CADASTRAL DATA INTEGRATION AND SPATIAL ANALYSIS FOR A CADASTRAL SECTOR, UAT ŞOMCUTA MARE, MARAMUREŞ COUNTY

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***Abstract**: The rapid advances in Geographic Information System (GIS) technology have had an immense impact on parcel data collection and on the evolution of conceptual models themselves. The application of GIS technology in cadastre is concerned on issues like land ownership, land planning and land management. Land ownership has been critical to the economic and philosophical development of the Romania. In a modern cadastral GIS, land parcel databases describe a combination of the rights, interests, ownership, and value of property. Land parcel databases represent the distribution of the real property assets of a community and its ownership, form the basis for all land use and zoning decisions, and represent the location of residences, businesses, and public lands. In other words, almost every aspect of government and business can be associated with a land parcel.*

***Keywords:** GIS, Cadastre, Spatial analysis*

1. Introduction

GIS plays an important role in the integration, management and the analysis of cadastral data. The GIS system can be considered as an information management system or as a support for the decision-making system. GIS provides the possibility to entry, to maintain and especially to interpret and to analyse rapidly and efficiently the data regarding the cadastral data. GIS can easily operate large data quantities, can offer the possibility to perform complex analyses on spatial data, and advanced possibilities to display the results of these analyses.

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The data integration and spatial analysis is for a cadastral sector, from UAT (Teritorial Adminsitration Unit) Şomcuta Mare, Maramureş county. The Şomcuta Mare city is located in Maramureş county, in the south of Baia Mare depression, at the bottom of Chioarului hills, on the course of Bârsău river. The studied cadastral sector are situated near of the county road 182C, between Şomcuta Mare and Baia Mare.

2. Data capture and integration

According to the studies that had been carried out, more than 80% of cadastral data have a geographical reference, thus the GIS support is necessary for the efficient development of the activities and for the informational flow fluidisation. Considering the importance of the geographical data in the work of these companies, the GIS applications have a great contribution to the optimisation of the informational flows.

The data represent the most important component of the GIS system. They represent the elements used in an Information System for modelling or representing the reality. The processes concerning the data definition, finding, cleaning and integration take 70-80 % of the time and costs necessary for a GIS project.

Spatial data frequently exists as maps, tables, computer files and paper based lists before their entry into a GIS. Data input is the process of converting data from their existing form to one that can be used by the GIS.

The data sources that were used for the data collection and further integration in the system were:

- Old cadastral maps (Fig. 1);
- Data gathered from GPS measurements;
- Orthophotoplans;
- Cadastral plans at 1:5.000 scale;
- Delimitation and situation plans certified by OCPI Maramureş.

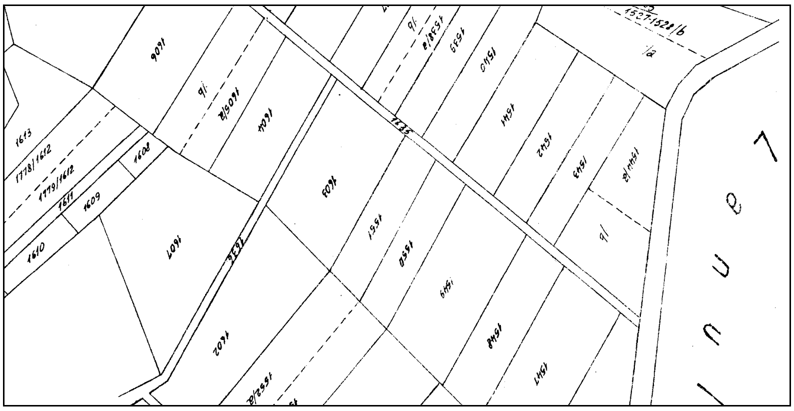

Fig. 1. Old cadastral plan from studied area

For the transfer from the data sources to the integrated databases, we needed to pass through several thorough planning stages with respect data integration into the system, as follows:

a. *Capture of the spatial data* (scanning old cadastral maps, cadastral plans at 1:5.000 scale, Delimitation and situation plans certified by OCPI Maramureş; vectorization; GPS measured data)
b. *Geo-referentiation* ('70 Stereogrpahical Projection, in single secant plan, on the Krasowski elipsoid)
c. *Editing/graphic cleaning* (identification and correction of spatial errors)
d. *Purchase of the attribute-type data (Fig. 2)*

Storing the data in the two formats, geographic (spatial) data and attribute-type (textual) data and connecting these two types of data make GIS an extremely powerful tool. Thus, GIS is not only a computerised system for automated map production or a computerised graphic system for general use, but it is a system that can store, process, combine and analyse data and information on spatial entities in a context integrated with databases, *producing new added-value information***.** I used AutoCAD Map for the storage of attribute-type data, as well as for creating the connection with the graphic data.

