the public institutions, organized under a predetermined conceptual structure that allows to show the situation and interdependence of economic, demographic and social phenomena, as well as its relation with the physical medium and the territorial space." In this sense, a strong bond between the NGIS and the IDEMEX exists, since in fact, this one can be considered as included in the scope of the former and is part of its integration and development. It is important to remark that since the Law was promulgated in 1980, the idea of SDI was embedded, though not implemented.

In the international scope, three organizations exist working on the implementation of regional spatial data infrastructures. Because of the interest one of them represents for the IDEMEX, a brief reference to these organizations will be made, remembering here that conceptually, regional infrastructures are assembled through national infrastructures:

- The Permanent Committee on GIS Infrastructures for the Region of Asia-Pacific (PCGIAP),
- The European organization for Geographic Information (EUROGI), and
- The Permanent Committee for Spatial data Infrastructures for the Americas (PC IDEA).

The PCGIAP is to date the best integrated one, under the Australian coordination, whereas the PC IDEA, for the American region, is of recent creation, in February 2000.

Regarding this committee, during the United Nations Sixth Regional Cartographic Conference for the Americas that took place in New York in June of 1997, resolutions number three and four were issued, by which it was recommended to the countries:

Number 3. To establish a Permanent Committee on Spatial data Infrastructure for the Americas, and

Number 4. To consider the establishment of national spatial data infrastructures and that all the states members participate in the committee defined in resolution number three.

In a meeting of delegates and experts of the United Nations resulting from the same Conference that took place in Aguascalientes, Mexico in March of 1998, the intention to create the Permanent Committee was renewed. The Committee was constituted through a provisional agreement signed by 21 countries of the area on 29 February, 2000, in Bogota, Colombia. In this meeting, the provisional chair was awarded to the Colombian representation through the Director of the Agustin Codazzi Geographic Institute, whereas for the vice-presidency Mexico was appointed through the representative of the INEGI. In later times, three more countries joined.

The Second Committee Meeting took place during the United Nations Seventh Regional Cartographic Conference for the Americas in New York at the end of January 2001. The Third Meeting (Cartagena, Colombia, 2001) was celebrated along with the Fifth Conference on Global Spatial data Infrastructure, where the Committee was formally established, final statutes were signed and working groups were created.

The Seventh UN Regional Conference recognized that SDIs are necessary as a foundation to support the development and management of geospatial information, reason why it was recommended to the governments of the region to create national conditions to guarantee that the infrastructure for the development of the geographic information is supported as a basic strategic policy. It was also recommended to all American countries to adhere to the SDI concept and develop implantation strategies to support regional and global initiatives, while at the same time taking care of national objectives.

Another recommendation was issued in the sense that member countries should share experiences and deal with common interests and necessities within the Americas and with other regions of the world through the PC IDEA. As information of interest derived from the Conference, Mexico will be the host of a special shop on the Integration of initiatives of SDI's and Cadastral Activities, which will take place at INEGI in Aguascalientes, most probably in 2003.

The creation of the PC IDEA is of importance in the national context as it sets conceptual guidelines for the implementation of the national infrastructure in a context of integration to regional infrastructures and the global SDI.

One of the declared objectives of the PC IDEA consists on promoting the creation of national infrastructures; thus, fulfillment of the regional objectives depends and is subject to the fulfillment of the national objectives.

Other objectives, while occurring regionally, are equally valid in the national context, and consist on developing legal and administrative guidelines for the collection and sharing of data, as well as to define the nature of the fundamental spatial data sets, those which are of primary importance for the different actors and users, including an indication of those that can be shared or could be subject to some sort of restriction.

For the regional infrastructure, norms and standards should be defined to allow for comparability, beginning with referencing systems; that is, looking forward for the uniformity and congruency between geographic reference systems. This is an example of a scheme going from regional to national.

Standardization associated to the IDEMEX is considered so much from the point of view of the national interest, as well as on the regional and global perspective. At the INEGI, necessary steps are under way to affiliate Mexico to the ISO/TC 211. The context is of importance inasmuch as the development of standards is very closely related to the several aspects having to do with the IDEMEX (metadata, terminology, transference formats, and many other.). On the other hand, it is of interest due to the possibility to participate and interact with the TC211 in order to make the Mexican position visible in the development of standards regarding geospatial information.

As a conclusion, in this paper an effort has been made to characterize and give content to the concept of a Spatial Data Infrastructure for Mexico, justifying its necessity as a technological and administrative imperative regarding the best use and rationalization of the national geospatial information. Initial steps occurring now in Mexico have been indicated through the participation of the INEGI in connection with the initiative to form and implement the Mexican SDI. The conceptual development, the ideas exposed with respect to implementation, the inclusion within the e-Mexico project, the search for agreements, the creation of interinstitutional relationships, agreements and commitments, signaling of key aspects, incorporation of geospatial information of INEGI in the Internet, the affiliation to the ISO, development of international relationships and ways of collaboration, as well as the national presence in the regional and global context, are giving form to the effort being developed in the country for which will be the Spatial data Infrastructure of Mexico in the next future.

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