Aspects of Cadastral Data Management Using GIS and 3D Software

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Abstract: - In this article we want to highlight a number of advantages of cadastral data organization using GIS. Also we highlight the opportunity to model certain real estate objectives using dedicated 3D products. Because these approaches can be applied in the local public administration, are finally highlighted the advantages and disadvantages of such solutions, taking into consideration a case study developed in Galati County.

Key-Words: - Cadastre, GIS, 3D, real estate, database, spatial modeling

1 Introduction
In last period the technological evolution and progress in technical and computer fields go to the need to implement complex coherent and effective digital geographic systems used for resource planning and systematization by Cadastre and Land Registration Offices or local governments. Their use must lead to obtaining accurate, true and complete informations. Due to the nature of spatial and textual data contained in the database can be identified more effective decisions in local government and county cadastral offices. Data must be updated periodically because the changes of real estate owners are producing continuous changes among cadastral data in the the category of use of the building, the area, the rightful owner, possible adjustments of the property limits, mergers, dismemberments, and other main activities related to surveying, such as evidence of authorized persons, relational spatial analysis, achievement of land records, cadastral maps.

2 Creating GIS Database
Since land book system was implemented prior to the completion of the computerization project, most cadastral offices have had to develop tools for archiving and record programs that allow then more
easily transfer data from the temporary structure to the database structure unified defined by the World Bank project.

Database design consists in establishing of detailed structure. Any omissions or errors produced in this stage are usually difficult to repair later.

Stages of development:

- Identification of the spatial characteristics, attributes and thematic layers required involves: identifying all spatial and attribute data, thematic layers organization, identifying of thematic layers;

- Defining of the register parameters for each attribute: identifying the necessary attributes of each thematic layer

- Providing registration of the coordinates: the database is made up of a number of layers that cover the same geographical area. If the overlay is not correct, will cause problems in the graphical presentation and the presentation of final reports. Avoiding of these problems is made by registration coordinates.

- Designing of working files implies building of the database by acquiring the necessary data. If the characteristic elements are not in digital format, they will be introduced by scanning and vectorization methods.

3 GIS Analysis

GIS environments are dedicated to spatial analysis and the information environment in which these analysis are made is the digital map, layered organized.

Spatial analysis simultaneously meets the following goals:

- examination and interpretation of data;
- obtaining additional information by aggregating data;
- quantitative and qualitative evaluation of entities, processes and phenomena analyzed area;
- provide practical support for making the right decision.

Spatial analysis requires the use of analytical procedures, integrated database management, statistical analysis, geostatistics, image processing, computer cartography. [4]

Spatial modeling can be regarded as a complex spatial analysis (knowing as multiple analysis), resulting in spatial scenarios, analyzing data from one or more layers. It is based on the cartographic and boolean algebra, cartographic statistics, etc.

Spatial data analysis is based on geometry of layers. The main types of spatial data analysis are:

- formatting data for use in GIS;
- introducing and exporting data;
- georeferencing;
- integration of data (eg operations which can be applied on vector data: merge, union, clip, buffer, intersect, etc.).
- geometric data editing;
- map generalization by reducing number of items according to scale;
- spatial queries (roads that intersect an administrative limit, shortest path from ... to ... , etc.)

Analysis of attributes are refering to the operations on the data from the tables associated to layers and it includes:

- queries;
- edits;
- analyzing and ordering.

This type of analysis involves DBMS tools that can be classified as:

- query functions – to identify that informations that meet certain
conditions. It is realised based on syntax of SQL (Structured Query Language) and returns crowd records satisfying the imposed condition, without altering the original data (e.g., selection for attribute construction "Status" equals "Very bad")

- functions of generalization – are applied to change level of detail, linking graphics based on the values of attributes;
- processing functions - data from a table of attributes depending on their type (string, integer, etc.) may be subject to processing methods based on the datatype dedicated functions. The fields of the same type can be used to obtain the values stored in the table as a new field.

Integrate analysis of spatial and attribute data implies both spatial elements and their attributes, and can be:

- selection functions (the result is a new layer that has the original attributes attached);
- classification functions (for identifying and coding elements on defined ranges for the values of a particular attribute - for example, a map representation about population by defined numerical intervals);
- measuring functions that allow finding distances, areas, volumes (such as how many areas with use category of "construction - yard" exist in locality ...)
- geoprocessing functions applied on several layers (e.g., intersection, merge, union, etc.). These new features generate new informations both at geometric and attributes level. It is realised using Boolean operators.
- neighboring functions are useful to evaluate the behavior of certain areas that are near a position specified through buffer;
- connectivity functions are useful to identify how are connected segments or polygons. These include network analysis, determining the optimal path, etc.

Based on documents, technical data and spatial information needed for the GIS, cadastral computerization thus interfering in all phases:
- acquisition and validation of graphical data (orthophotos, topographical maps, cadastral parcel maps);
- processing of these data in purpose of including in a GIS project;
- alphanumeric data collection from the real estate sheet about the technical, economic and legal aspects of parcels and buildings and validation of data;
- collecting of alphanumeric data from cadastral records, general entry register and other various reports (such as authorized persons list, statements of property titles, removed aside of arable land);
- organizing and structuring the GIS project database and alphanumeric data;
- updating the textual data and graphic files to any change in the field;
- correlation between graphical and textual data;
- developing and maintaining applications of textual database management;
- developing and maintaining GIS project management processes;
- achieving of textual reports and graphical applications and some more complex queries requested by beneficiaries.

In Figures 1, 2, 3 are highlighted various specific queries of the situation in the study area from Galati County.

