RELATIONSHIPS OF CARTOGRAPHY, GEOGRAPHIC INFORMATION SYSTEMS AND THE MEXICAN SPATIAL DATA INFRASTRUCTURE (IDEMEX)

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ABSTRACT

This paper outlines relationships among the development of cartography, GIS and the Mexican SDI (IDEMEX) at the National Institute of Statistics, Geography and Informatics (INEGI) of Mexico. An overview of geographic Information development is introduced, as produced in the period 1968 - 1988. The National Statistics and Geographic Information Law, defines the National Geographic Information System (NGIS), setting its principles and concepts. The first part of the nineties witnessed the change to the digital format, providing for the general advancement and use of cartography in the context of the NGIS. Following worldwide tendencies and according to national needs, INEGI has launched the initiative to develop the National Spatial Data Infrastructure, IDEMEX, including related tools and standards, intensive use of modern information and communication technologies, solution of issues related to access and distribution, and the integration of national geographic information according to the NGIS in the context of the IDEMEX.

INTRODUCTION

It is quite evident the there should be a close relationship between cartography, Geographic Information Systems and the new ideas surrounding the concepts of Spatial Data Infrastructures. However, the nature of this relationship and its implications, though recognized in several media, is not so much considered among those who have to deal with modern concepts regarding the optimal use of geospatial information.

Everybody is convinced that growing demands for geographic as well as statistical information lie in the core of decision taking for the economic and social development of countries all along the world, especially those living through a development process. The last days of the XXth. Century witnessed the start of a growing awareness on the importance of geospatial information and its close relationship to the increase of the Gross National Product in developed nations, how this increase is more and more related to decisions taken in the realm of geographic information and how the bringing to the best use existing cartography, implementation of new mapping schemes, Geographic Information Systems development which in many ways depend on the existence of good cartography, and the initiatives for the establishment of operational and technical administration resources as represented by the Spatial Data Infrastructures are on the order of the day.

These infrastructures are conceived for the best use of data and information, including the important contribution of Statistical Information in the economic, demographic and social fields. It is only through this merging of Statistics and Geographic Information that information acquires a real meaning as useful information for decision takers through the process of data generation, its conversion to structured information, development of informed knowledge and the exercise of responsible decisions taking.

In this paper the intention is to bring together the above ideas and conceptually establish the relationships between geographic information as represented by cartographic products, the geographic information systems as emergent instances of a higher level and the technical and administrative tools which can by applied to both cartography and GIS in terms of the Spatial Data Infrastructure of Mexico, IDEMEX.

For this purpose a brief historic account of geographic information development in Mexico is given and then considerations are included as related to the circumstances which gave birth to new and modern geographic knowledge development schema connected with the obliged conformance to technological development, the globalization environment characteristic of these days, and the demands imposed by the Economic Sustainable Development to which several nations are committed. The paper continues with a description of the Cartographic and Geographic information development at the General Directorate of Geography (DGG) of the National Institute of Statistics, Geography and Informatics (INEGI).

A reference is made of the legal frame as represented by the Statistical and Geographic Information Law (Abbreviated LIEG in Spanish) and its relationship with the National Geographic Information System (Abbreviated NGIS in
Spanish), which became the first useful legal tool for further geographic information development. Some issues as contained in the Law are discussed, to arrive later to the modernization of the geographic activity at INEGI with digital technology, and then going on into the initiative to build the Spatial Data Infrastructure of Mexico, describing its main components and establishing the relationships with both cartography and the NGIS.

SETTING THE STAGE; A BRIEF HISTORIC ACCOUNT

The history of geographic information development in Mexico can be traced up to the prehispanic times with the description of places, placenames and travelers and traders voyages which by some means were depicted in ancient codices, many of them lost after the Spanish conquest in the XVth Century. In the Colonial times which lasted up to the XIXth Century, Cartography was devoted to the general knowledge of the territory through the works of some devoted scholars and institutions like the Corps of Engineers of the Colonial New Spain for the geographic location of the principal economic activities as represented by silver mining, for some land transportation development trying to connect the production and consumers centers and for the intent of territorial organization as related to the church administration, including some delimitations of provincial governments. All of this can be considered as cartography for the general knowledge, with very limited formal applications.

