GIS FOR LOCAL GOVERNANCE

Vlad PĂUNESCU[1], Alexandru Iulian ILIESCU[2], Cornel PAUNESCU[3]
[1] *Eng. PhD., SC CORNEL&CORNEL TOPOEXIM SRL SRL, vlad.paunescu@topoexim.ro*
[2] *Eng. PhD., SC CORNEL&CORNEL TOPOEXIM SRL SRL*
[3] *professor Ph.D., University of Bucharest,cornelpaun@gmail.com*

Abstract*. New developments in computing technology has brought an improvement in saving and accessing information. A GIS has two major advantages: positiononig and describing an object at the same time. These two charactheristics may be extended even further bringing all information in a single database. Data collected from cadastre may be at this moment the main layer for a GIS that tackles with the problems of local administrations.*
Key words *:GIS, systematic cadastre, data*

1. Establishing the project purpose
1.1 Generalities

Development of applications in GIS is one of the latest trends existing in the local administration . In a society where access to information leads to effective decision making , GIS applications are indispensable.
By creating a GIS for local governance it is desired to emphasize the advantages of applying this technology both in local decision making and in terms of the immediate benefits for the users .
A GIS application has two main components. The first component refers to the position of objects (geographical) and the second is an information component that describes objects (attributes) that can be either textual or graphical (photos, PDF files , etc). These data types represent any GIS infrastructure .
The positioning will be achieved by taking spatial data from different sources and from on site operations (measurements) and visualized by means of specialized software. The geometry component will be matched with the collected attributes in a single database.
These processes are carried out in a GIS application to manage all these elements to streamline decision-making in the local community .
The application is based on evidence that , locally , the degree of computerization and automation of the activities taking place in municipalities is very low . In most cases the information is still stored in analog format. In the few cases where there are systems, they are specialized and designed for specific departments. Therefore , the exchange of information between the various services in the town hall is very hard.
Locally there are a few basic services town hall : taxes, agricultural , social , legal , heritage .
The purpose of the research project is to collect specific attributes that these departments are currently working and store them in a single GIS database that all employees have access to these services. By this procedure it is possible that officials from one department to consult information belonging to another department.
With functions that a GIS application can perform, a number of models may be created that can standardize and automate a number of processes related to infrastructure , agricultural and forest land management and social management .
Infrastructure chapter can make a model that can automate file expropriation achievement .
Forest management can make a model with which to be able to automatically locate the areas that will be subject to afforestation and to be able to determine the amount of trees required.

Land management can make a model that can automatically provide the optimal solution for land consolidation . Also , based on the digital terrain model and risk maps to achieve a model for automatic determination of the restricted area for construction. Social chapter can make a model by which to identify people who can get various benefits.
Virtually every direction from City Hall or service will have access to information and use it to make correct decisions in short time. There will be no need to consult the registers, analogue information that , because of the way in which they are found, can lead to errors in decision making.

1.2 General objectives of the project

- Facilitate decision-making process through a GIS. It will adopt solutions faster, with lower costs , available with all the necessary elements of a single database for all services .
- Reducing costs necessary for expropriations by an existing cadastral infrastructure and by performing automatic file expropriation.
- Improving the environment , efficient use of land and prevent landslides by automatically determining areas requiring afforestation
- Improving agricultural production and increase land value by land consolidation
- Disaster prevention by establishing the best and safest areas in which to build . The safeguarding of heritage by imposing building restrictions
- Reducing costs with social benefits through access to information recorded in common database .

2 . Scientific description of the project.

Step 1: Preparing the project
Given these things , first, the current state of informatization level of city hall in question should be assessed. It will then identify specific needs and will analyze what application is appropriate for that institution.
The application aims to provide a wide range of information both textual and graphic. This information will help the decision makers to have access to a range of elements that can help in the decision making process .

