The Spatial Data Infrastructure of México "IDEMex"

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Key words:

SUMMARY

Objectives: The paper deals with the way México, through the INEGI (National Institute for Statistics, Geography and Informatics), is developing, spreading and implementing the concept of National Spatial Data Infrastructure. It pretends to show the general frame and the main components that support the philosophy.

It includes the main definitions for IDEMex and describes the so called “Dimensions” of the Mexican NSDI with it´s components:

"Human factor" Dimension:
- Producers and Users Component
- Human Capital Component
- Willingness Component

"Management" Dimension:
- Legal Frame Component
- Organization Component
- Capacity Building Component

"Technique" Dimension
- Data Component
- Standards and Specifications Component
- Technology Component

Results: Also it is mentioned the main results and advances on data generation, national standards, organization agreements, and capacity building. Over this last issue, special mention is given to the definition and certification of the personnel capacities. In this respect, the new Law of the Career Professional Service of the Federal Public Administration is supporting the IDEMex, so inducing the personnel certification in the technical matters, and the steering personnel certification in the management capacities, thus approaching the IDEMex model to the best developed SDIs.

On the organizational aspect, driven by the Law of Statistics and Geography Information, the INEGI has convoked and led the establishment of the Technical Committees for the 19 strategic sectors of the country (Energy, Commerce, Education, Agriculture, Navy, Tourism, Health, Social Development, Transport, Environment, etc.), and for the 32 Regional Committees (one for each state), with the purpose of elaborating the correspondent Statistic and Geographic Information Development Programs, in agreement with the strategic lines

defined by the Advisory Technical Committee of Geographic Information. Within this scope, the creation, development and maintenance of data will be methodical and shared.

Conclusions: As conclusion the main challenges are highlighted, with special mention on the lacking of a national policy for geographic information, an the need of a very high level sponsorship for having better results over de IDEMex development.

Significance of the work: To give an example in the Latin American region that it is possible to create schemas for national cooperation with very good perspectives for having a reasonable plan for develop a NSDI with results on the short run for pushing the rational use of data, information and knowledge on behalf of the nation welfare.

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1. INTRODUCTION

The spatial data infrastructures (SDI) belong to a concept worldwide applied at different scales, from the Global Spatial Data Infrastructure (GSDI), to the regional, national (IDEMex: Infraestructura de Datos Espaciales de México), state or provintial, municipal, local (urban) and institutional (INEGI: Instituto Nacional de Estadística, Geografía e Informática) levels. The SDI concept is the answer to overwhelming facts that in certain regions or countries have positive manifestation and in other areas, negative ones. For example, in regions characterized by geographic information availability, together with the power of the Geographic Information Systems (GIS), the tools for the decision making support, databases, the world wide web (WWW) and the necessary interoperability, the manner in which societies with better resources face the serious matters of social importance, environmental and economic aspects, is really changeable. Nevertheless, even in the amazing computer and great network age, users confront strong difficulties both to find and use critical geographic information. This may lead to project desertion, or to unnecessary -and expensive- duplication of data and geographic information, already existent.

For these and other reasons, the need, at all scales, of spatial data access from different sources as a decision making guide is obvious. Therefore, our ability for making intelligent decisions collectively at local, national, regional and global levels depends on spatial data infrastructure conceptualization, development and results, which, among other purposes, must facilitate and achieve data and information access and use under the common concept of data and information comparability, shareability, compatibility, reliability, consistency and completeness.

Defining:

The IDEMex may be defined as the collection of resources, standards, technologies, policies, and the legal, administrative and organizational frames necessary for the effective development, compilation, management, access, distribution, sharing and use of spatial data.

The concept extends beyond the definition of a classical infrastructure based on physical components, data and standards.

The IDEMex is highly inclusive and supported by a sense for data and information sharing in all ambits and levels.

For an initial understanding of the IDEMex concept, we will make an approximation describing "dimensions and components".

Dimensions:

"Human factor" Dimension:
- Producers and Users Component
- Human Capital Component
- Will Component

"Management" Dimension:
- Legal Frame Component
- Organization Component
- Capacity Building Component

"Technique" Dimension
- Data Component
- Standards and Specifications Component
- Technology Component

2. BASIC DESCRIPTIONS

2.1 "Human Factor" Dimension

Producers and Users. The pair formed by direct producers and users of data and geographic information is what moves the machinery of a long process that must culminate with the benefit for more than 100 millions of Mexicans. The "Producers" is a group formed by organizations from the Federal Public Administration, the Powers and the State Services of Statistics and Geographic Information, as well as some others representing the private, academic and research sectors.

