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THE STANDARDIZATION OF CARTOGRAPHIC DATA

by **Jasmine D. Salachas**, Cartographer

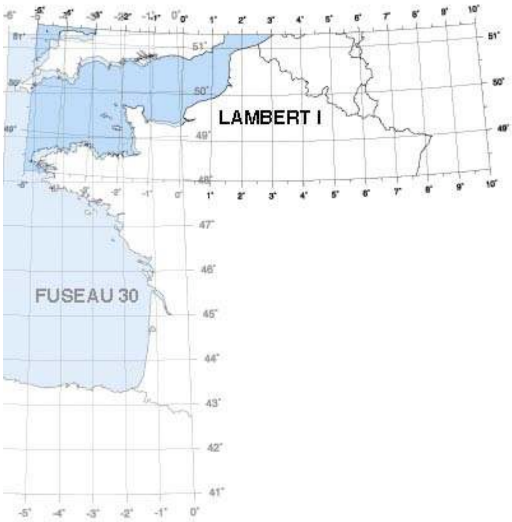
A state-of-the-art decision-making tool, geographic information is increasingly indispensable in a widening range of applications, as maps have become ubiquitous in daily life.

At a time when our digital tools all too often create the illusion that a map can be made in a few clicks, or that it is only a complementary illustration produced without any deontological rules, it is essential to remember just how much work is involved in designing and producing a map: research, data collection from documentary archives or field surveys – always dated – methodology to structure the data and rigorous attention to its representation.

Each object or feature must first be measured and surveyed to be represented on the map, a certain number of scientific parameters referring to a set of spatial coordinates in relation to an ellipsoid, a geodetic system, a cartographic projection, which determines how it will be represented, at which scale for which display format, on whatever theme, with the appropriate level of detail.

Before beginning to place these features on a map, it is essential to master the reference systems upon which this geographic information will be structured.

The databases for these different representations can be from any source ; yet, they must be expressed in the same reference system to be valid. They will often have to be converted for all the features from all the various sources to become homogeneous.



Geometric differences in data represented in different reference systems. Multi-source or multi-scaled databases can cause numerous inconsistencies in data files. Large scale data must be exhaustive and highly precise to avoid discrepancies that may appear at smaller scales.

Databases contain objects or features from the real world represented, symbolized and modelled as digital data, according to strict rules.

Each object described is represented by its geometrical shape : point, line or arc, area and position on a reference matchpoint localized in space (1D,2D or 3D,)which determines its coordinates (X, Y, Z).

This data is the main component in a geographic information system.

It is the high quality of this basic data and its precise placement which, for example, allows newly acquired or created data to be integrated onto this reference background with additional elements, or updates.

To guarantee the quality and reliability of these manipulations, the data to be integrated must meet several criteria : it must be pertinent, exact, precise, exhaustive, accurate and up-to-date.

These databases, from reference data or basic data, are known as geographic referentials. They are systematically designed by public agencies responsible for their management and availability to all users.

The development of Geographic Information Systems (GIS) proceeds from the definition of these referentials, from their technical specifications, the ways they are produced, maintained, updated and distributed.

Aside from basic data, the geographic information contained in a GIS comes from the specific fields of application each GIS is designed to represent.

Today, the acquisition techniques of this basic data are in constant evolution. And continuous Earth observation provides images, measurements and positions of objects or features with formerly undreamed of precision.

The concept of *metadata* has appeared with the development of data exchange. A metadata bank describes the specifications of a digital file and expresses each piece of information as a datum.

For geographic data, metadata indicate all the information required to represent available files : specifications of localization, geometric data structures, modalities of data access, etc.
Metadata are used in data file transmission, but may also be useful to select data.

Among the huge volumes of available metadata can also help to identify the subject of the data files described.

As a general rule, non-inventoried information can be definitively lost. And this risk cannot be taken in the establishment of a digital file: when data is manipulated, an unattributed source cannot be used.

There have been a great many indispensable rules adopted to describe metadata for consultation : subject by key word, placement by geographic link from embedded layers, and network queries, which simplify search strategies.

However, most systems have their own metadata servers.

The standardization of data capture procedures, acquisition tools, management tools, the establishment of geo-listings, unified common formats, common rules, should make data searches more efficient.

There are a great many GIS in complementary fields of application.

Supply on the market has increased, GIS ergonomy has improved, their costs have decreased and new applications have appeared : hardware manufacturers and software producers, data providers and editors, institutional researchers, small start-ups or major computer companies, today propose an infinite number of tools for a wide variety of approaches for spatial analysis and management.

The development of GIS still depends on the quality of available data, the compatibility of tools to manipulate it and exchange it, as well as the skills adapted to the context to use it.