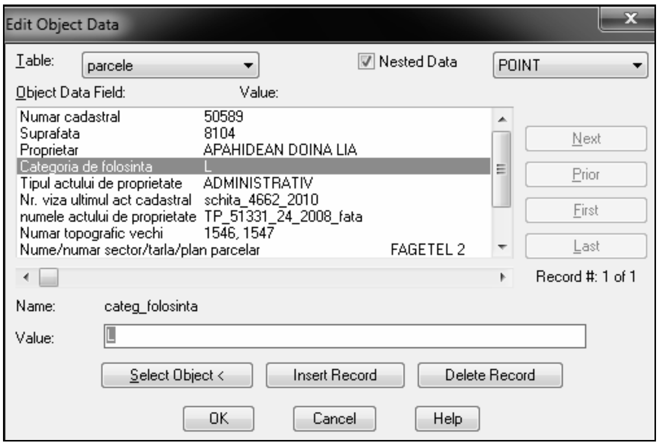

Fig. 2. A sample of attribute data atached at parcel with 50589 cadastral number

In fig. 3 is presented a fragment from final digital vector map and the map layers.

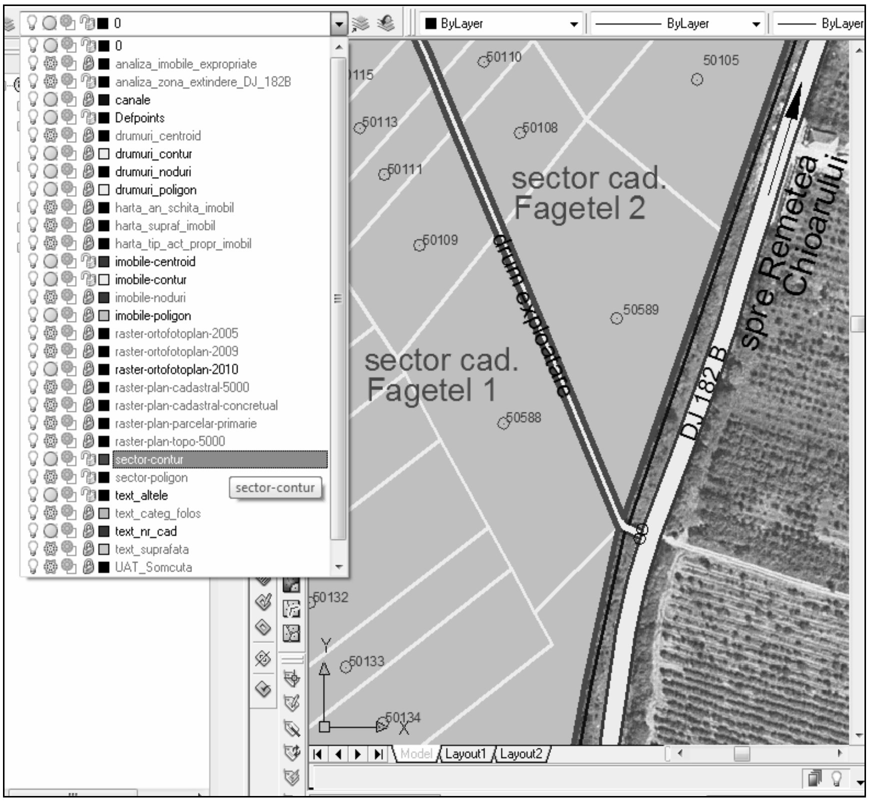

Fig. 3. A fragment from digital vector map

Topology is an important concept in GIS. Topology expresses the spatial relationships between connecting or adjacent vector features (points, networks and polygons) in a GIS.
A GIS can recognize and analyze the spatial relationships that exist within digitally stored spatial data. These topological relationships allow complex spatial modelling and analysis to

be performed. Topological relationships between geometric entities traditionally include adjacency (what adjoins what), containment (what encloses what), and proximity (how close something is to something else). Topology is necessary for carrying out some types of spatial analysis, such as buffering or overlay.