During the 8 decades of independent life in the XIXth Century, Mexico experienced a very agitated life trying to consolidate as a new young Nation, where political turmoil, short lived governments, and two international wars characterized life in the country. There was not so much chance to go into developing the geographic knowledge through cartography, though there were many important efforts from scholars as Antonio García Cubas and the works of Baron Alexander Von Humboldt, including the establishment of some geographic institutions. In any instance the cartography remained as a source of general knowledge and not so much for planning or decision taking.

In 1822, following the War of Independence a concern from the young government developed to organize the territory in political and economic terms, so a Commission was established to elaborate the first General Map of Mexico with no so much success. In 1833 the National Institute of Statistics and Geography was created, becoming in 1839 the Mexican Society of Geography and Statistics, an institution still living, which compiled a Geographic Chart of Mexico. In 1856 a Geographic and Historical Atlas of Mexico was elaborated, followed in 1873 by a “Carte du Mexique”, a product of the French intervention in Mexico.

In 1877 The Geographic Exploration Commission was created with the responsibility to develop a new General Map of Mexico. Positioning methods resorted to geodetic triangulation and around 800 stations measured by astro observations. 1899 saw the establishment of the Geodetic Mexican Commission which did not last too much.

In 1913 an Agreement to unify geodetic systems in North America was signed by the revolutionary Mexican Government with the U.S.A and Canada, by which Mexico adopted the reference system which in a few years became the 1927 North American Datum, as well as the Clarke 1866 Ellipsoid as the geometric reference surface. This NAD27 and Ellipsoid were in use in Mexico for almost the rest of the Century.

After these dates and up to 1968 several cartographic organizations were created like the Directorate of Geographic and Climatologic Studies, the Military Geographic Commission, the Intersecretarial Coordination for the Production of the Geographic Chart of the Republic, and so on, many of them short lived. In the first days of October 1968 the Commission of Studies for the National Territory (CETENAL) was created, with the responsibility to develop the inventory of natural resources and infrastructure of the country through the production of the Topographic Map Series at the scale of 1:50,000 as well as the corresponding natural resources mapping in the themes of Geology, Soils, Actual Land Use, and Land Use Capability at the same scale. This Commission was the forerunner of the actual DGG at INEGI and the official main organization dealing with the generation of geographic information at the national level, including coordination of other agencies and standardization development, according to the Law. There are several other federal agencies dealing with geographic information development for specific purposes according to the nature of their functions and needs, as well as many other in the state and municipal governments. The picture includes both the academy and the private sector. For all of these instances, DGG is the prime basic geographic information provider.

GEOGRAPHIC INFORMATION DEVELOPMENT IN MEXICO

A brief analysis on the actual geospatial information status in Mexico shows that through time activities on the matter have been characterized by the production of a huge volume of analogical cartographic data in several government organizations. Through a modernization of activities beginning in the early 90’s at INEGI the change to the digital approach has consistently been growing both in extent and coverage, where a high share of the activities have been
devoted to convert former analogical cartographic data and mapping to the digital format, including a general tendency to develop, populate and operate geographic databases.

Considering the national extent, in the majority of cases geographic data integration in appropriate schema of use does not exist, that is, there is not a formal geospatial information body aimed to foster responsible knowledge corresponding to the data-information-knowledge schema, nor a well developed integration with statistical information which every day is growing in importance. What is directly appreciated is a general deficiency of geospatial information administration systems, in most cases existing data and information is not known to important decision takers, the data is not shared, has difficulties for access, is of unknown or questionable quality, it is not standardized and is very much disperse among the several organizations.

This is the national context. At INEGI we are conscious of this fact. Though the Organization is responsible by Law for the production of a high share of fundamental and basic digital data and mapping for the whole country, which is very much used in several other organizations, the scope should cover all organizations, both in the federal, state and local governments, including the academia and private sectors for the generation of basic and added value data and information. This, in many aspects shows why INEGI has taken the initiative to develop the National Spatial Data Infrastructure, IDEMEX.

During the 36 years of life of the DGG at INEGI several achievements can be accounted for dealing with important developments in the field of cartographic generation both for topographic mapping as well as for Natural Resources charting. Major developments lie in the actual total coverage (almost 2,000,000 km$^2$) of topographic mapping in the scales of 1:50K, 1:250K and 1:1KK, all of them available both in the analog and digital format, including natural resources charting in the fields of Geology, Surface and Underground Hydrology, Actual Land Use and vegetation, Soils, Physiography plus others connected with Meteorological variables, most of these in the scales of 250K and 1:1KK. Besides this, the organization has complete coverage of the country and is continuously updating aerial photography and satellite imagery acquisition, working hardly in the development of geodetic data for the horizontal, vertical and gravity nets to support all geographic information development of INEGI and other agencies, including the new topographic project in the 1:20K scale.