Step 2: Spatial data
Quality geospatial data in a GIS depends mainly on collection methods , because errors will be amplified by processing.
The position of the objects is given by the contur points. Each point is identified by plane coordinates and possibly height . For this reason it is important how to determine the coordinates x and y or north and east in the national system , respectively Stereographic 1970 .
The main issue is the accuracy with which the position of these points is determined according to the purpose in which we use them. Considering that the GIS will serve all services of a Town Hall, including surveying, agriculture and urbanism, centimeter accuracy is needed. The method of determination must ensure this accuracy. For example the situation of a building that must be located in a particular area or at a distance of a monument .
It requires a good accuracy in the determination of surface expropriations , especially if the land in the area has a high price .
Given the above, it is necessary to determine the position accurately. Points composing the object must be below ± 10 centimeters. It may use four methods for determining the coordinates of the contour:

- Classical method using total station ;
- Use real-time GNSS receivers ;
- Using photogrammetric method coupled with air Laserscan.

Regardless of the chosen method, it is required to achieve a unified geodetic network throughout the town where the GIS is Implemented. The network will be projected on topographical maps 1:5000 and on orthophoto, so it will cover the entire area, both urban and terrain. Geodetic network points will be chosen at the intersections of major urban streets and in city limits, as possible on high ground to ensure visibility. Points will be materialized by FENO terminal type . Measurements will be performed both with total stations and GNSS measurements on each point . In this network will be included points that are unstationable, but later used, as: churches, water towers , antennas GSM , etc. . Compensation will be achieved by least squares method , indirect measurements with equations on directions , distances and differences of plane coordinates . This network will provide the basis for future topographic surveys , regardless of the method .

The description of the methods for determining the contour points .

1. The classical method using the total station. A geodetic network is required to determine thickening points of detail: building corners , property boundaries , roads , dams, detail elements , etc. . Measurements of directions and distances between points network will be made and points of detail must be determined. Compensation will be based on the points in the network that are considered as fixed points . Compensation method will be the method of least squares , indirect measurements . This network will cover permanent basis points of geodetic network .

2. Using real-time GNSS receivers . It can be used in two ways:

- Using ROMPOS ;
- Using receivers that can measure in real time by sending corrections to a fixed station broadcaster (RTK - Real Time Kinematic , or , OS GNSS real-time kinematic corrections) .

Both methods give the best results and in very short time. ROMPOS method is preferable , but in areas where there is no GSM operator can not be used . Method ROMPOS ensures an the accuarcy needed. For the RTK method we need in the area at least one point to be determined very accurately in the WGS84 system using the static method with help from EUREF points in the network .

With this method we encounter one drawback , some points may be skewed due to inherent errors. For example signal loss for a few seconds , etc. . For this reason, the points will be checked by a parallel method (overlapping aerial images , compared to sketch the terrain , etc).

3. Using photogrammety coupled with air Laserscan. In this method, frames will be used throughout the time taken in the area . They can be purchased for a fee from ANCPI or APIA and processed with special software . Given that there are many points determined GNSS or with total stations in Stereographic 1970 system, these points can serve as landmarks . It may also use the last flight conducted by the Military Topographic Directorate , which provides very good accuracies.

The first product resulting from tahe data colescted is the topographical plan. This plan provides the exact position of elements on the ground and also give planimetric position of each point . The second product resulting is the cadastrial plan that relies on determining each parcel , each sector of land and then closing the administrative boundaries of administrative territorial unit.

Together with tese, a number of attributes must be collected, depending on the specific GIS solution adopted.

Attributes are important because they describe the a specific object or a phenomena involving an object. For local administrations, attributes are essential because after implementation, a GIS has to be consulted and analyzed.
Also, the purpose is to be able to make connections between information without consulting an expert, only the database.
To manage a local government by a single GIS application many attributes must be collected.
1. Agriculture and land registry services attributes may be: the owner, area , category of use , quality of soil , forest . These data are taken directly from the field measurements and in the office by taking documents from the land owners and visualization.
Also , given the tendency of land consolidation (merger), it is needed to identify botanical classes of soil for each area separately and then each parcel separately. These data are collected from county agricultural service , which has detailed map of trustworthiness soils on each locality .
2. Urban service attributes may be: construction material used to build the type of heating , type of foundation, roof type . This data is collected from the archives of the City Hall and on site.
For buidings tahat are data that may be collected from existing laws and regulations:
- Distance that can accommodate a building from the street, historical, neighboring construction , etc. .
- The location of a building from areas where disasters can occur : rivers , lakes, forests, land slope , mining areas , saline .
- Acces to the parcels
3. For tax services attributes may be: area, owner and location . The program may calculate the tax according to the value / square meter land and location (within or outside the city , it is located in the category of use) .
4. Social services. For this service are required attributes that relate to population : income / family , occupation, ethnic minorities , the elderly and health problems , people with disabilities, etc. . These attributes will be collected from the archives of the City Hall and the data collected in the census and will be joined with information graphics . For these services , information graphics dosn t have to be very accurate (positioning), but given the other connections , it will preserve the accuracy of the previously discussed .