The GIS market is dominated by a number of international and national institutions that define these standards and encourage their application.

These institutions have established standardized databases produced by public bodies, thematic databases, harmonized reference structures on which other data providers can graft their own spatial data.

Generic standards aimed at guaranteeing the quality of exchanges among ever growing communities, to make a series of efficient processing tools available to all, organized by precisely defined types of needs, so that they can be used, distributed and enriched by all.

- *Proprietary formats*, internal GIS work formats, called native, allow direct consultation of data supplied by the GIS producer. This data can evolve from one version of the GIS to the next and can limit exchanges;

- *Export formats,* data cannot generally be read directly, but must be imported into a GIS. These relatively stable formats are accepted by most GIS.

- *Standardized exchange formats*, recommended by public bodies, aim at facilitating data exchange and limiting costs.

Data are documented, stable and independant of GIS. In practice, proprietary formats are in fact the most frequently used.

It is essential to be able to exchange GIS data safely. Multiple formats produced by GIS causing supplementary delays and costs, has led to the adoption of a universal language, an intermediary to bridge the gap : an *interface*.

Every data transfer towards another system leads to the development and use of a specific interface.

To enable any software to work with any other software, as many interfaces had to be developed, updated to keep abreast of the most recent versions of the GIS software involved.

Standards aim at facilitating these flows of database content specifications between different GIS and as the CNIG[1] recommends « *by altering their meaning and specifications as little as possible ».*

The constant requirements for geographic information of quality, the weight of investments necessary for their production and use, have brought producers and users to work closer together.
To promote this cooperation, advisory institutions responsible for innovative research have been set up.

The National Council of Geographic Information (CNIG), an interministerial advisory council in France, has encouraged significatant advances in research since its creation in 1985 : e.g. contributing to the establishment of standardized specifications, economic studies at an international level, cooperation in research and education, documentary tools, research days, symposiums, etc.

Since 1986, The French Association for Geographic Information (AFIGÉO) has taken on an operational role in certain projects and has contributed to decisions made by international organizations on matters of geographic information.

In Great Britain, the Association for Geographic Information *(*AGI*)*, a multidisci-plinary non governmental organisation founded in 1989, has similar objectives.

There are also the German Umbrella Organization for Geographic Information (DDGI*)* founded in 1994 for Germany; the Spanish Association of Geographic Information Systems (AESIG) founded in *1*989 for Spain ; the National System of Geographic Information (SNIG) founded in 1990 for Portugal, etc.

European collaborative institutions have also contributed to making the different divisions of the European Commission aware of the essential role played by geographic information in international endeavors.

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[1] CNIG : The National Council of Geographic Information, whose role was defined in July 1985.

According to the terms of its constituent decree, the CNIG *contributes, by its studies, advice or propositions, to the consistency of national policies relative to geographic information, to encourage the development of geographic information and to improve corresponding techniques, by taking into account the needs expressed by public and private users.* The CNIG's main objectives are – (extract) :
- Promote the consistent development of public geographic information taking into account the increasing role of local levels in order to better employ both human and financial resources ;
- Establish clear procedures enabling the private geographic information sector to make its place and develop, identifying catalyzers and brakes on development, within the context of the European Union and the globalization of the world economy ;
- Coordinate the players in technology improvement, procedures and education ;
- Encourage the adoption of a national policy setting up a French Infrastructure of Geographic Data (IFDG), including :
    - knowledge of available data ;
    - reference data, and in particular, the large-scale geographic reference database (RGE) ;
    - common specifications, standards and norms ;
    - legal procedures and costs to access data ;
    - following the establishmpent of geographic reference databases (content, set up, maintenance and accessability);
    - inventorying all legislative and reglementary texts, both national and European, liable to have an impact on the sector of geographic information, to influence the different stages of their preparation and to study the consequences of their application.

ÉDIGéO (Data Exchange in the Field of Geographic Information) is a standard proposed by the CNIG and made official in 1999.

EuroGeographics, the association created in 2000, groups 56 national mapping and cadastral agencies from 45 European countries, initially aimed at making geographic data available in Europe more accessible. This association is responsible today for the production and maintenance of several homogeneous geographic reference databases with paneuropean coverage.

The European INSPIRE[2] directive aims at establishing a European geographic data infrastructure – its role is to promote the development of this infrastructure, by establishing the interoperability of its members' geographic reference data.

An institutional standard has introduced a certain neutrality in relationships of exchange. It also imposes specific developments, which must take into acount the simplest to the most complex database files.

Furthermore, national standards must be compatible with the more general structures of international standards.

ISO Quality Standards of the 211 Technical Committee (**ISO/TC211**)[3] involves geographic information.