So, after capturing and integration of spatial and atribut data, was created 2 polygon topology, one for the land parcels (Fig. 4.) and one for the county road (182J).

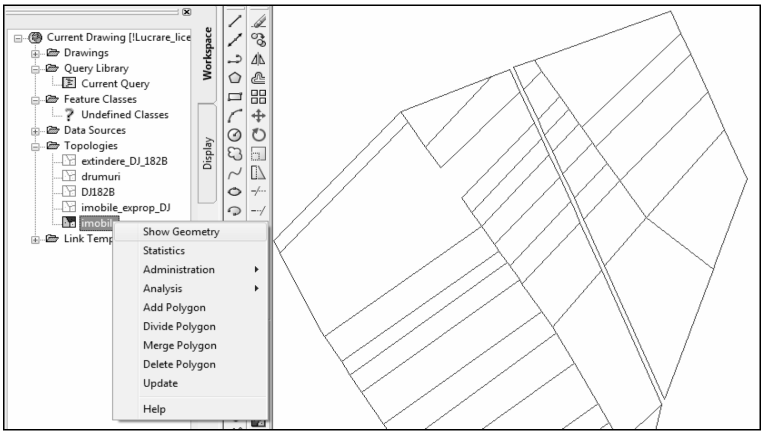

Fig. 4. Polygon topology for land parcels

3. Spatial analysis

GIS can easily operate large data quantities, can offer the possibility to perform complex analyses on spatial data, and advanced possibilities to display the results of these analyses. Nowadays, the success of an organisation depends on the possibility to reduce the decision process time, to make better decisions and to share strategic information within the organisation. The employees in the public and private sectors found that they could take better decisions using the spatial element of the existing information. The possibility to view the spatial information and to make spatial analyses provide them a strategic advantage.

Spatial analysis is a set of techniques for analyzing spatial data. The results of spatial analysis are dependent on the locations of the objects being analyzed. Spatial analysis includes any of the formal techniques which study entities using their topological, geometric, or geographic properties.

The main objective a GIS is the Spatial Analysis of geo-referential data and of regionalised variables. In other words, we could state that GIS is an informaict background for spatial analysis. (Haidu I. and Haidu C., 1998)

Query. Retrivieng data by quering a GIS database is one of the most common task for wich a GIS may be used.

In general we may like to think of queries being of two types:

- attribute queries – "what are …"
- spatial queries – "where are…?"

Fig. 5 and 6 ilustrated two atribute query: the attribute data, the scanned delimitation situation plans and title deed of 50588 cadastral number.

