A SPATIAL DATA INFRASTRUCTURE (SDI) FOR THE PETROLEUM INDUSTRY

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ABSTRACT

Introduction

A Spatial Data Infrastructure (SDI) is the set of technologies, policies and organizational agreements designed to facilitate availability of and access to geo-information (GI).

A SDI provides a new paradigm and a new world trend towards working in the field of GI.

GI involves the georeferenced spatial data required as part of scientific, technical, administrative or legal operations. Eighty percent (80 %) of the world's existing corporate data is considered to involve this geographic component.

Oil companies' GI encompasses all data on which such companies rely to generate their exploration, production, transport, safety, and environmental protection projects, among others.

Objetives

The objectives of SDI are to facilitate access and integration of geo-information, promote the metadata standard as a method to document the GI and encourage cooperation among agents.

Methodology

The development of a SDI for the petroleum industry requires serious commitment from those responsible for the GI, the contribution and work of an interdisciplinary team and finally the full participation and contribution of all users of GI.

Results

Implementation of a SDI in the oil industry will provide the GI unified, standardized, reliable, updated and easily accessible through Internet servers.

Conclusions

In the immediate future all the GI will be managed by the net through SDI, as part of ISO-TC 211 and OGC. SDI is already underway. If the oil industry as a whole is not up to now that train is going to be very difficult to catch up.

Introduction

For less than five years the stage of collection and generation of GI is undergoing important changes. The remarkable advances in information technology and telecommunications enabled a substantial improvement in computational power, storage and deployment of information and are allowing the information transits smoothly between users.

In the last 15 years spent in Argentina of a few producers of spatial data, usually institutions such as IGM, SHN and FAA, and some government agencies and specialist firms, a large number of local collectors, including the central administration, municipal, private investigators, companies geosciences, and almost all oil companies in the Argentine market.

Also increased the potential users, by improving the use of software for spatial data and the existence of spatial reference data.

But technological advances were not accompanied by improvements in distribution channels and user access to the data being generated. In this sense a scene into two key players: the potential users and the bottleneck for the development of the GIS sector. Conflicts that arise are different: the data are often scattered across networks and are difficult to find, not easy to contact the producers of data, in many cases the data generated is not well documented or some unknown details of their data, and may be incomplete or outdated. It is also common to find problems such as the attitude of distrust or secrecy to publicize or share data, little experience or little willingness to act as a team, and administrative or inflated prices for the acquisition of data. One can see that there is high demand for GI by the oil companies is an important and unmet production sufficiently exploited. This paper proposes a solution to this problem which is rapidly making its way into the world of geosciences.

Developments in the Management of georeferenced information

The first phase of this development was the migration from analogical format (paper) or ASCII (text files) to the digital vector format, implemented in YPF from 1989. This phase was characterized by a lack of organization, proper management of quality and standardization of criteria and software. The result were georeferenced data lawless, unreliable and in different formats virtually incompatible.

The second phase began in 1992 with the acquisition of a GIS (Geographic Information System) which allowed to homogenize all formats to the standard GIS format, and continue loading more orderly. However, it continued to target stubborn to move to digital format everything that was in sight. Attitude that, while substantially accelerated migration is detrimental to the quality and hierarchy of the data.

The third phase began around 2002 with the inclusion in GIS of a new model and concept in the management of the increasing volume of georeferenced data: the Geodatabase.

A Geodatabase also allows the physical storage of geographic information, set conditions, trends, patterns, models, behaviors, validation rules, and a wide range of functionality for centralized management of interrelated data. However did not resolve the major problems that still afflict the producers and users of data: the multiplicity of simultaneous efforts are taken, lack of standardization, quality, accessibility and integral exploitation.

Thus we reach fourth phase, currently under development in the oil field, which is the implementation of what is considered the new paradigm in the field of geoinformation management: Spatial Data Infrastructures.

Spatial Data Infrastructure: The New Paradigm

The classical definition of a Spatial Data Infrastructure is essentially technological, as presented as a decentralized network of servers, which includes geographical and attribute data, metadata, search methods, visualization and evaluation of data (catalogs and mapping network) and a mechanism for providing access to spatial data. But from an organizational point of view, can be defined as the set of technologies, policies and institutional arrangements to facilitate the availability and access to georeferenced information. In this sense it is understood that the term infrastructure is what we want to emphasize the existence of an environment that ensures reliable and sustained operation of the system. SDI can be implemented on a single firm, a research center, in an official body to manage their own spatial information, and can also be implemented as a public or private service, and linking other SDIs.