Several international scientific associations, each bringing its own skills, contributes to the international cooperation to standardize data exchange : the International Association of Geodesy (AIG), the International Society of **Photogrammetry and Remote Sensing** (ISPRS), the International Cartographic **Association** (ICA), the International Hydrographic **Organization** (OHI), the International Maritime **Organization** (OMI), etc.

Other collaborative organizations focus their activities on the unification of reliable, structured geographic information, made available to the public to facilitate its integration into a GIS : the African **Organization of Cartography and Remote Sensing** (OACT), the Sahara and Sahel **Observatory** (OSS) ; GIS Africa (African Network of Geological Information for Sustainable Development) ; the National **Institute of Cartography and Remote Sensing** (INCT), etc.

Other standards have been elaborated by user groups on particular thematic projects :
The OpenGIS Consortium *(*OGC*)* is an industrial grouping created in 1994, which, although not an official body, with no defined aims, today groups private companies, public administrations, and universities from various countries.

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[2] INSPIRE, acronym in English of the *« INfrastructure for SPatial InfoRmation in Europe »*, is a European directive aimed at establishing an infrastructure of geographic data in support of the community's environmental policies : it organizes access to reference data in digital form, by online services of data and metadata.
INSPIRE aims at establishing a framework for international cooperation for public authorities in the widest sense, including States and their administrations, the representatives of public services and companies in the private sector responsible for programs of general interest.
The INSPIRE directive contains five chapters and there are three annexes describing the data concerned :
- The first annex includes the coordinate referentials, geographic linking systems, geographic attributes ; hydrography, administrative units, addresses, cadastral parcels, transport networks, protected sites.
- The second annex includes general complementary data : altitudes, digital terrain models, landuse, orthoimagery and geology.
- The third annex deals with thematic data : statistical units, buildings, landuse, human health and safety, public utility services and public services, environmental data capture installations, industrial sites and workplaces, agricultural facilities and aquaculture, population distribution and demography, regulated zones, areas with restricted access and customs control units, areas of natural risks, atmospheric conditions, geographic, meteorological and oceanographic features, habitats and biotopes, species distribution, energy sources, mineral resources.

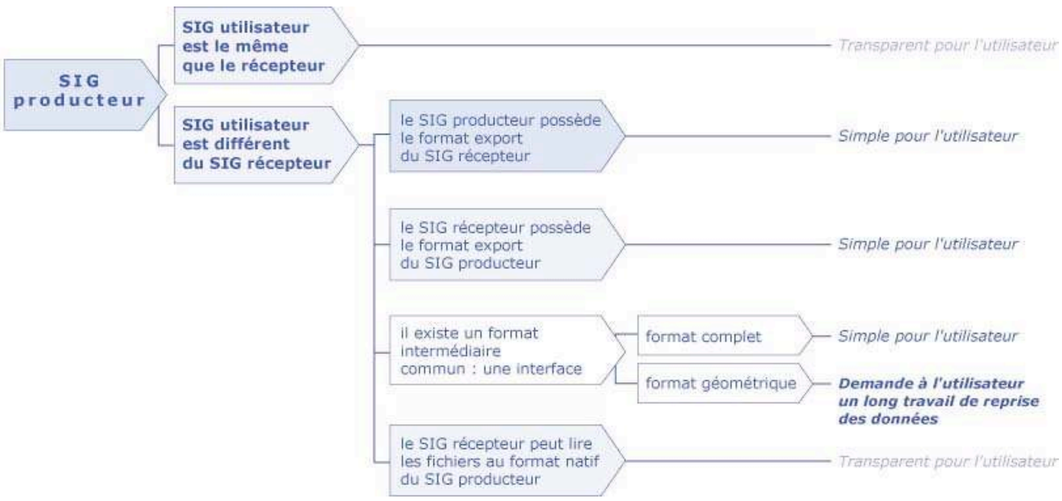
[3] ISO (International Organization for Standardization), is made up of representatives from national standardization organizations from 158 countries.

AFNOR (French Association of NORmalization) is a member of ISO.

This organization's objective is to develop and promote open standards, freely available, to encourage the exchange of geographic information and associated services.

The ***Geographic Data File*** *(GDF)* is used to describe and transfer data related to road networks. This standard defines the objects, their atrributes and relationships : it is found in a great many applications in the field of traffic circulation : transportation, onboard navigation systems, etc.

GIS user same as receiver ....User-friendly
GIS producer
GIS user different from GIS receiver
GIS producer has GIS receiver's export format...simple for user
GIS receiver has GIS producer's export format...simple for user
There is a common intermediary format: an interface
Complete format ....simple for user
Geometric format ....requires user to transform data
GIS receiver can read GIS producer's files in native format..User-friendly



Conditions of data transfer from a GIS producer towards other types of GIS receivers.

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