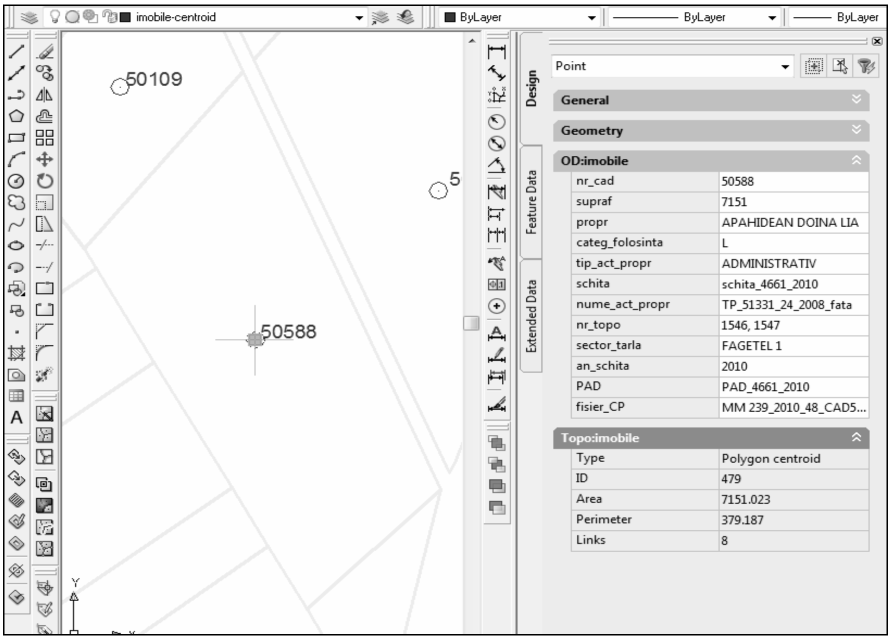

Fig. 5. Attribute query: the attribute of the land parcel with 50588 cadastral number

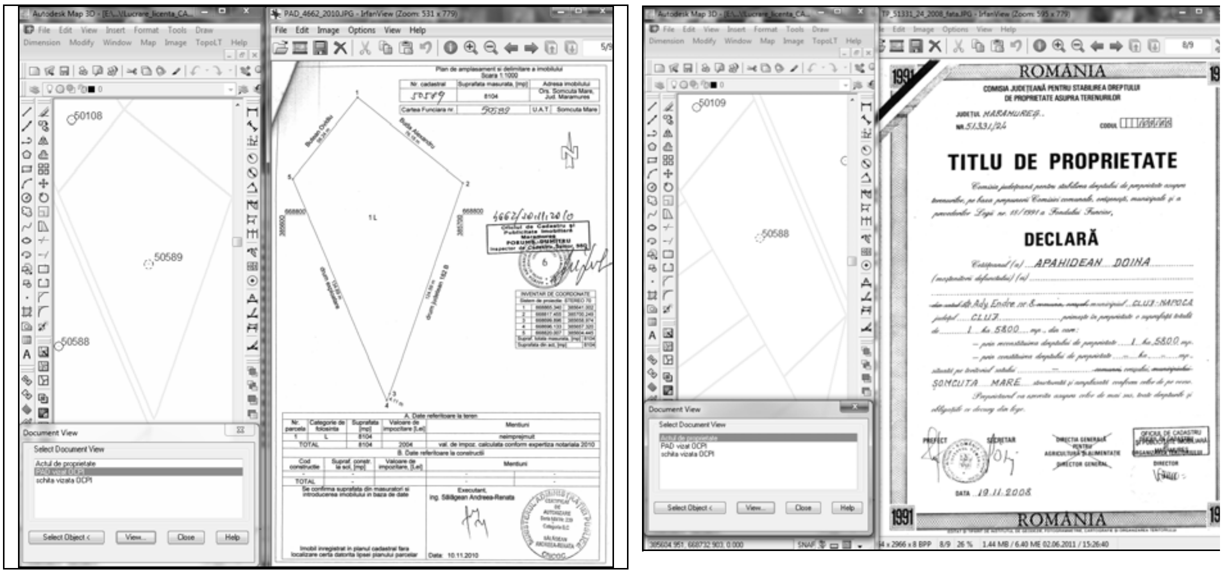

Fig. 6. Attribute query: Delimitation and situation plans and title deed of 50588 cadastral number

<u>Thematic map</u>. Thematic mapping uses display properties such as color, line type, and symbology to visualize attribute data corresponding to specific map features and to help identify and compare spatial patterns. Thematic maps are usually marked using only simple lines and colors. Different shades are used for different readings, such as concentrations of a particular soil type. Different colors are combined when more than one variable is being inspected, such as the different classes of property owners and where they intersect. Patterns are also used to denote more specific information on each variable.

Fig. 7 ilustrated two thematic maps: one by the area of land parcels and the second by title deed.