The "Users" is also, in good extent, the group of organizations of the Federal Public Administration, the Powers and the State Services of Statistics and Geographic Information, as well as the private, academic, research and educational sectors. Nevertheless, there is another group of "users", widely diversified and identified as the "public", attended at INEGI selling centers, for example.

We may use another term: "customer", in the sense of entities (organisms, groups with annotated responsabilities) that need to be attended with "specific solutions". In this category are, for example, Sectorial, Regional and Special Technical Committees on Statistics and Geographic Information, in charge of elaborating the development programs of Statistics and Geographic Information in the ambiences of their correspondent competences.

In the concept of the SDI, its components and the world trends, Mexico has organized, through the INEGI (the IDEMex leader), a National Meeting and a National Convention of Geography to convoke producers and users to interchange opinions and experiences and to know customer expectations and needs. Also, the INEGI has shown the strategy and tendencies followed for the IDEMex development. Outstanding in the meeting and

convention was the invitation to establish alliances for the sharing of data and information development, as well as to coordinate the national program of norms.

Human Capital. This component refers to people, both the ones responsible for establishing standards and generating data in the work flow and integrating data in the information collection, and the ones in charge of facilitating its access and interoperability. On the other hand, it includes those who play a role in the promotion and dissemination of data and information with the very producers, users and customers in all ambits and levels, particularly, within the Federal Public Administration, the Powers and the State Services of Statistics and Geographic Information.

The Technical Advisory Committees of Statistics and Geographic Information deserve special mention with respect to their responsibility of giving sense, directing and planning the development of sectorial, regional and spatial programs and to the Organization Component actions, below mentioned.

Willingness. Through the process of conceptualizing, developing and operating spatial data infrastructures, including the institutional or organizational data origin and the restrictions of data access and use, there is a general conclusion that only the willingness of the people involved in the SDI, the infrastructure data and information sharing for common welfare main purpose may be achieved; not despiting the reduction in money, time and human effort, of course.

2.2 "Management" Dimension

Legal Frame. The legal frame plays a critical role in the IDEMex, because it annotates the obligations, responsabilities and scope in the performance of all the components of the organization. It conforms basically to the National Plan of Development, The Law of Statistic and Geographic Information (LIEG) and its Regulation, and of the National Program of Development of Statistics and Geographical Information as one of the mandates of the LIEG. From this component a whole range of policies, criteria, guidelines and standards is derived for planning, coordinating and organizing activities, as well as for standardization and normalization of classifications and operative procedures used to collect, organize, process and divulge data and statistic and geographic information.

In the national context, and according to the LIEG, the INEGI has convoked and led the establishment of the Technical Committees for the 19 strategic sectors of the country (Energy, Commerce, Education, Agriculture, Navy, Tourism, Health, Social Development, Transport, Environment, etc.), and for the 32 Regional Committees (one for each state), with the purpose of elaborating the correspondent Statistic and Geographic Information Development Programs, in agreement with the strategic lines defined by the Advisory Technical Committee of Geographic Information. Within this scope, the creation, development and maintenance of data will be methodical and shared.

Organization. The Organization Component is assumed as a hierarchic structure with clearly defined functions, to agree in the highest levels the policies and scopes of the subordinated parts (Sectorial, Regional and Special Technical Committees on Statistic and Geographic Information), and to advice and decide the making of the plans and programs of these committees. This component also includes technical structures linked to the technical norms design and to the generation of fundamental and basic spatial data that sustain particular and detailed activities, such as those of the 19 "sectors" of the Federal Public Administration, and the development of state and municipality information, where spatial data resulting may be catalogued as added value data, as far as its fine detail nature is concerned.

Understanding that the IDEMex must have an adequate organizational support, the INEGI, as the leader of the IDEMex, has modified its internal structure in order to fit the development process of the national infrastructure. Now, the INEGI includes the Direction of the Spatial Data Infrastructure in charge of facilitating the IDEMex construction, specially the development of a Technical Norms National Program, Data Standardization and the formal documentation of processes, with an emphasis in the advancement of metadata documentation.

Capacity Building. The Capacity Building Component is a more advanced concept than training and education, but also includes these three. Within the SDI ambit, this component should have a wide vision so to influence on the data generation and integration technical areas, as well as on the formal organization, interoperability, and data and information use and exploitation areas, in order to have, from the beginning, a minimum knowledge.

An elementary part that should not be neglected is the Capacity Building in the organizational segment responsible for the definition of the Problem-proposal of Solution-decision making System. Herein, the capacities are directed to enhance the ability for analyzing possibilities in the operations of combined information groups for settings and forecasts generation with the multiple variables of physical and geostatistic data population, housing and economy environments.

This is the component that provides cohesion, sense, vitality and motion to the SDI concept; without it, all effort may turn out to be vain and frustrating. It goes side by side with the statistic and geographic culture development of the society as a whole, and the plan and program updating and modernization at every educational center, country-wide. Finally, it must give a collective answer to a national educational program at an immediate, mediate and long term.

Another aspect developed by INEGI refers to the definition and certification of the personnel capacities. In this respect, the new Law of the Career Professional Service of the Federal Public Administration is supporting the IDEMex, so inducing the personnel certification in the technical matters, and the steering personnel certification in the management capacities, thus approaching the IDEMex model to the best developed SDIs.

2.3 “Technique” Dimension

Data. Firstly, this component demands the definition of data: "Objects or entities abstracted from the real geographic space; they may correspond to the nature elements, to man made elements o to mere numerical abstractions derived from the process of quantities related to those objects or entities. Its essential characteristic is the spatial reference in two or three dimensions, so data must contain a temporal dimension. Synonyms for data: Geospatial Data, Spatial Data, Geographic Data, Geographic Object, Entity and Feature.

Then, data refers to minimum units with attributes that describe, characterize and locate the data in a three-dimensional space. For this, a model has to be elaborated and documented according to the rules for data generation. Also, a classification has to be made for the data administration, management, process and exploitation. A tripartite classification is the following:

Fundamental data: Data without which logical, consistent, accurate, rational and interchangeable information buildings cannot be built. Data has to be analyzable and has to accept overlapping of any kind of data groups, provided that this data fulfill with the corresponding standards and specifications applied to Fundamental Data. The corresponding Standards and Specifications are an obligation and responsibility of INEGI. The following are the groups proposed for this classification:

- Group of Geographic Names
- Group of Cadastral Data
- Group of Hydrographic Nets
- Group of Aerial Photography and Satellite Imagery
- Group of Relief Data. Elevation Models
- Group of Boundaries. Coastal, International, State and Municipal Boundaries.
- Group of Geodetic References.

The adjective "Fundamental" corresponds to the data nature; here is an exercise for a better understanding. If the Group of Geodetic References disappears or does not exist, no coordinate framework would be available for the georeferentiation of cadastre data, elevation models nor any other group of a higher level, following the ascending order of the seven groups above mentioned. Even more, if there is no group of international and coastal boundaries, no geometric definition would exist for the location of any kind of data, which when overlapped would share the same boundary: this is like having a unique and general data container for each and everything, for every data scale defined and agreed.

Basic data: This data complements the Fundamental Data for generating the ingredients that allow obtaining groups of complete information to be used as a general platform for any specific subject. As with Fundamental Data, the Standards and Specifications are an obligation and responsibility of INEGI. In order that Basic Data work, Fundamental Data should already be available. In practice, both Fundamental and Basic Data function as the "Data Infrastructure". The Basic Data are grouped as follows:

- Group of Geostatistic Data
- Group of Natural Resources
- Group of Communication Routes and Planimetric Features

Added Value Data: This data could be considered as a Specific and Complementary Data Structure. Additionally to Fundamental and Basic Data, Added Value Data is of a very specific interest and thematic detail for the diverse users and producers from any level, sector or ambiance. This data may come from the sectorial, regional, state, municipal ambit, etc., and may refer to any subject. The Standards and Specifications for this data are generator's obligation and responsibility. Obviously, for consistency and order, the basic and fundamental data and their normative frame have to be used, so that added value data or information to be generated will also become scalar, dimensional, accurate, geometric and attributively consistent, basically with the general foundation provided for Fundamental and Basic Data.