GIS DEVELOPMENT AT INEGI

Geographic information systems at INEGI must be considered in two different contexts; one is the widespread context regarding GIS as tools for the analysis and treatment of data and information as conceived in the operating and commercial environment, and the other as a concept developed at INEGI through its modernization of geographic activities with digital technology as connected with the GIS concept contained in the Statistical and Geographical Information Law. This is what we call the institutional approach, close linked with the operating one.

The Operational GIS Approach

A common accepted definition is that any GIS is a computerized based system used to capture, store, manage, edit, display and present geographically referenced data. According to Burrough, (1986) they are also defined as a set of powerful tools for the collection, storage, retrieval at will, transform and display of real world spatial data for a particular set of purposes. Also, following Aronoff (1989) they are any set of manual or computerized procedures used to store and manipulate geographically referenced data. A variation says the GIS is a system of computer hardware, software and procedures designed to support the capture, management, manipulation, analysis, modularity and display of spatially referenced data for solving complex planning and management problems.

These statements leave us apparently without a universally accepted definition of what GIS’s are, but we believe that the functionality and characteristics are well understood and that while practical and significative results can be obtained we can adopt, for example, the last of these definitions.

GIS are conceived to perform analysis operations on geographic data, differing from other systems by containing the definition of space relationships of data in the system, which goes beyond simple geometric descriptions and data location. In addition to these characteristics a GIS contains data on attributes and explicit topology so giving additional information about the data.

GIS not only offers a higher potentiality for the treatment and data analysis as compared with other systems as developed earlier, generally oriented to map and imagery reproduction, but they also impose higher demands on the availability and accuracy of the data, which is not always recognized. An important issue around GIS is given in connection with the way they can offer a realistic and accessible view of the real world, an item which goes far beyond
the simple drawing of maps. The implications involved in its development as connected with geographic information are far reaching as they offer a technology which can dynamically modelate the geographic world in much better ways.

The Modes of Operational GIS. GIS are developing at high rate, even for those who have been in the field for some time. GIS can have some different meanings according to their different purposes which can be synthesized through three interrelated and distinctive modes, that is a) the map, b) the database and c) the space analysis mode.

Regarding the map capacity, GIS’s can be seen as cartographic production systems or at least as geographic information display systems. In the cartographic process each data set is represented as a map or as a map layer, usually in a raster format managed through some function which can add, subtract or search for patterns, with an output which is another map. This approach is favoured by cartographic production organizations which put the emphasis in the capability of GIS to generate high quality maps, usually in vector format. Actually, cartography rests on the exploitation of a cartographic database where the GIS output functions are oriented to edit and prepare for automated reproduction.

In the database approach, the importance lies on the availability of a well implemented database with its respective management system. This mode is predominant within the community of GIS having a computer background where there are applications oriented to register transactions and require the frequent attention to queries from the users.

The third mode puts all the weight on space analysis, where GIS’s are seen more as a spatial information science than as a technology where it becomes clear that this is a very important development area. This point of view is probably the most accepted within the GIS community and can be used to establish a difference with other GIS’s. In this sense, the main difference with any cartographic system lies precisely in the analytical capacities along with the necessity that data should be totally structured. In fact, GIS have an origin in several media as a result of geographic information requirements associated to the planning of social and economic development. It was learned that cartography as seen as an information tool for such purposes was insufficient and limited from the point of view of the demands for information, which sets the need to develop and use more dynamical analysis means as required for planning, and resort to new tools for the management of geographic information, so answers could be attained in shorter times.

The Institutional Approach of GIS

GIS and SDI concepts are 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 which allows showing the situation and interdependence of economic, demographic and social phenomena, as well as its relationship with the physical medium and the territorial space." First of all, this definition calls for structured data where cartography is under the concept of a NGIS as comprising the then only way to present geographic information.

The seed of a GIS is embedded in the definition in terms of the annotated purposes regarding the establishment of means to show relationships between statistical and geographic information, and linking economic, demographic and social phenomena in a spatial context. On the other hand, a link is established between the SDI and Geographic information when data sets are connected to producers in the whole public administration. However, this leaves out, for the moment, important bodies and contributors in the academic, private and other sectors.