Step 3 : Creating spatial database
Databases are a collection of data collections which shapes reality .
One essential thing for a database to be functional is to be established logically. If modeling relationships between attributes and entities is done logically, in the query results will be unique and clear .
The database will consist of textual entities attributes taken from the ground.
A database management must be designed adapted to the specific requirements of the project. This software will be such as to have a number of fields corresponding to attributes that will be collected in the field. It will consider the use of spatial database (geodatabase), effectively encompassing geometric data , geographical and topological object attributes .
The program must be able to meet the specific characteristics of any management system thereby allowing: data description , data manipulation and query data. A database must be organized according to certain rules. In time, a number of models have been concieved that can organize data : hierarchical , network, relational and object oriented . The most common ways of organizing are tabular and hierarchical (tree).
Data collection can be synchronous or asynchronous to achieve GIS maps .

It will establish patterns of organization of classes and entities in the database and file management .
SQL language has to be used and its corresponding standards . Such data table will be achieved by specifying the structure and the corresponding attribute data types , defining restrictions on entities , defining relationships and indexes . No management system relational database can not be sold without having the SQL interface . This language facilitates procedures : description, manipulation and query data .
The data table that coresponds with the spatial type must take into consideration: defining alphanumeric fields , defining geometrical fields to specify primary key constraints, define the space.
Management system database must allow for specific queries themed project.
Special attention should be paid to issues that may arise in creating a databases. The collection must be done so that there are no redundant information . Once information is stored, it means that it was updated and distributed once. For a database to be useful and to meet the requirements for which it was made , it must be constantly be renewed.
Security of information in the database can be ensured by introducing an account and password for users and restricting the type of operations that can be controlled by certain people.
The degree of information collected and entered into the database will be very large and varied to be able to benefit as many services in the municipality.

Step 4: Making GIS maps
The map is the traditional method of storing spatial information as an abstract representation of the geographic area . The main characteristic of spatial objects is represented by their coordinates, thus determining their position in a particular projection system.
For proper management of information shall specify metadata . Such system will be designed using Stereographic 1970 coordinate system X and Y , and the Black Sea quota system in 1975 The data regarding the map scale must be given and the accuracy for data integration.
GIS maps will be achieved by integrating spatial and attribute data collected in the field.
In GIS applications the focus is on spatial relations, but a strict observance of geographic location is needed, given that many GIS applications does not put great emphasis on the latter.
There are basically two types of arrangement of graphical information : raster model and vector model, each with advantages and disadvantages. The data will be arranged in layers so that the vector model, the raster model and the data may be overlaped.
The large volume of data and their variety leads to the adoption of algorithms for achieving digital maps. Regarding vectorization there are a number of ways that can be done. Both CAD programs , as well as the GIS allow automatic vectorization.
Also a series of digital thematic maps according to the theme of the project will be produced. These maps will be the result of subsequent manipulation of the computer system results.

Step 5: Making connections in our database
Although basically we talk about the existence of a single database , in fact it has two components . The graphics and the textual . Between the two have made links of various types.
A series of connections between tables will be done. Thus an object will benefit both its attributes and the attributes associated with the new table.
The data manipulated in a geographic information system are both geometrical and non geometrical. They must be used together, correlated, in order to obtain adequate results.

Prior to last in operation will be a data quality check . They should be checked at the start of the collection and the process. Such a system should include routines and procedures to be followed by operators. It may relize a series of automation in the introduction, automatic checking of fields according to certain conditionalities . Problems that can occur in the composition of the database may be related to: data redundancy and inconsistency , absence of well-defined standards , involvement of the human factor in the introduction of data.