Certainly, it is possible to develop the IDEMex, in its "national" concept, due to the existence, advance and achievements of the Spatial Data Infrastructure of Mexico; although not distinguished by this denomination, the IDEMex complies with a national cartographic and institutional model. In this sense, the IDEMex has a data and digital product holding in cartographic format, in several themes and at different scales:

Topo Maps Scale	Paper maps	Vector data (digital map)	*Orthophoto*
1:50 000	*X*	*X*	*1:20 000*
1:250 000	*X*	*X*	
1: 1 000 000	*X*	*X*	

Topo Maps Scale	% coverage of total land area	% coverage of urban areas	% coverage of rural areas
1:50 000	*100*	*100*	*100*
1:250 000	*100*	*100*	*100*
1:1 000 000	*100*	*100*	*100*

Natural Resources Maps Scale	Land Use and Vegetation % coverage of total land area	Soils % coverage of total land area	Geology % coverage of total land area	Hydrology % coverage of total land area
1:50 000	*35*	*35*	*30*	*N/A*
1:250 000	*100*	*100*	*100*	*100*
1:1 000 000	*100*	*100*	*100*	*100*

Standards and Specifications. Within the Technique Dimension, the standards and specifications constitute the ruling frame, so data generation and information integration may have the common denominator of Comparability, Shareability, Compatibility, Reliability, Consistency and Completeness.

The importance of the standards and specifications can be appreciated in the experiences of other countries and several Mexican organizations, where problems due to the lack of the proper data design and of standards and specifications are shown, leading to these countries and organizations to a critical situation, because they possess great volumes of data produced without standards and specifications. This kind of problems obstructs the access to information and provokes very high costs for both the generating organizations and the users.

In the data generation area, besides the problem caused by great volumes of data and the scarce available volume, on the other side, the absence of geometric and positional consistency, the lack of update and the limited use of data and information for development planning are manifest. Today, the multiplication of isolated efforts in order to generate updated information or geographic data is a common practice; on the other hand, the linking of statistic information with vectorial data to referenciate spaces is an increasing necessity. Those who work in national organizations must be aware of the need to apply national normative frames for data generation, and to carry out the necessary efforts for the implementation. This is the beginning for centering the efforts of a nation to obtain the desired results of possessing opportune and interchangeable quality data.

The standards and specifications must be elaborated for each of the Fundamental and Basic Data groups, because they will be general, national and transjurisdictional.

The meanings of "standard" and "specification" are different as far as ambit is concerned, but complementary in the practice. Assuming a standard as mandatory, like a descriptive expression (of obligatory nature, necessary fulfillment), in its natural text form, it indicates in a general way "what" to do. The "specifications" constitute a complement of the standards, in order to numerically show the aspects characterizing the data in such parameters as scale, length and area minimal dimensions, positional accuracy, geometry and attributes subject to measurement and comparison, for example.

Another useful assumption for an integral concept of "standard" refers to the "graphic" elements that represent a huge topic for discussion, among producers and also among data and space information users. In other words, in the geographic domain, the standards have not only an expression and an implementation in the written form, but also in the graphic form. A classical example is the shape of the country (national outline, model, or more accurately, national information container); this consideration is easily transferred to the state and municipal context. For the case, the outcome is the same: if the outlines or "data containers" used by data producers and data users are different, the results are already known: there is no efficient way to interchange and assemble the data and everybody has to redo, at great cost, the data adjustment in the container surroundings.

In the context of SDIs, the INEGI is elaborating a National Program of Standards for generating data, integrating data as information and sharing data. The Program already includes the four Official Technical Standards already published: Geodetic Reference System, Positional Accuracy, Aerial Photography and Key Homologation of Federative Entities, Municipalities and Localities. These four standards establish the base for data and information standardization, as they constitute the standard for input generation for the production of fundamental and basic data.

In this Program schedule, the standards for data generation for each theme and scale, based on quality criteria, must be finished in the 2006.

Technology. This refers initially both to the technologies for the capture, extraction, process, organization, integration and representation of geographic and statistic data and information, and to the ones necessary for sharing, interchange, and interoperability due to the digital nature of the data, its extraordinary volumes, and the convenience offered by the information technologies. This component also includes the hardware complement, that is, the software, because in "Technology", these two are correlated and are developed in parallel, although not always at the same speed.

3. IDEMex CHALLENGES

The main challenges are the definition of a policy for the national geographic information, the obtention of the President of Mexico or a State Secretariat sponsorship, the achievement of agreements and alliances with every sector (state secretariats, state and municipal governments, academy and private sector), the advancement in the organizations technical training, and the obtaining of guaranteed funds in every level for the IDEMex to deliver complete, integrable and interchangeable results.

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