USAGE OF GIS IN DETERMINING OPTIMAL LOCATIONS FOR PARKING SPACES. APPLICATION ON A CADASTRAL SECTOR FROM THE CITY OF BAIA MARE, MARAMUREŞ COUNTY

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***Abstract**: Due to the necessity to integrate, administer, and interpret, with the utmost efficiency, a large volume of data, as well as due to the rapid development of information technologies, Geographic Informational Systems (GIS) prove their necessity and utility for several domains that deal with spatial information. The paper at hand presents a case study which aims to determine the most favourable locations for parking spaces in a cadastral sector of Baia Mare, Maramureş County. The goal is to present the utility and efficiency of GIS in such analyses, in order to make the correct decisions.*

***Key words:** GIS, cadastre, spatial analysis, spatial data.*

1. Introduction

Geographic Information Systems or GIS play an important role in the integration, management, and analysis of cadastral data. GIS can be considered an information management system or a support element for the decision-making structure. GIS provide the possibility to introduce, maintain, and especially rapidly and efficiently interpret and analyse data regarding cadastral information. GIS can easily operate with large data quantities; it can offer the possibility to perform complex analyses on spatial data, and advanced ways to display the results of these analyses.

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 on reality: they provide a quicker and better understanding of the facts and phenomena we analyse and act on.

Spatial analysis must fulfill at the same time the following goals: data examination and intepretation, obtaining additional information that is apparently hidden, quantitative and qualitative entity evaluation of processes and phenomena from the analysed space, and providing concrete support for correct decisions.

2. Description of the study area

The first stage of every GIS project consists of the identification of the area that is to be studied and its transformation into a spatial model. The creation of the model represents a continuous iterative process, as the more information we get on the environment and transfer it into the model, the more we can identify the model's weaknesses and modify them. One of the most important stages of GIS applications' development is the definition of the required data, which is the point when we go from simple design to actual implementation (that is the transfer from the profound cognition of the problem to the GIS analysis usable method).

The area from the City of Baia Mare's built up area for which GIS technology was implemented is a cadastral sector demarcated by Bucuresti Boulevard to the south, Republicii Boulevard to the west, Unirii Boulevard to the east, and Sasar River to the north. The surface area of this cadastral sector is 36.13 ha.

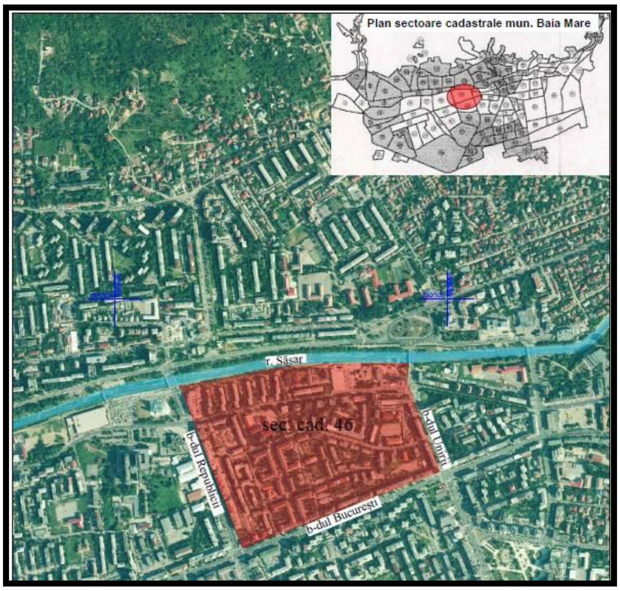

Fig. 1. The study area – cadastral sector from the City of Baia Mare

According to the General Urban Plan of Baia Mare, the sector at hand is comprised of mixed function areas, with collective housing and services.

Being located close to the central area of Baia Mare, the sector is a mix of functions, being heavily used by its inhabitants. The built structure is very dense and consists of buildings of different heights; thus, there are one floor buildings (generally consisting of services), and apartment buildings, most with commercial functions at ground floor and with a height of GF (ground floor)+2, GF+3, GF+4, GF+5, the highest reaching 10 stories high.

The main existing public facilities in this sector are educational institutions (George Coşbuc School, Nicolae Iorga School, Kindergarten no. 9 of Baia Mare, the Planetarium), healthcare institutions (St. Mary Policlinic, Helena Pharmacy), financial institutions (banks), religious buildings (a church), commercial areas (grocery stores at ground floor or individual buildings – a Billa supermarket).

Besides the major roads that define the studied area, there are secondary streets used to access buildings, such as George Cosbuc, Gh. Bilascu, Aviatorilor, Nicolae Iorga, Ana Ipătescu, and Ion Sugariu streets.

All constructions are connected to the public local water, sewage, gas, electricity, and telecommunication networks.