Step 6: Making GIS application

As noted, the application must meet the requirements of as many services in the rural municipalities . A server will have information and each service will have a terminal providing access to the database . Only people who have access approved must be able to make changes into the database. Maintenance of the base will be provided either by a company specializing in a certain period.

Display of query results can be made spreadsheet or spatialy.

Examples of interconnection to the database :

- The tax service will work with the data provided initially. For properties that change the owner changes and updates will be made.
- The urbanism service will update the database according to the new constructions or demolished . The taxes service will be the beneficiary of these changes.
- Changing the number of animals in a household will be operated by the Service agriculture. Tax Service will benefit.

For some of these services a series of models may be created:

Since 2008 Romania has faced a financial crisis that forced the central and local governments to reduce their budgets . One of the pressing problems was represented by the large number of social benefits provided by the state . These grants are awarded based on the assisted conditions which must be fulfilled . Also, to preserve the benefits, the person has to fulfill a number of conditions. A database that can link all the sevices in the city hall can help keep trace of these cases.

1. Model of land consolidation (merger) .

Inputs :

- Soil grades creditworthiness of the village ;
- Parcels and owners ;
- Water supply, power supplies, etc. .
- Property assessments

Elements output :

- Optimal surfaces in combination or individual farms ;
- Class of optimal reliability for specific crops.

The model will determine the areas where we can set up farms which have: soils , water, and energy , all at minimal cost.

Land consolidation is a concept that enhances using land in an efficent way . It appeared for a long time in developed countries, but it is new in Romania . This involves a process of readjustment and relocation of properties and owners . This need arose in Eastern Europe as a result of the fragmentation of property after falling of the " Iron Curtain " . Strengthening property is primarily for raising agricultural productivity and minimize costs . This activity includes: irrigation systems design , land use change , land protection . It will develop a model by exploiting the specific functions of GIS software and try to determine the optimal reallocation of parcels for productivity growth.

2. Model for the location of constructions outside areas subject to disasters and building restrictions .

This model has two purposes : to establish areas of potential risk and to avoid construction in areas with high agricultural potential .
Inputs :
- Establishment of risk to landslides. Will be made by determining the slope of land, afforestation and other elements established norms;
- Establish flood risk areas This data can be taken from the Water Risk Management project that has been accomplished in Roamnia a few years ago
- Assessment of other risk areas. The County Council will take over managing this map ;
Elements output :
- Areas that can not be built ;
- Areas where there is minimal risk ;
- Areas in which to build ;
- Areas which are more appropiate for agriculture than for construction.
A thorny problem is the way buildings were erected in Roamnia after the Revolution . Due to unclear procedures and lack of transparency and access to information , building permits were granted , often at the discretion of officials from City Hall. It will develop a model to try automatic determination of areas in which to build according to existing laws and safety restrictions .
3. Model for the construction of communication pathways in a locality .
Inputs :
- Projected path for the roads ;
- Parcels that the comunnication path is crossing and their owners ;
- Width of the corridor ;
- Land price according to the scale of notaries .
Elements output :
- Generating cadastrial files for expropriating every owner ;
- Generating the evaluations ;
- Generating the communication path corridor and tabulating it on the name of the expropriator.
This model will be based on the specific functions of a GIS and will refer in particular to the issue of expropriation for infrastructure projects. Modeling will be done on extra urban areas, considering the fact that in intra urban areas it is very difficult to create a model due to the existing constructions and fences.
4.In mountain villages of the problems facing local government is deforestation . This impacts both the landscape and the environment. In these conditions the GIS application may monitor the changes of forrest areas and a model will be made to standardize the afforestation process by authomaticlly choose land use and the type of work that will be done, esthablishing a timeline of afforestation and computing the formulas for wood resources.

3. Conclusions .

3.1 Outcomes:

- Gathetring the data available to create a single database in which all the services from a City Hall may have acces . This database allows for specific queries and analysis.
- Development of GIS applications that automate procedures related to land management , provision of social benefits , expropriations .

3.2 Benefits:

- The possibility of accessing the database by all services will lead to shortening of reaction to current problems

- Reduce the cost of purchasing the services of expropriation by generating infrastructure using GIS applications .
- Provide social benefits to people who really need it by making an application to quantify , monitor and help decizonal about the social problems
- Monitoring forest and automatic calculation of volume and wooded areas , resulting in savings of time and money
- Land management application will benefit increased productivity in agriculture , increase land value, optimizing geometry of land parcels and the urban development taking into consideration construction restrictions and hazzard areas.