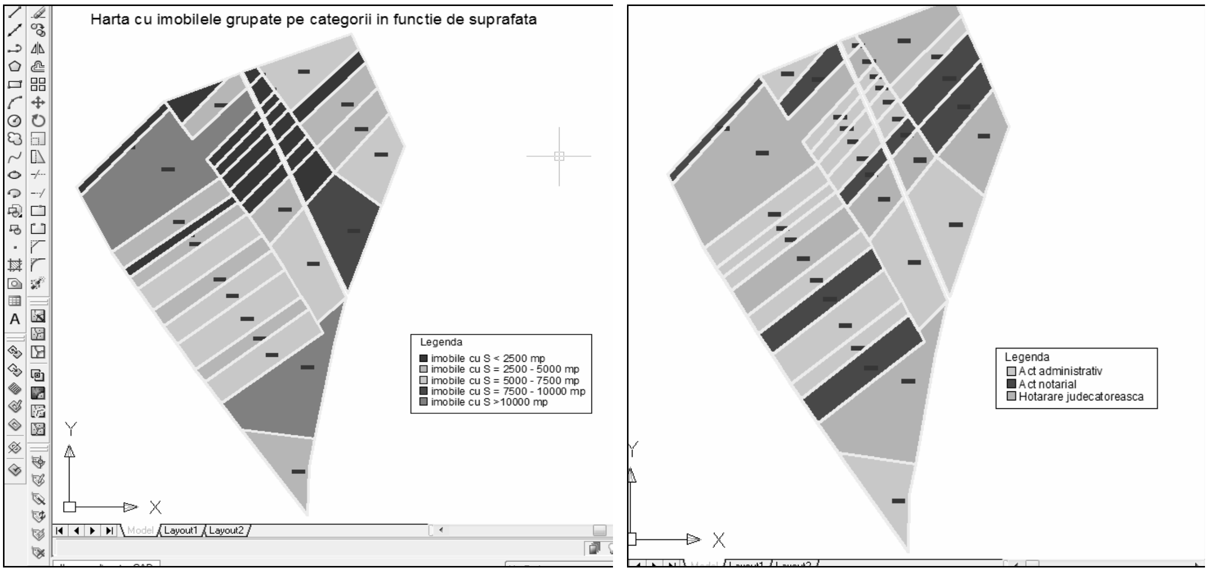

Fig. 7. Thematic maps: left by area, right by title deed

Buffer Analysis. A buffer is a polygon that is created at a specified distance from a feature or set of features. Buffers are used to determine proximity and to select other features for reporting or additional analysis. I used the buffer analysis to identify all affected land parcels by the country road 182C development an modernisation. In the present the road had 8.5 m width and for the modernisation in this area, the road will must have 20 m. Affected properties are identified by determining which parcels lie within a 10 m for the road axes (the buffer distance). Fig. 8 ilustrated the the buffer polygon and the land parcels from the studied area.

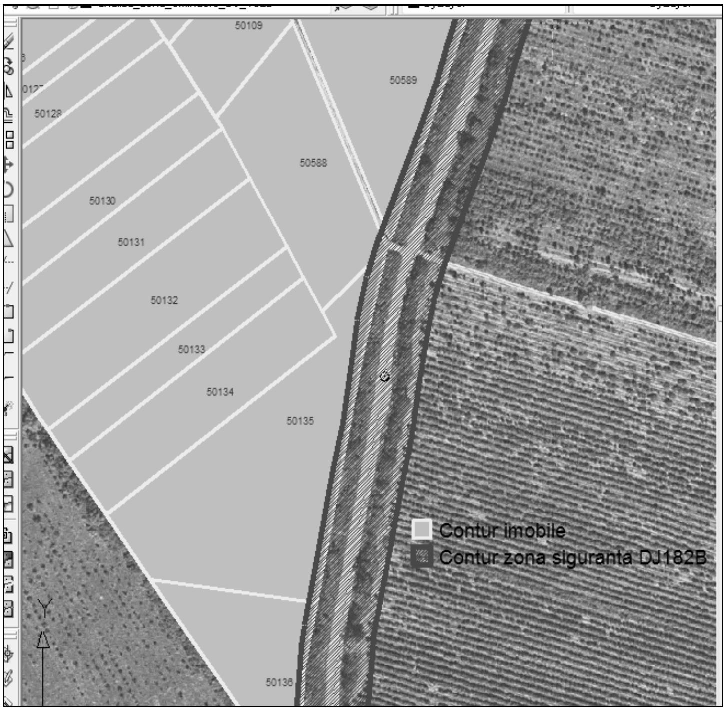

Fig. 8. Buffer analysis: Buffer polygon generated to identify affected land parcels after the 182C county road modernisation

<u>Overlay analysis</u>. Overlay analysis is used to determine the spatial relationship between different topologies. The method accepts two input topologies to create a third based on a stipulated overlay operation such as intersection, union, and clip. The reason these operations are known as "topological" overlay is because the overlay process includes the rebuilding of the topological relationships that make layers function. In the GIS, where lines intersect between one layer and another, vertices are created. Where lines or points share the same space as polygons, the lines and points inherit the attributes of the spatially corresponding polygons. New layers are formed which can take on the attributes or coordinate properties of input datasets. Some or all features from the input datasets are passed on to the output. Attribute values from both input datasets are passed on to the output dataset.