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 already embedded, though not implemented due to several reasons, one of them that the SDI concepts have not been born yet. Prior to the nineties geographic information was becoming digital in several media according to technological change and the strong influence of computer technology, so at INEGI became clear the necessity to go digital, having on the other side the mandate from the Law to integrate and develop the NGIS.

The above purpose materialized when beginning 1992 a strong effort was implemented to establish the NGIS according to the Law by developing a operative NGIS composed of several modules and taking care of the three modes of GIS as explained before. Cartographic, Database and Spatial Analysis, so the System comprised the Conversion, Production, Updating, Visual Deployment and Automated Reproduction components in the field of Cartography, while modules for Database development and Spatial Analysis were also included. This arrangement, with minor changes is still working.

RELATIONSHIP BETWEEN GIS AND CARTOGRAPHY
An important issue, dealing with the subject of this paper from the conceptual point of view is the relationship between GIS and cartography, which calls for the necessity of having a clear idea regarding both subjects.

During a good stretch of time Cartography was conceptually defined as the science, art and technology of making maps and its study as both scientific documents and works of art according to a former International Cartographic Association definition, or as the discipline dealing with the conception, production, dissemination and study of maps, following the definition adopted by the 17th General Assembly of this same body in Barcelona, Spain, 1995.

From a definition standpoint it seems somewhat difficult to establish a relationship between geographic Information Systems and Cartography, except when systems include the geographically referenced spatial data concept. This is a commonplace in most GIS definitions. However, the link concept with cartography is not at all absolute from this perspective as any piece of data can at these times be geographically located and be entered in a database without necessarily coming from a map, though analog maps are a good source and the most common geographically referenced data for GIS. We have learned this at INEGI through the massive conversion effort of almost 12 years for the topographic mapping at the scale of 1:50K. This also shows that GIS are not totally dependent on cartographic data; they can also be developed through direct surveys.

From a formal point of view, both cartography and GIS have to deal with geographic information and are communication instruments for ultimate decision taking. Both instruments, however with different capacities, allow for the treatment and analysis of geographic information.

Regarding the dependence relationships there is much to be discussed; GIS’s are capable of generating outputs with all cartographic formalities, including media different from the traditional; on its part cartography is generally the most important input for GIS. The fact is that any relationship of dependence should be defined in the context of institutional objectives and purposes or in connection with specific application plans or projects, as the relationship can be very much point directed and not necessarily be adjusted to any preestablished schema.

GIS have arrived on the cartographic scene with a tremendous impact causing interest and concern among cartographers in an environment which will not be the same from then on. For those who have spent some time in the field it is of some concern the future of cartography, with the development of automated systems and the advent of GIS. If the reference is towards technological issues one could be talking of a practical activity associated to an applied science in a context of a systemic treatment according to a set of principles and rules directed to a determined subject. We point this in the sense that cartography is a discipline, while GIS is labeled as a technology.

There were some times when cartographers were highly appreciated scholars and frequently spent a whole life building one or a few maps. Facing the up to day growing demands for geographic usable information, cartographers after having developed expertise and knowledge now have to see themselves seated facing a computer monitor and feeling confused and distrustful without not so much self confidence on what they are doing. This feeling is hard to eliminate if the ideas are not clear. There is a high risk of loosing valid traditional cartographic concepts, and that cartographers will become just standby spectators and which is worst, becoming just key pushers in a computer environment where one has to follow not well understood instructions from a computer software. We feel this is a negative relationship between cartography and GIS.

To solve the above the solution has to resort to the development of a new cartographic awareness or “cartographic feeling” in an environment of new technological developments where GIS should be included as one of the main subjects by using all available means, especially capacity building on theoretical aspects, concepts and ideas and not just for operative training regarding computer hardware and software. Institutional strengthening and Capacity Building are important issues regarding the development of the IDEMEX as in other well conceived SDI initiatives.

The above refers mostly to the relationship between traditional cartography and GIS. This relationship is much clearer when the context is in the field of computer assisted cartography. It is necessary to keep in mind that what is conceived in the general level in terms of cartography has been the cartographic production systems which have to deal with presentation and visualization aspects, while in the geographic and spatial data environment what matters is the parameterization of the space and spatial relationships.