SDI provides a new paradigm and a new global guidance for working in the field of GI (geographic or georeferenced information). GI involves the georeferenced spatial data required as part of scientific, technical, administrative or legal operations. Eighty percent (80 %) of the world's existing corporate data is considered to involve this geographic component. The GI of the oil companies brings together all the data that feed these companies to generate their exploratory, production, transportation, security, preservation of environment projects.

Some of the subjects of IG are satellite images, wells, exploration permits, exploitation concessions, seismic lines, 3D seismic cubes, rivers, geology, roads, biodiversity environment, protected areas, administrative boundaries, pipelines, etc.

Until today, GI is a strategic resource of expensive production cost and difficult access. Some of the themes of GI are incomplete. Others are redundant. Others differ. The application of SDI technology contribute greatly to solving the current problems in the quality management, data management, accessibility and use of the GI. The implementation of a SDI in the oil industry is to cover any individual corporate GIS and any Data Management system. The elements that make up an SDI must meet certain conditions such as interoperability standards, specifications, protocols and interfaces. They all meet international standard like ISO and others.

Principles of SDIs

The goal of creating a SDI is to integrate applications across the net in the data, metadata, services and georeferenced information that is generated in the oil companies, giving all users the easy location, identification, selection and access to those resources. All initiatives for the establishment of a SDI include some common principles: Institutional framework: needs and agreements between producers of georeferenced information, especially among officers producers to generate and maintain the fundamental spatial data (Framework data) for most applications based on geographic information systems.

Standards: setting standards that must conform to the geoinformation, exchanges of this and interoperation of systems that manage.

Technology for the establishment of the network and the mechanisms that allow software to search, view, find, access, supply and use geographic or spatial data. Such as to allow incorporation of metadata and catalogs organized to offer the network through servers.

Data policy: the establishment of policies, alliances and partnerships necessary to increase the availability of spatial data and to share technological developments.

Objetives of SDIs

The objectives of SDIs can be summarized in the following 3 points:

1-To facilitate access and integration of geoinformation, both at institutional and enterprise, which will extend the knowledge and use of information and optimization decisions.

2-Promote the metadata standard as a method to document the GI, which will reduce costs and avoid duplication of efforts.

3-Encourage cooperation between agents by promoting the trust for data exchange.

Background on SDIs

To find the origins of what we now call SDI or IDE stands in Spanish we must go back some 15 years ago. Based on three fundamental pillars:

1-The enactment by President Clinton in April 1994, Executive Order 12906 (Clinton 1994) to compile the proposals of the strategic plan developed by the FGDC (FGDC-Federal Geographic Data Committee-1993) and ordered to advance the development of a national spatial data infrastructure (NSDI) coordinated between the federal, state and local, private sector and university, to designate the Federal Geographic Data Committee (FGDC) to be responsible for their progress at the federal level.

2-The Open Geospatial Consortium (OGC) was established in 1994 and brings together more than 250 public and private organizations. Its purpose is to define open standards and interoperability.

3-PC IDEA Constitution (Standing Committee for Geospatial Data Infrastructure of the Americas) from the initiative taken within the UN during the Sixth Regional Cartographic Conference for the Americas in 1997.

Components on SDIs

Basically a SDI consists of Data, Metadata and Services.

Data

There is now an international consensus that classifies the spatial data that can handle the SDIs in:

1-Reference Data

Georeferenced data are those which provide basic framework or skeleton for building or referencing any other thematic data.

Serve as the geographic information used as a reference base that allows you to combine common data and integrate applications of all types to be the link or nexus.

The European initiative INSPIRE identified issues to be considered as reference data: Coordinate system, Geographical grids, Geographical names, Administrative units, Transport networks, Hydrography, Protected sites, Elevations, Identifiers Property, Cadastral parcels, Land cover, Ortho imagery.

These reference data are also applicable to the oil business.

2-Thematic Data

They are data for specific applications that exploit the GI with a specific purpose. Include qualitative and quantitative values that correspond to attributes associated with reference data such as vegetation, geology, climate, traffic, pollution, etc..

In the case of the oil business are thematic data: Wells, Seismic lines 2D, Seismic 3D, Exploratory blocks, Production blocks, Pipelines, Power lines, Fields, Reservoirs, Surface facilities.

Metadata

Metadata describing the characteristics of existing data, so that users can interpret what and how these data represent, to facilitate searches, selections and queries that interest them most and can use and exploit it effectively.

