Integration of Topographic Information into GIS

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***Abstract**: The decisions of governmental and local bodies, those of the business world rely more and more on space data – geographical data. Almost every decision we make is influenced by certain geographical factors. Any land management decision, such as that of establishing the optimum place to build a business centre or a house proves how useful maps and geographic data analysis tools are.*

Known as the Geographic Information System – GIS, geographic data analysis has experienced a spectacular growth. GIS operations on space databases turn theses systems into instruments to produce maps, but mostly to analyze information related to earth surface.

Defining GIS

GIS can be defined in several ways, and the best known definition is: a Geographic Information System is an ensemble of software, hardware), norms and methods (algorithms) that aim to process geographic data and present space data with the aim of solving complex land planning and management problems.

Any GIS is based on a space database that reunites graphic information (systems of coordinates, reference systems) and an alphanumeric database (tables), which contain the attributes of graphic elements. The main purpose of such a system is the analysis of this information in a rational context that allows for complex decisions.

A space data belongs to a certain geographic entity (item) and is accompanied by its position expressed in space dimensions (coordinates).

The geographic entity is a fixed material element, natural or artificial – man-made, located on the ground and that can be represented on a map.

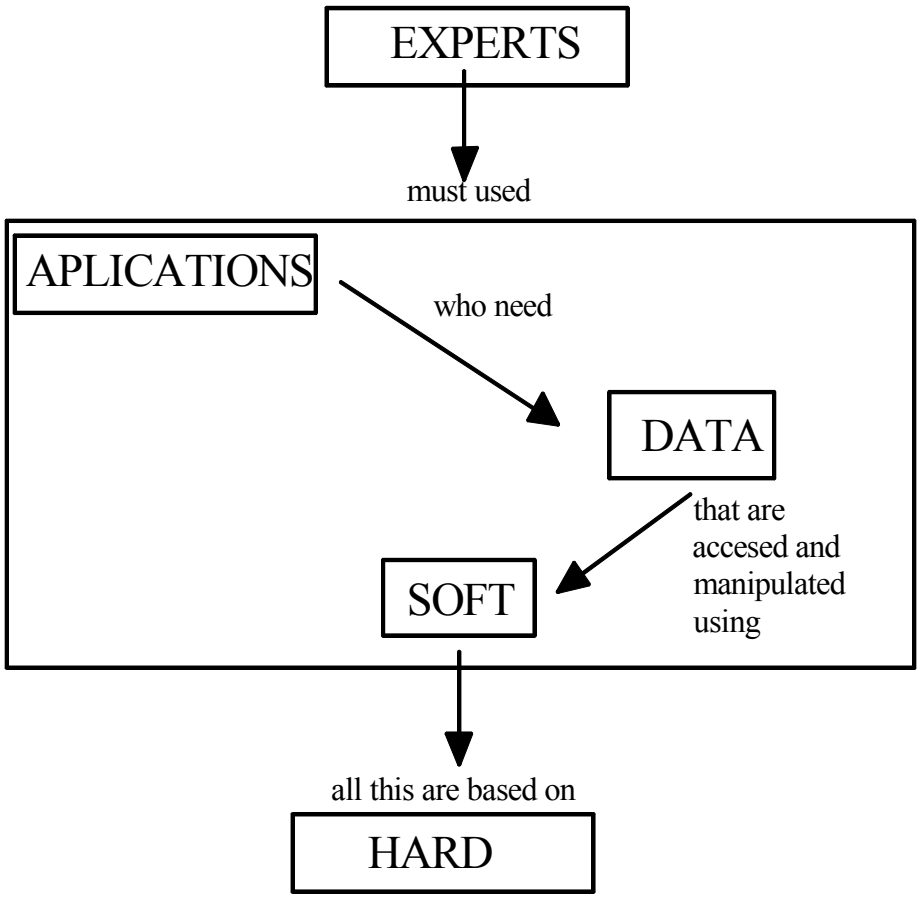
A geographic entity can be defined through the following four components:

- position expressed through coordinates (location);
- attributes expressed in values that characterize the item (nature);
- space relations expressed by vicinities (topology) and positions related to other surrounding items (the relations as to the other entities);
- time expressed by the date when the respective entity was identified (since it was located).

The above definitions prove that GIS contains a space database, namely a digital map.

GIS is composed of:

- hardware;
- software;
- an appropriate organizing context;
- geographic reference data;
- experts.



Why we need GIS?

The territorial administrative unit is an extremely complex social, economic, territorial, historical and cultural structure whose management and upkeep raises many problems and involves permanent decision making with different areas of influence in space and time.