Using analog based methods, cartographers have collected and stored data and made from that all map products. Using digital technology cartographers still collect and store spatial data and make maps, but it happens that an entirely new class of “cartographers” can now make their own spatial communication products using cartographic databases and available cheap digital technology. GIS is the suit of tools that allows for this. It is also argued that cartography is
“democratizing” and that now any layman with a little training can make maps to suit his or her special needs. This is also true for GIS; anyone with some applications software at hand can now develop a GIS, where this is proving to be an empowering set of tools that allows everyone to communicate spatial relationships more easily than ever before by using modern Technology Information and Communications means, i.e., the Web.

Probably, the relationship between cartography and GIS can be best visualized from a practical point of view. One of the approaches of GIS is the cartographic one, but this is mostly given in the context of applications and not necessarily as an objective reality. Computer cartography has a specific production objective, but lacks the analytical capacities of a GIS. On its part, GIS can include in its structure cartographic capacities, which being important have not the same weight as the analytical. However, GIS depends basically on cartography for the capture of data, which in many case has to be converted to a digital format, be structured and put in a database, processed as required and finally given some sort of output, which normally is a cartographic presentation or a visual display.

ABOUT THE IDEMEX

Mexico is under a technological and organizational imperative to develop the national SDI in answer to demands as imposed by globalization, sustainable development and explosive technology increase. There is a marked awareness in the high decision centres of Mexico about the importance of geospatial information, which on the other hand sets increasing demands for useful information for everybody through defined schema of responsible management of this kind of information

Since 1997 INEGI has been developing the idea around the SDI. The Statistical and Geographic Information Law of 1980 which calls for the integration and development of the National Geographic Information System as said before, contains conceptually the first seed of the SDI.

In a general context, three stages as related to geographic information development in Mexico can be identified; one is the historical frame, then the influence of several kinds of phenomena and thirdly the compliance with the advance of technology.

The first stage in the XIXth century witnessed the first formal productive efforts of geographic information through cartography at small scales. However, the initiatives were mostly isolated through a set of a few scholars. The production at those times was not so much disseminated, though it constituted the first efforts devoted to the knowledge of the country although it did not influence much decision centres, nor increased much the geographic culture.

Taking a leap to the XXth century, the second half of this period witnessed the first real and systematic efforts to develop geographic information of the country.

The actual DGG of INEGI was created with a strong official support which recognized the importance of geographic information for planning purposes; the objective was then to complete the inventory of natural resources and infrastructure of the country. This first stage characterized by the overall productive effort of basic topographic and natural resources mapping. Through time the production diversified to cover for themes of interest and other scales besides the first in 1:50k. At the same time, other official, academic and private organizations joined, increasing the national productive effort.

Going to the second stage the last decades of the Century saw the modernization of the geographic activities with digital technology and changing to a new environment, adapting to the new technologies; so, the second stage is characterized by changing to the new technologies.

In the third stage a pressing need arose to coordinate and normalize the information. A good deal of thought was devoted to analyse the necessity to adopt rational and efficiency criteria for the integration and management of geospatial information in terms of a definition of availability, knowledge of its characteristics, considerations on access and distribution and the intensive use of information and communication technologies. In this context the idea about the IDEMEX began to develop as an instance answering to known definitions of SDI, so the third stage is beginning to characterize by the rise of the IDEMEX both in the institutional as well as in the national level.

For our purposes, the IDEMEX is the set of policies, technologies, standards and human resources used to collect, organize, integrate, manage, display, disseminate and use of geospatial data and information in the national Mexican context.
In terms of the functional scope of the IDEMEX, it is conceived to support the integration and development of the National Geographic Information System (NGIS), as well as a useful tool for the management of the information contained in it, facilitating its operation, and having in mind the end to provide for the best geographic information service. We sometimes say the IDEMEX is designed to be the right arm of the NGIS.

As in several other initiatives of SDI, the basic technical components of the IDEMEX are those next listed:

- Catalogues and fundamental data, Metadata and Clearinghouses
- Access, distribution and Interoperability
- Norms and standards development
- Construction of alliances, institutional strengthening and Capacity building

There is a general support for the IDEMEX from all sectors which recognize there is a need for coordination and cooperation under a coordinating body, which in this context is INEGI, according to Law. There is a growing awareness about the application of agreed standards, as well as to the need to avoid duplicities and adopt rationalization production schema, making the geospatial information available for all interested parties. The information, which has to be managed through the best ways, has to be also looked at with a vision of future. There are some official basic concepts regarding the geospatial information in connection with the IDEMEX.

First is the need to upgrade the NGIS according to present needs, so providing a further step to democratize the geospatial information for the benefit of society; both the statistical and geographic information systems must satisfy the information requirements of all sectors within a participating context. In terms of national requirements there is a need to promote communication and interchange of ideas and experiences, as well as to fortify links among institutions through agreements for the permanent updating of the NGIS and the establishment of common agreed standards. There is also a need to come to terms with other national organizations to avoid duplicities, looking for complementarities and rationalization of the production. The above concept has to be oriented also to reinforce the building of the IDEMEX.

As a strategy to promote awareness and commitment about the IDEMEX, in 2003 INEGI organized a National Geography Convention which was attended by representatives of all sectors, especially the official one. The objective was to position geographic information as a strategic resource for the building of the Mexico of future, innovating and transparent, with the purpose to attain consensus and a committed interinstitutional participation and cooperation. In this context, the main subject of the convention was the IDEMEX.

Some of the results of the convention were the development of a general consensus to implement the IDEMEX as well as to convene for a first interinstitutional workshop. Another outcome was the installation of the so-called Technical Consultative Committee on Geographic Information, about which we shall talk a little later. Some months later the first interinstitutional workshop on the IDEMEX took place, which covered three main subjects: Norms and standards, Geographic frame, Fundamental data, and Data access and distribution

There are some interesting aspects regarding the organization of the IDEMEX to put it in the proper frame, through a set of relationships with some instances; that is with the Statistical and Geographic Information Law and the NGIS, with the consultative and participation instances established by the law for the integration and development of the NGIS, including the National Geographic Development Program, and with the National Development Plan 2001-2006

About the technical committees, the most important one is the Technical Consultative on Geographic Information Committee, integrated by high level officials from the Federal and State governments. The main function is to issue opinion and define priorities for the National Geographic Development Program (PRONADIG) and on geospatial norms and standards. Given the high level of this Committee, the strategy has been to put the IDEMEX under its umbrella.

There are other committees specified by the law, which are of an executive character, characterized by the place they hold in the government administration. All of these committees are responsible for the definition and execution of their own geographic development programs. The IDEMEX is also covering these committees

The PRONADIG is an instrument calling for the ordering and regulation of productive activities. The Program establishes priorities as set by the corresponding Consultative Technical Committee, including the definition of hierarchies for the objectives and the corresponding goals. This program, elaborated by INEGI, has specific considerations connected with the IDEMEX. On the other hand, there is a relationship with the National Development Plan 2001-2006, the main planning document of Mexico. The IDEMEX adheres to the principles of the plan for which there are considerations regarding geographic information, environmental issues and sustainable development.
One of the resolutions from both the Convention and the Workshop was to disseminate the idea of the IDEMEX by using mainly the website of INEGI; we are implementing this, where forums are open for feedback, interaction between interested parties, consultation, discussion and analysis of key issues, with the general idea to upgrade awareness and interest about the IDEMEX. In June of this year INEGI organized the 2nd National Geographic Convention 2005, where once again, the IDEMEX were the main subject.

INEGI, as an institution has been contributing to the IDEMEX, through a sustained geospatial information production, development of conceptual issues related to data, continuous metadata generation, establishment of an operating clearinghouse and gateway node, and giving attention to standards compilation and generation. Besides the previous remarks, INEGI has contributed so far with the conceptualization of the National Geographic Database and providing for the administration of some courses. This also includes the formalization of alliances with national, regional and global organizations.

There is a growing awareness on the importance that in actual times has geospatial information as a fundamental tool to aid in promoting national development. Several fields are not yet covered, due to the necessity to integrate and organize the various actors involved to come to agreements. But the door is open and we are committed to keep on the road to promote awareness and knowledge about the project and make it a success in due time.

THE RELATIONSHIPS BETWEEN THE IDEMEX, NGIS AND CARTOGRAPHY

There are four important factors in GIS; that is, hardware, software, dataware and liveware. Enough is already known about HW and SW, so we will not deal with those here. Regarding data, it is of a growing concern that the output from the system is only as valid as the data input. Put in garbage and you will get garbage as well. On the other hand, while HW and SW are becoming more powerful and cheaper, it is recognized that the most expensive part of any GIS is the collection and processing of data and this is not universally recognized. This fact brings to attention the vital importance of creating or gaining access to reliable and accurate collected and maintained spatial data, which on its part establishes a relationship of GIS and cartography with SDI.