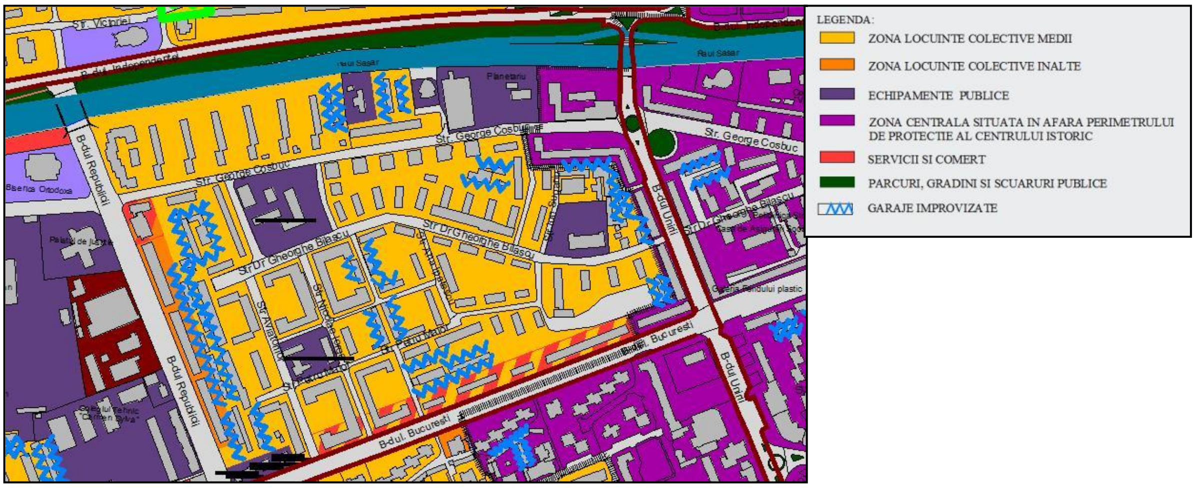

Fig. 2. Reglementations from the General Urban Plan for the study area

3. Data sources

Data represent the most important components of GIS, and act as the elements used in an Information System for modeling or for reality representation. The processes dealing with data definition, finding, cleaning, and integration take 70% to 80 % of the time and costs necessary for a GIS project.

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

Fig. 3. Digital vector map and orthoimage

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

- cadastral plans of the City of Baia Mare, 1:2000 scale;
- orthoimages of the City of Baia Mare, 1:1000 scale;
- the General Urban Plan of the City of Baia Mare;
- studies of public infrastructure;
- attribute data attached to spatial entities were mainly obtained through field research and from Baia Mare City Hall's data bases.

4. Spatial analysis

Most activities of local governments depend on geographic information, decisions taken at local levels depend on knowing the location of information and on understanding spatial interdependences.

GIS implementation within local governments is necessary, due to the following benefits:

- much more efficient data organisation;
- redundancy in data storage is eliminated;
- easier data update;
- efortless analyses, statistics, and searches;
- specific reports, statistical situations, etc. can be automatically generated;
- offers simple solutions to complicated problems;
- one can build prognoses, predictions, and trends of a phenomenon in time and space;
- better decisions can be taken.

The ArcMap application has an extension dedicated to spatial analysis functions. This operates with raster files and can be accessed from the ArcMap menu, by activating the Spatial Analyst function.

The functions of this extension are very useful, especially for urban planners and environmental protection specialists. They emphasize the true power of a geographic information system, through their complexity.

A multiple and complex analysis was created for the study zone, with the aim of finding the optimal location for developing a parking area, depending on two parameters: distance to existing parking areas (to be as far away as possible) and distances to apartment buildings (to be as close as possible).

For the two layers (apartment buildings and parking spaces) that were part of the multiple spatial analysis function, we first used the *Distance – Straight Line* function in order to determine the areas situated less than 50 meters from the buildings, and the areas situated at least 200 meters from any public parking space.

Fig. 4. The result of the Straight Line function for apartment buildings (20 m)