To this end, the information contained in the metadata describing the acquisition date, content, covering the spread, spatial reference system, pattern of spatial distribution, security and legal constraints, update frequency, quality, etc.

This concept of metadata as "data about data" that was extended after consolidating services as an essential component and focus of the SDI environment. Thus, metadata became "data about data and services" or even more general information about resources.

The structure and content of the metadata must be based on a standard accepted and widely used such as ISO 19100 for Geographic Information that provides a basis from which national or sectorial profiles or norm adaptations can be developed.

Currently there are different standards and profiles within the field of metadata:

ISO 19115 "Geographic information - Metadata: from ISO 19100 family, developed by the Technical Committee 211.

Dublin Core Metadata Initiative: open forum dedicated to the development of standards in line with the metadata.

For further information, please consult website: http://dublincore.org

Services

Much more appropriate to conceive something as a SDI based on the geographical data available, it is thought that a SDI is a set of services that offer a number of features that are useful to a community of users. So the emphasis is on service and utility.

SDI Services offer accessible functionalities by net with a simple browser, without need for other software.

1-Web Mapping Service (WMS) for displaying geographical information.

2-Web Feature Service (WFS) to access and view all the attributes of a phenomenon (feature) geographically.
3-Web Coverage Service (WCS): analogous to the WFS, but for raster data.
4-List Service (Gazetteer): to find a phenomenon of a particular geographic name.
5-Geoparser Service: analyzes word given a digital text.
6-Catalog Service for the Web (CSW): allows you to publish and find information (metadata).
7-Style Layer Descriptor (SLD): describes a set of encoding rules that allows the user to define custom styles symbolization of entity

Standards

Standards and agreements are essential substrate which provides consistency, compatibility and interoperability needed for SDI data, services and resources can be used, combined and shared. Something similar happens to the infrastructure of pipelines: the standards related to the diameter of pipes and pressure injected to help make better use of infrastructure.
It is important to distinguish between standards, norms and recommendations:
Standards
Are defined by ISO (International Organization for Standardization) at International level.
Norms (or rules)
Are established by companies and organizations such as OGC (Open Geospatial Consortium). Examples of OGC specifications are: Geography Markup Language (GML) 3.0, Grid Coverages 1.0, Web Coverage Service 1.0, Web Feature Service 1.0, Web Map Service 1.3, Web Map Context Documents (WMC) 1.0, Styled Layer Descriptor (SLD)
Recommendations
Are issued by national agencies such as the IGM in Argentina.

SDI Software

There are many software tools to develop and deploy applications that meet the standards of the Open Geospatial Consortium and therefore can be integrated (for customers OGC) and accessible (for services OGC) through a SDI.
Within these products OGC can distinguish different levels of compliance:
-OGC certified software, and therefore has been verified by a certification test (compliant products).
-Software that is declared in accordance with OGC specifications and has requested certification (implementing products).
(See www.opengeospatial.org/resources/?page=products)
These tools are both free software and proprietary software. Free software is a concept based on the Four Freedoms defined by the Free Software Foundation

(www.gnu.org / philosophy / free-sw.es.html) with different characteristics, properties and results that can be used to implement any or all of the services of a SDI.
You can view data and use the basic features of services available in the net of a SDI, using a browser (Explorer, Netscape, Opera or Mozilla), a thin client.
Another possibility is to access the services of a SDI using a thick client: a GIS application that offers search functionality, visualization, analysis and consulting based on OGC services available:
gvSIG http://www.gvsig.gva.es/
uDig http://udig.refractions.net/

Institutional Frame

Administrations should:
-operate as suppliers of consulting, access and visualization services, called geoportal.
-take charge of registration of suppliers information to make them public.
-stimulate the generation of thematic priority data.
-establish access to spatial data.
Due to the flexibility of Internet, its use as a carrier will allow a highly distributed organizational architecture and high level of consensus among the SDIs by outflowing information. In the case of Argentina, the initiative PROSIGA (Geographic Information System Project of the Republic Argentina) has set the "integration challenge" determining the basis for developing the project IDERA (Spatial Data Infrastructure of the Republic of Argentina) and promoting SDI proyects in other levels of government and organizations.
There is also a global initiative SDI hosted by the UN, the Global Spatial Data Infrastructure (GSDI), and at the other extreme, it is also possible that a municipality or a company or group of companies to launch their own SDI. There is the possibility of creating thematic SDIs covering the GI of a specific sector of activity or knowledge. These thematic SDIs should be recorded in the official SDI for your geographical area of operation.
In Argentina, PROSIGA is a joint initiative of 18 public agencies and municipalities, but open to participation by all entities that wish to collaborate. IDERA on the first day was held on April 19, 2007 and set targets, working groups and recommendations.

Politics

To a public SDI can operate is necessary that the Administration agrees to provide adequate resources for implementation and maintenance, to encourage the production and harvesting of metadata production and to ensure equality of presence and transparency of access.
As it is necessary that all involved agents use a common reference so that it can manipulate data without ambiguity, will be needed for some specific policies to ensure the existence of reference data. A simple operation as overlaying two layers of GI requires that both are related to a geodetic system and use the same projection. If you

also want to make GI understandable, it is important to show topographical information that helps the user to locate, for instance, urban areas, roads, hydrography, toponymy, etc..
Another type of policy is related to the accessibility of data, mostly to the baseline, ie pricing policies and licensing for use. The European Union is in favor of free data. For its part, the IDEE advocates using the Internet as a system of dissemination of the GI.

Status of SDIs in Argentina

The PROSIGA-IDERA (Geographic Information System Project of the Republic of Argentina for a Spatial Data Infrastructure of the Republic of Argentina) is an initiative carried out by public bodies of Argentina looking to form a new map of the country with information created by official producers, in digital format, and available for public access via the Internet. Ie in line with the fundamentals of the SDIs.
This project was officially launched with the signing of a cooperation agreement between the Secretariat of Energy of the Nation, the Government of the City of Buenos Aires, the Ministry of Agriculture, Livestock, Fisheries and Food and the Military Geographic Institute, in October 13, 2004. Merits recall that 10 years ago, in 1999, there was an attempt to develop a national GIS project through SIGRA (Geographic Information System of the Republic of Argentina).
GCBA and these agencies worked in coordination, sharing responsibilities, efforts and project management on a horizontal working forming one homogeneous group with clear objectives, which succeeded in the term of one year to implement a digital map on the Internet for public access and make available documentation developed for those who needed it.
The project aims to develop, together, based on the SIG 250 of IGM, an integrated GIS with data from the participating agencies for consultation by Internet.
The purpose is achieved through coordinated actions the development and implementation of common standards, availability of digital data, and interoperable technology to support decision making at all scales for multiple purposes. These measures include policies, organizational skills, data, technology, standards and delivery mechanisms to ensure that all those working at global, regional or national level are not prevented from achieving their goals.

Conclusions

Today it is estimated that over 80% of the GI of the oil business is in digital vector or raster format. However a large part of this huge volume of data being replicated in different oil business companies, many of dubious quality, incomplete or outdated over time. Moreover, there is almost no data exchange between the oil companies because of a sickening zeal that still prevails among producers and users for data ownership, although these data are reference data, and therefore they are public data.
A little more than 15 years ago YPF was a pioneer among oil companies and one of the first organizations of Argentina (after the IGM) to incorporate GIS technology.

This technology is considered the second major paradigm of geosciences (the first was the map). The advent and mass distribution of GIS started a revolution in the management and use of the GI (so far on paper) and YPF check one trend and a way forward. Now we are facing a new paradigm that SDIs are, and the oil companies can not stay behind in any way. IG volume is very large and requires an immediate solution to the almost chronic problems mentioned above.

The development of a SDI for the hydrocarbons industry will require serious commitment from those responsible for the GI, contribution and work of an interdisciplinary team and finally a full participation and contribution of all GI users.

The effort will be great, but the benefits outweigh quickly, because in a short time will be available:

-unified GI. Not exist the problem of redundancy with different qualities.

-standardized GI. The recent demands of the Secretariat of Energy for oil companies to deliver all their data to a standardized reference system identified an inflection point.

However there are still far to achieve standardization of the GI according international regulations that SDIs require.

-updated and reliable GI. Since you choose the highest quality and are updated on a single server, without needing to replicate elsewhere.

-accesible GI via Internet servers. In this way users could have the GI without the need to make copies of discs, CDs or pendrivers.

These benefits simplify substantially the activities of the oil industry in terms of exploration, production, transportation and marketing.

In the immediate future GI will be managed by net through SDIs, as part of ISO-TC 211 standards, and OGC. This will involve the development of tools to get the GI through the net, and then be able to process it locally or remotely with software-enabled for that purpose.

Also will be developed geo-integrators (geo version of the current Internet search engines like google, yahoo, altavista, etc.) that will allow to consult the GI available.

SDIs are already underway. If the oil industry as a whole does not catch up now, is going to be very difficult to recover lost time.