I used the topology overlay intersection, for the land parcels topology and buffer polygon, to identify affected land parcels after 182C county road modernisation. Intersect determines the geometry that overlaps in the Source and Overlay feature sources. Anything that does not overlap is discarded from the output, so the resulting layer represents what the Source and Overlay have in common. The resulting topology includes features from the areas common to both source and overlay inputs and contains attributes from both.

Fig 9. ilustrated the land parcels affected and the attribute data. This information are very usefull for expropriation and the future development of the county road.

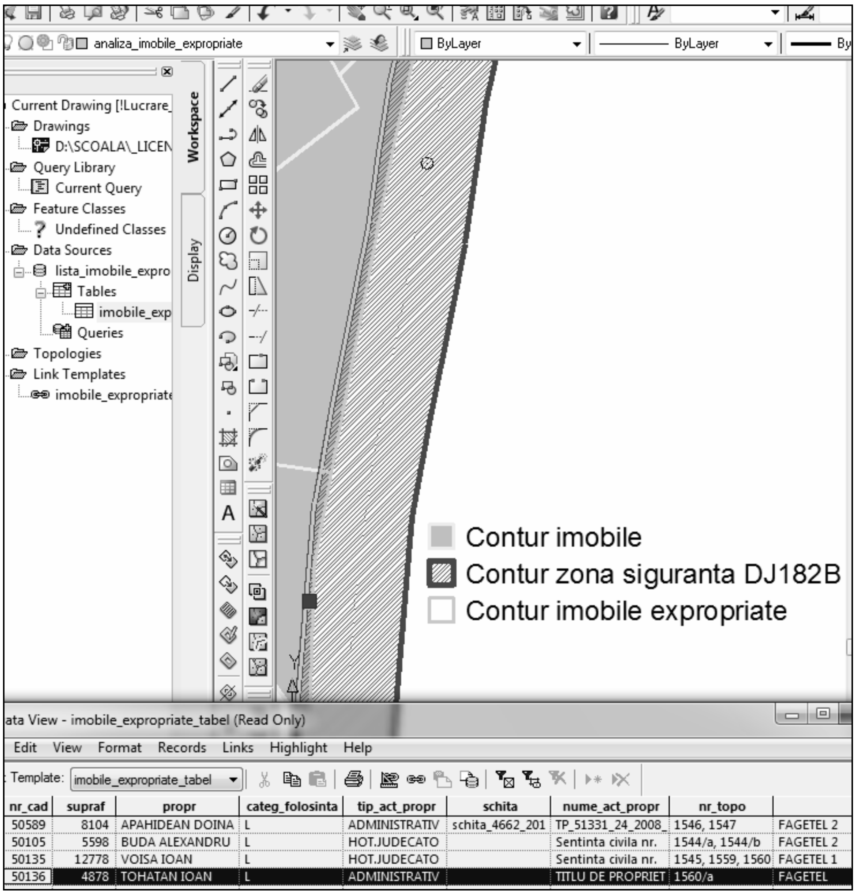

Fig. 9. The land parcels affected and the attribute data

4. Conclusions

The GIS processing results are not only much more effective in the information process – decision-making, production, inventory – where they are used, but also they entirely change our perception with respect to the surrounding reality: they provide a quicker and better understanding of the facts and phenomena we analyse and act on

By using the GIS technology for cadastral data, I integrated the data into the system, this operation being extremely difficult to perform using other methods. With this operation I tried to combine different data in order to obtain new information.

The spatial analysis (query, thematic map, buffering and overlay analysis) is very usefull in the management and decision process for land parcels and for the future modernisation and development of infrastructure.

5. References

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