The efficiency of decision making depends on an exact and complete knowledge of the region, which implies the existence of an appropriate information system, namely of a technical and organizing compound comprising a team of experts, equipment, methods and regulations that collect, verify, transmit, stock, analyze and present the data and information pertaining to a territorial area. Practically, all the bodies and institutions that contribute to the well-being of a locality have their own information and management system that allows them to fulfill their tasks to a certain extent and with certain efficiency.

As we can notice, the current data management system presents a series of shortcomings influencing the efficiency of decision making, causes delays in solving problems, malfunctions of the relationship between the citizens and the administration, with a high degree of uncertainty regarding the direct and side effects of a certain decision, and etc; This situation is generated by several factors, one of the mainly technical factor being the old information registration and reference technology. There are many institutions and bodies that organize their data in paper collections, registers, files, maps and plans. This type of data storage is time-consuming when performing an update or other activities and the preservation and protection of these documents require an extremely high amount of effort.

Most data that characterize a territory are relevant if shown on a topographic base, that is if presented on theme plans and maps. We can notice that many times, although the electronic support exists, most information refers to text data, the post address being the way of localization. Consequently, there is no topographic reference.

GIS premises and requirements

The main element at the basis of the new method to set up a cadastre database is the computer with the intention to turn the current information system into a practical computer system without changing the organizational framework.

The proposed management system is based on space data and starts from the assumption that there is topographic basis necessary to report these data; in other words, the necessary technical requirements are ensured to render the respective data on a topographic plan. However, considering the premise of the information system, the map has to take an appropriate form.

Thus, maps are used in order to store space data and in order to present various users. This double function implies a series of constraints: on the one hand, the quantity of information contained on a map page is limited by the necessity to be readable an don the other hand, the way of representation is influenced by the necessity to contain as many information as to cover the needs of as many potential users as possible.

These constraints show us a series of disadvantages of analogical maps and namely: limiting the quantity of information to a map scale table, un-useful details, the need to keep the original copies on non-deflecting support (zinc) accompanied by difficulties to preserve, update and distribute the map, difficulties of handling and use that appear when the studied phenomenon covers multiple map pages that will need assembling.

These problems connected with analogical plans have determined a passage to the new conception of map, where the storage function is separate from that of presentation. In computer-based systems, space data can be practically stored with the highest level of details and selectively related to various scales of representation and for certain areas.

As the data are kept entirely in a numerical form, the deflecting support disappears, simplifying many of the map conservation, update and distribution problems.

The use of computers to store and handle space data determines higher usage possibilities through the analysis functions that can be implemented. Once it has been created, the database can be jointly used by several institutions or organizations. In the situation of multiple users and multiple data sources, in order to prevent a resource waste through overlaps and dysfunctions, the requirements below need to be met:

- Only one topographic support;
- Mutual access to data;
- Coordination.

GIS setup stages

As a rule, we can distinguish the following major stages for setting up a geographical information system:

- set up the topographic base;
- collect and report (register) data;
- track changes in the territory and modify them in the database;
- draw reports.

Certainly, each stage implies resources, logical and staff.

How to prepare a GIS project

Space data sources:

In general, space data can come from various sources:

- Measuring equipment (total station);
- Photogrammetrical methods (base don space photos);

- GPS (Global Positioning System);
- Underground radar (when the position of underground items is unknown);
- Laser scanning methods (they only create digital models of the field);
- Camera;
- Scan plans in an analogical format, their transformation from a raster system to a graphic system through graphic referencing;
- Registers and files;
- Databases executed with compatible software or with software that can be conversed.

Conclusions

The objective of general cadastre is to provide land fund information at any time, information required by the authorities, from economic, social or political reasons, at a local and especially at a national level.

Because the classic (old) management system, base don handwritten files and registers is outdated, the high number of information required for the introduction of general cadastre in Romania has encouraged a complex and complete automation of all activities necessary to draw up the documents to introduce and maintain general cadastre.

The following requirements have to be met: using digital data in all the stages of cadastral activities, a topographic and cadastral database that allows to record them, an Information System of their own, organized within the national and county Agencies.

The requirements mentioned above can allow an automation of all the stages of cadastral activities, beginning with the collection of data to their processing for various purposes, including graphic representation on certain themes.

For these reasons we have defined this collection of data created in order to obtain useful information as a database.

The present paper defines and analyzes the information system of general cadastre. As proven later on, this implies the organization of relational, graphic and alphanumeric databases for technical, economic and legal management related to real estate and their owners.

The Local Agency for Cadastre and Land Registration is responsible for the technical part; the Land Register Office is responsible for the legal part while the specialty cadastres are responsible for the economic part, which is based on documentations set up by ministries, central government institutions or divisions.

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