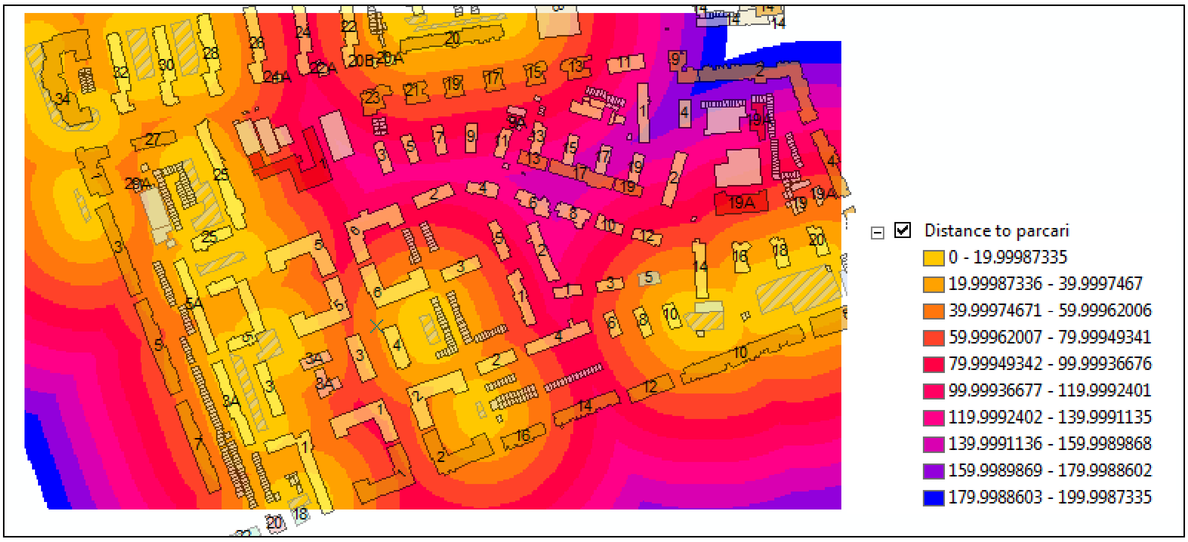

Fig. 5. The result of the Straight Line function for parkings (200 m)

After applying these functions, a reclassification was used (from the Spatial Analyst menu – Reclassify), which means "grades" from 1 to 10, depending on the areas' suitability with the proposed objective. Thus, the areas closest to apartment buildings received top "scores", while the closest to parking spaces received the lowest.

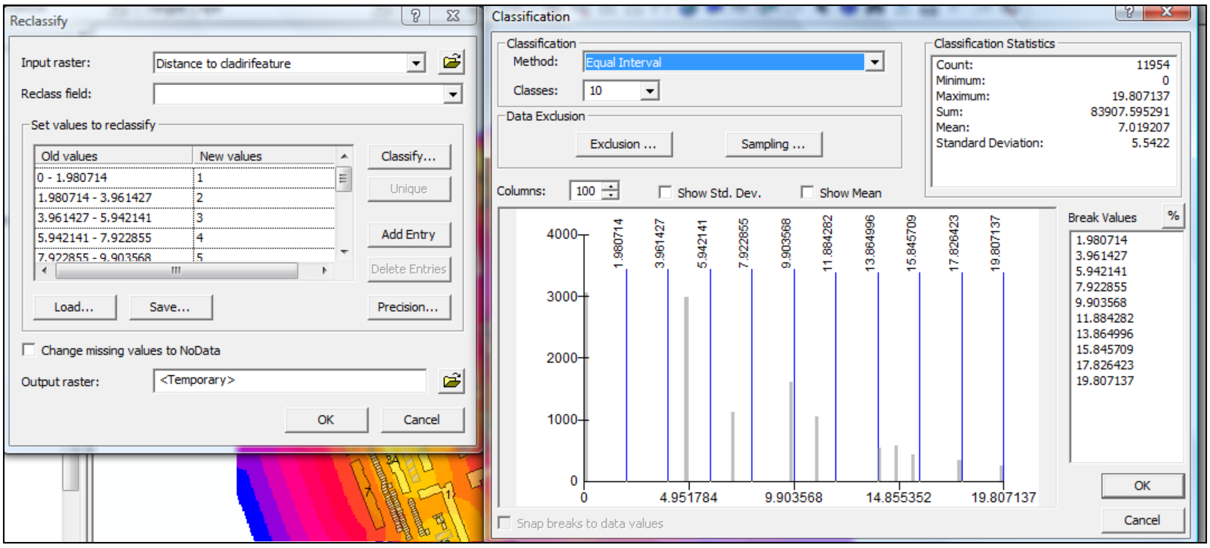

Fig. 6. The reclassification of the Straight Line result for apartment buildings (20 m)

Fig. 7. The reclassification of the Straight Line result for apartment buildings (20 m)

Fig. 8. The reclassification of the Straight Line result for parkings (200 m)

Finally, an expression was applied for the resulting classification functions, in which a value is attributed to each of the two imposed conditions. With the help of the *Raster Calculation* command, we created the following expression: "[Distance to cladirifeature] * 0.25 + [Reclass of Distance to parcari] * 0.75" – that is the allocation of 75% for the distance to existing parking space conditions and 25% for the distance to existing buildings conditions, leading to the optimal locations, represented in pink in the figure below.

Fig. 9 The optimal locations for parking lot development

5. Conclusions

The built GIS model is a stepping stone for developing a complex, practical geographic system, capable of spatial analyses and modelings, but mostly one that is essential for users working in local public administrations.

By using GIS technology, we integrated the data into the system, this operation being extremely difficult to perform by other means or methods. By conducting this operation, we tried to combine different data in order to obtain new information.

The spatial analysis is very useful for the management and decision process within local communities, and for the future infrastructure modernisation and development.

6. References

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