Another relationship with SDI is that prior to the availability of comprehensive GIS, sample data from cartography were important for two reasons. First, they were the only data available. Secondly and not often recognized, they approached the maximum amount of information a user could process manually. With the aid of computer based GIS, decision makers are asking for much more detailed data to input into an analysis (but this approach is somewhat questionable since the tendency now is to use significant data, the most important and used one, which calls for the concept of Core or Fundamental Data as conceived in SDI’s). This not only requires the ability to collect, store and analyze this larger data set; it also requires that we put tags or index the data so that the system can retrieve it efficiently and with confidence, which calls for metadata development.

Another requirement is that data as collected for a GIS should be multipurpose in nature since the costs involved in collection, indexing and storage require that the data be collected once correctly and made available to a wide array of actual and potential users. This is also connected with SDI.

Also, in a SDI environment as related to GIS requires that standards be set and met by the data providing community. Metadata, that is data about the data contained in a digital file are required. These metadata should be standardized, where data quality and data lineage information should be two of the important components.

Regarding liveware, to operate a GIS people or operators are needed. This is not a cheap component and so GIS education is necessary as something lacking today. Operators need to be computer literate and understand the functions available in a GIS. They also need to know what cartographers have traditionally been taught about analysis and display of spatial data. Few people today are adequately trained in all of these areas, nor there are much of quality training programs available. This calls for what is known as capacity building in a SDI environment.

Capacity building as well calls for the fact that technicians can perform some of the tasks required to operate a GIS with only a little training, but the person who is over the operation and whose responsibility is to take decisions, must be professionally trained. Such well trained professionals are scarce and most are learning the hard way on the job.

More attention is being paid now 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 geographic information through the IDEMEX, which so rises as an invaluable tool for the efficiency and rationalization of the information. The IDEMEX represents 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, define, and standardize it,
- To share, facilitate transference, access and use
- To establish an effective understanding between producers and users,
- To rationalize the production, and handle it with the greatest possible efficiency.

The IDEMEX comprises 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 INEGI.

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. Institutional SDI’s should be in the first place oriented to higher SDI’s, so we have the SDI for INEGI in the first place.

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 strong 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.

CONCLUSION

The several remarks as contained in this paper have been devoted to explain the way we at INEGI think of the relationships existing between Cartography, our NGIS and the IDEMEX, beginning with an account of cartography developed through time as a communication tool for planning of the social and economical development of the country, then through the emergency of the GIS technology which came to upgrade cartography and materialized in the NGIS by setting new stages and paradigms as conceptually defined by the Law, which are under actual implementation, and in the third place through the necessity for the implantation of new and good administration and best management means for the geospatial information by giving way to the IDEMEX. This is by no means a new scenery in which we have to act and perform for the best of the country in the context of the Sustainable Economic Development.

REFERENCES


BRIEF BIOGRAPHY OF THE AUTHOR

Francisco A. Hansen Albites was born in Mexico City, in 1932. He spent 26 years living in Nicaragua, where he graduated as a Civil Engineer from the National University of Nicaragua, holding several posts in the former National Geographic Institute (IGN), doing mainly geodetic field work and leading the cartography division as well as activities in geophysics. He was heavily involved in the National Cadastre and Natural Resources Inventory Project and held during 10 years the position of Deputy General Director of IGN. He spent some time (1962-1963) at the Ohio State University where he specialized in Geodesy, Cartography and Photogrammetry. He was also a professor of Geodesy and Topographic Surveying at the National University, besides teaching other engineering subjects. In 1973 he moved to Mexico where he joined the National Commission of Studies for the National Territory (CETENAL), now the General Direction of Geography (DGG) of the National Institute of Statistics, Geography and Informatics (INEGI), where he has gone through several responsibilities ranging from Statistical Quality Cartographic Control to coordinating the development of National Standards for Geodesy, integrating and providing geographic information services through a first effort to develop metadata and doing internal and external teaching work in cartography and other subjects. He was also involved in the modernization of geographic activities going from analog to digital, and lately in the field of remote sensing and GIS applications at DGG. He was in 2002 given the responsibility of coordinating the integration and development of the National Spatial Data Infrastructure of Mexico (IDEMEX) and since May 2004 he was appointed as Director of Geodesy and Imagery. He is the author of several papers dealing with geographic information and related subjects. During the 4th meeting of the Permanent Committee of Spatial Data Infrastructures for the Americas (PC IDEA) in Costa Rica, June of 2003, he was elected as Executive Secretary of this Regional Organization.