Bibliography

1. *Badut Mircea - GIS - Sisteme informatice geografice, fundamente practice - Editura albastra 2007*
2. *Beregovskih Anna, Grishechkina Irina, Shalakhina Dghamilia, Miller Sergey , Petrovich Mikhail - Legislative Base, Spatial Planning, Transport and Ecology, GIS Technology, Vienna, 18-20 May, 2010*
3. *Chiritoiu Marin - Realizarea unui sistem informatic cadastral pentru gestionarea si sistematizarea localitatilor, Teza de doctorat, UTCB,2001*
4. *Cristea Catalina - Aplicatii ale tehnologiei SIG in domenii neconventionale, Teza de Doctorat, UTCB, 2011*
5. *Dou Jingli, Chen Yingyi, Jiang Yinjun, Wang Yuan, Li Daoliang, Zhang Fengrong - A web GIS based system for rural Land Consolidation in China, New Zeeland Journal of Agricultural Reserch, 2014*
6. *Droj Gabriela - Introducere in GIS - note de curs*
7. *Ghitau D, Paunescu C, Iosif G – Geodezie teoretica, Editura Universitatii din Bucuresti, 2013*
8. *Hien Le Ti Thu - Application GIS on envoiremental zonig and management (Case study in Hontai, Hanoi, Vietnam), 7th FIG Regional Conference, Spatial Data Servin People: Land Governance and the Envoirement - Buiding the Capacity, Hanoi, Vietnam, 19-22 October, 2009*
9. *Food and Agriculture Organization of The United Nation - The design of land consolidation pilot projects in Central and Eastern Europe, Rome, 2002*
10. *Kaufmann J, Steudler D - Cadastre 2014, 2008*
11. *Moldoveanu Constantin – Geodezie. Notiuni de geodezie fizica si elipsoidala, pozitionare, Editura MATRIXRom 2002*
12. *Moldoveanu Constantin - Sisteme Informatice in Masuratori Terestre, note de curs, Facultatea de Geodezie, UTCB, 2011*
13. *R K Lallianthanga, Hmingthanpuii - Integrated Land Use Planning of Aizawl District, Mizoram, India Using Geospatial Techniques, International Journal of Advanced Remote Sensing and GIS*
14. *2013, Volume 2, Issue 1, pp. 341-350*
15. *Palaghianu Ciprian - Impaduriri, Indrumar de intocmire a proiectului, Universitatea Stefan cel Mare, Suceava, Facultatea de Silvicultura, 2012*
16. *Sultan Stefan - Realizarea unui sistem informatic urban avand la baza date cadstrale, Teza de doctorat, UTCB, 2006*
17. *Teodoro A C, Duarte L - Forest fire risk maps: a GIS open source application – a case study in Norwest of Portugal, International Journal of Geographical Information Science, Vol 27, Isuue 4, 2013*

18. *Thu Trinh Thi Hoai - Monitoring changes in land use, 7th FIG Regional Conference, Spatial Data Servin People: Land Governance and the Envoirement - Buiding the Capacity, Hanoi, Vietnam, 19-22 October, 2009*
19. *Tongco Alejandro - Developing a GIS for rural villages in the Philippines, International Journal of Multidisciplinary Research, Vol 1, May 2011*
20. *Tourino Juan, Bullon Marcos, Parapar Jorge, Gonzalez Xesus, Crecente Rafael, Doallo Ramon, Rivera Francisco, Brugera Javier, Alvarez Carlos - A GIS embedded to support land consolidation plans in Galicia*
21. **** GIS for Cadastre Management, ESRI*
22. **** Proiect de reconstructie ecologica prin lucrari de impaduriri in vederea reabilitarii potentialului stational al padurilor care in prezent sunt degradate si neproductive (comuna Taureni)*

- *http://www.meteo.md/metodf1.htm*
- *http://www.ingr.ro/despre_noi/sectiune.php?id_sectiune=154*
- *http://www.esriro.ro/about-esri/about/index.html*