Figura 2 – Query of registered real estates
4 Aspects about three-dimensional modeling of buildings

Another relevant aspect is the use of cadastral information in local government to identify aspects of new construction and compliance with specified characteristics in building accord, or to issue a building authorization. To issue a new building authorization is easier to find in a digital 3D model the appearance and the facets of a building. For this purpose, the 3D modeling of built area could be useful. The hall architect can take a decision knowingly better the looking of the others buildings, the height regime, etc.

In figure 5 could be seen a part of 3D building model of the studied area. In this way the overall aspect of the locality could be improved, and the peoples and authorities cand have the certainty that the new buildings will not spoil the image of the locality. [3]

For this purpose can be used dedicated software. Usually the 3D model of the building is made in a third format such as 3ds Max, COLLADA, OpenFlight, or SketchUp. These models can be integrated with other existing data for an optimal viewing. There are several ways that can be used to import these models into a geodatabase for use in ArcGIS. The method is chosen depending on the type of model was available and the information contained in it. If the format includes information about the location of the model, it can be easily imported using a geoprocessing function for import of 3D files.

At international level, in the context of high urbanization process, the governments are experiencing a number of major issues such as [1]:

- developing an unplanned urban development;
- illegal construction of buildings;
- traffic congestion;
- pollution and environmental degradation.

To choose successfully an appropriate software must know the characteristics of each existing solution. In this paper, in Table 1 are shown the main elements of three software solutions.

One good choice is SketchUp software. Often, the authorities need to edit the detailed 3D geometry of objects. In this sense, often is an easier way to export the object to be edited in ArcGIS using a COLLADA model, and then uses a 3D modeling package of choice (eg SketchUp), followed by replacement of the old geometry object with the new object in an ArcGIS edit session. [2] We considered that is the easiest way because in this way are not necessary a very complex GIS knowledge, but is enough to solve the problem.

The COLLADA files (Collaborative Design Activity) is an XML representation of a 3D object.
that can mean additional image file image to be used as textures draped on 3D object geometry. This means that an item multipatch in COLLADA export is highlighted the modeling process using the modeling software SketchUp, applied to a new building from the studied area.

Table 1 – A Comparison between three 3D Softwares (adapted from [7])

<table>
<thead>
<tr>
<th>Software</th>
<th>Using</th>
<th>Developed by</th>
<th>Accepted formats - import</th>
<th>Accepted formats - export</th>
</tr>
</thead>
<tbody>
<tr>
<td>SketchUp</td>
<td>Computer Aided Design, Animation, Rendering</td>
<td>Google</td>
<td>JPG, PNG, TIF, TGA, BMP, SKP, SKP+KMZ, 3DS, DEM, DDF</td>
<td>FBX, 3DS, AI, ASE, ATR, BLK, DAE, DF, DWG, DFX, FLT, HTR, IGS, LAY, LP, M3G, OBJ, SAT, STL, VW, WRL</td>
</tr>
<tr>
<td>3ds Max</td>
<td>Modeling, Animation (Video Games), Lighting, Rendering</td>
<td>Autodesk</td>
<td>BX, 3DS, PRJ, AI, DAE, DEM, XML, DDF, DWG, DFX, FLT, HTR, IGE, IGS, IGES, IFT, WIRE, IAM, LS, VW, LP, OBJ, SAT, SHP, SKP, STL, TRC</td>
<td></td>
</tr>
<tr>
<td>Blender</td>
<td>Animation, Lighting, Modeling, Rendering, Video Game Creation, Visual 3D Effects, Sculpting, Basic Post-Production Video Editing</td>
<td>Blender Foundation</td>
<td>TGA, JPG, PNG, OpenEXR, DPX, Cineon, Radiance HDR, Iris, SGI Movie, IFF, AVI and QuickTime GIF, TIFF, PSD, MOV (Windows and Mac OS X), 3DS, Wavefront OBJ, DEC Object File Format, DirectX, Lightwave LWO, MD2, Motion Capture, Nendo, OpenFlight, PLY, Pro Engineer, Radiosity, Raw Triangle, Softimage, STL, TrueSpace, VideoScape, VRML, VRML97, X3D Extensible 3D</td>
<td></td>
</tr>
</tbody>
</table>

Figure 6 – Modeling and draping of images in SketchUp

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4 Conclusion

Each local authority must design a plan which have the following goals:
- organising intravilan areas;
- protecting natural areas;
- preparing designing of the public infrastructure;
- providing the legal context for new buildings.

In this plan, must be included [5]:
- limits of urban areas taking account of characteristics of soil;
- assignments of zones according to planned use (industrial, rural, etc.);
- building density in populated areas;
- designing and establishing the location for new roads;
- evidence of protected areas (ecological areas, archaeological areas, forest, etc.)

Cadastral data collected by location and delimitation map, tables and registers of cadastral numbers, must be designed to allow optimal queries on the existing situation in the field at a time.

The advantages of using GIS for cadastral and local authority purposes consist of integrating different types of maps in the purpose of presenting realistic images, three-dimensional situation, which present information more effectively than traditional paper - 2D dimensional.

Graphical presentation using GIS techniques make visible the relationships between elements of the map, increasing the ability to extract and analyze the information.

In this way could be combined different maps and can be integrated informations from various sources of satellite information, simulating interactions in natural systems.

Briefly, the advantages of using GIS for cadastral and local authority purposes are:
- coherently organized data
- eliminating data redundancy
- easy updating
- conducting analyzes, varied statistics queries
- increase productivity

As disadvantages we can mention:
- complexity
- difficulties in training staff

References:


