

GIS BASED AUTOMATED VALUATION MODELS – A GENUINE SOLUTION FOR REAL ESTATE VALUATION IN ROMANIA

Gabriela DROJ, Lecturer – University of Oradea, gabriela.droj@urbangisconsulting.ro
Laurențiu DROJ, Lecturer – University of Oradea, laurentiu.droj@gmail.com

Abstract: *In the latest period, the usage of statistical models in the valuation of real estate properties became very popular among appraisal specialists, bankers and researchers from this field. Many Automatic Valuation Models (AVM) using different statistical and mathematical models like regression, neural networks, and fuzzy logic were proposed and developed with the purpose of assessing the value of a property. Also Computer-Assisted Mass Appraisal (CAMA) became popular for mass valuation of the real estate in fields like taxation or banking sector.*

The main weakness of an AVM and a CAMA is the absence of the locational analysis of the real estate; even if the spatial component is a main characteristic in establishing the commercial value of a certain property. Geographical Information Systems may be used in order to improve the accuracy of the Automated Valuation Model (AVM) or Computer-Assisted Mass Appraisal (CAMA) by combining the statistical evaluation methods with the spatial locations on property value.

The cadastral maps as part of a geographical information system are essential to correct the mathematical models used in Computer Assisted Mass Appraisal. In this article, we analyze the applicability of geographical information system in property assessment, evaluating if the GIS automated models can be a solution for real estate valuation using a case study from the city of Oradea, Romania.

Keywords: *GIS, Automated Valuation Models, AVM, cadastral maps.*

1. Introduction

During the financial crisis of the latest years, both the companies and the banking system have been affected by the massive reduction of the values for the commercial properties bought or developed before the crisis. The main issue for the banking system all over the world was the recalculation of the warranties for the mortgages. The same issue was raised by the National Bank of Romania which asked all the commercial banks operating in Romania to re-evaluate their properties. In Romania, ANEVAR (National Association of Authorized Romanian Valuers) is the only recognized Romanian valuation organization and also the main authority in regulating the valuation activity and establishing standards similar to international standards. The *Methodological Guide - GME 520 – Valuation for ensuring guarantees for the loans* is mentioning the fact that global assessment of properties can be realized only for properties which can be organized as statistical populations (ANEVAR, 2014). In these category are included the real estate properties such as: apartments, residential land or individual housing units. The mass appraisal of the real estate properties became more and more an important discussion at the level of the major valuation associations such as: International Association of Assessing Officers (IAAO) which issued Standards on Mass

Appraisal of Real Property in 2013. These standards consider that the “market value for assessment purposes is generally determined through the application of mass appraisal techniques”. IAAO(2013) defines the mass appraisal process as a valuation of “a group of properties as of a given date and using common data, standardized methods, and statistical testing”. In order to determine a parcel’s value, the assessor must rely “upon valuation equations, tables, and schedules developed through mathematical analysis of market data”(IAAO, 2013). The main instrument in mass property appraisal is considered to be the Automatic Valuation Model (AVM). The Automated Valuation Model was defined by RICS(2015) as an instrument which uses “one or more mathematical techniques to provide an estimate of value of a specified property at a specified date, accompanied by a measure of confidence in the accuracy of the result, without human intervention post-initiation”.

In order to establish a value for a singular property every Automatic Valuation Model is using different statistical and mathematical models applied to a set of different properties with common characteristics. Computer Assisted Mass Appraisal (CAMA) is an informational system for collecting, storing and valuating properties by using different Automatic Valuation Models in order to ensure uniform valuation.

During the time different types of valuation models were used mainly based on hedonic models. Usually the hedonic models are estimating the value of a property based on the decomposition of the property into different characteristics which are estimated independently. Based on the hedonic model two similar properties situated in different neighborhood should have similar values therefore these models should be corrected by taking in consideration the spatial attributes of the property.

The evolution from descriptive to perspective maps increased the role of computer in map making. Geographical Information System represents a powerful set of tools for collecting, storing, retrieving at will, transforming and displaying spatial data from the real world.

The dependence of the value of the property with its location open the possibility to improve the accuracy of the Automat Valuation Models (AVM) and Computer Assisted Mass Appraisal (CAMA) with GIS. In the following we present the possibility of integration of GIS, cadastral data and modelling technologies applied to the field of appraisal

Usually the assessors have different AVM or CAMA application with databases including prices and costs for multiple types of characteristic which are influencing the value of a property. In order to improve this type of software we propose integration with cadastral information and if possible even with surveying data.

2. GIS based valuation models – study case on Oradea municipality

In the last three decades Geographical Information System (GIS) became a very powerful tool which proved its application in a big variety of fields. The popularity and the range of application of GIS has been constantly increasing while the cost of GIS applications and the cost of high quality remote sensing information have declined.

Nowadays GIS are used to improve the quality of statistical based appraisal valuation models. The quality and the efficiency of cadastral maps and different geostatistical information are useful in correcting the statistical and hedonic models used in classical Computer Assisted Mass Appraisal. The increased efficiency in inquiring the geospatial information and the vast possibility of displaying different thematic maps extend the AVM and CAMA with spatial components.

A geographical information system makes possible the graphical displaying of land usage, public networks, areas with environmental risks, neighborhoods, functional areas, public transportation, dynamics of the area, criminality and also market trends.

In a GIS based CAMA every type of information can be geocoded. Therefore by integrating GIS and CAMA allows to create and maintain more accurate and complex databases, useful not only for valuation purposes but also for establishing a fair tax valuation or for appraisal of commercial or residential properties. In this case, GIS provides a single geodatabase functioning as a repository of parcel geometry, descriptive data and mass appraisal input (ESRI, 2008).

The remote sensing data can be a very accurate source of geospatial information for any assessors. The 3D model of the terrain can offer information and allow different analyses like the influence of slopes, sunlight, wind direction, over the overall value of a certain property.



Fig. 1. 3D model of the city of Oradea, Romania – Model generated by the author

By integrating cadastral maps within a CAMA the assessors have all the information needed for the appraisal: type of property, zoning, public transportation, leisure areas, public utilities at parcel level but also information regarding the property itself like surfaces of a plot, area of a building, number of rooms, bathrooms, number of levels and all utilities connected. The integration of cadastral data in a CAMA makes accessible all the non-geospatial characteristics, influencing the value of a property, with a higher accuracy than in a statistical based CAMA or AVM.

In the following picture we present the cadastral information of a selected property in Oradea, all the cadastral information of the real estate property can be seen in the Attribute widow adjacent to the selection.

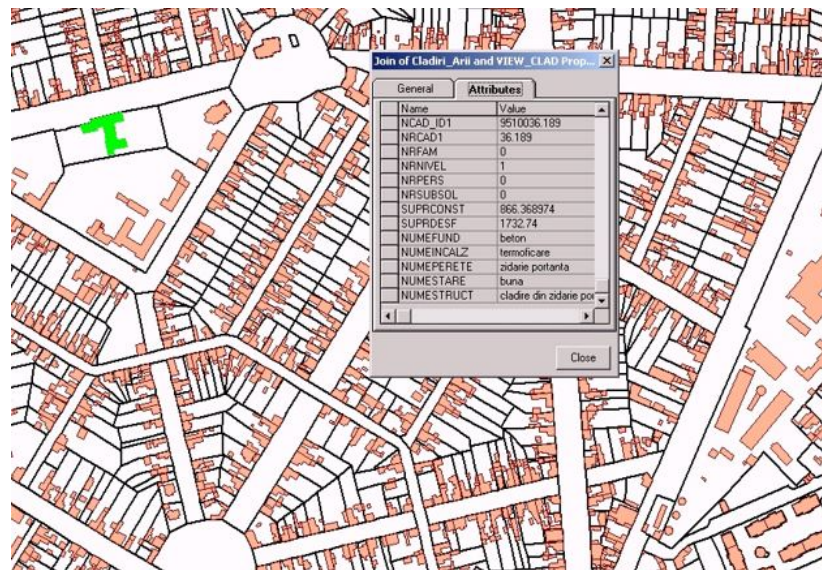


Fig. 2. CAMA Generation - Cadastral information about a property in the city of Oradea - Generated by the author

The following maps are presenting the effect of a GIS based CAMA. During the last decades, in every CAMA or AVM, the characteristics of a property was considered as the main influencing factor for a property valuation. The ANEVAR established every year a table with reference prices per square meter for each type of property (apartment depending on the number of bedrooms, commercial buildings and industrial buildings, name of municipality) based on the declarative prices.

This indices are used in any type of CAMA software in Romania, in taxation, banking sector and also by the insurance companies. The GIS based spatial analysis should improve the assessment by detailing any locational information to neighbourhood level. In the last week Romanian economic mass-media for the first time highlighted the problem of the enormous gap between similar real estate prices in same town but different neighbourhood from 633 euro/ square meter to 2164 euro/square meter (Ziarul Financiar 20.10.2015).

The GIS based CAMA developed for Oradea municipality allow price indices analysis for the neighbourhood. In the below picture was presented the thematic map regarding the average prices for single bedroom apartments in Oradea in September 2015. The lowest price paid for a single room apartment in Oradea in this period was 14,000 Euro and the highest price was 46,000 Euro in the central historical area of Oradea.

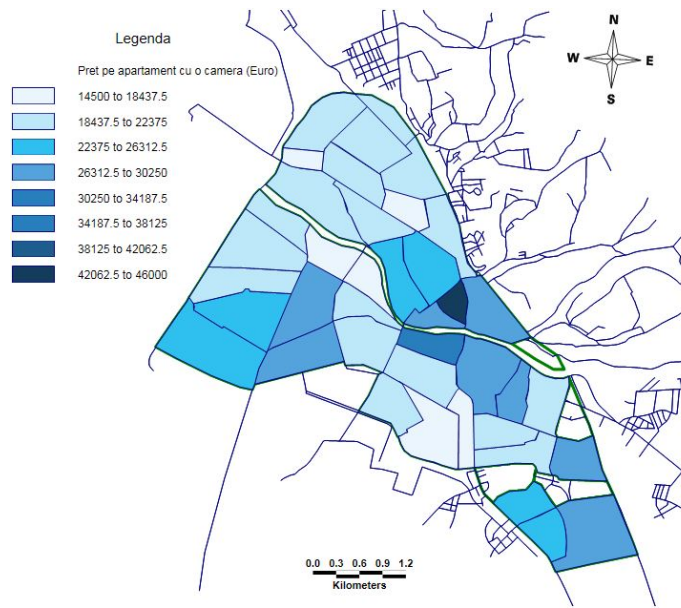


Fig 3. CAMA Generation – Average price for one room apartment depending on the neighborhood - Generated by the author

The neighbourhood with the highest average price is the historical part of the town adjacent to the pedestrian street followed closely by the surrounding neighbourhoods. A similar situation can be seen on the thematic map regarding the two room's apartments.

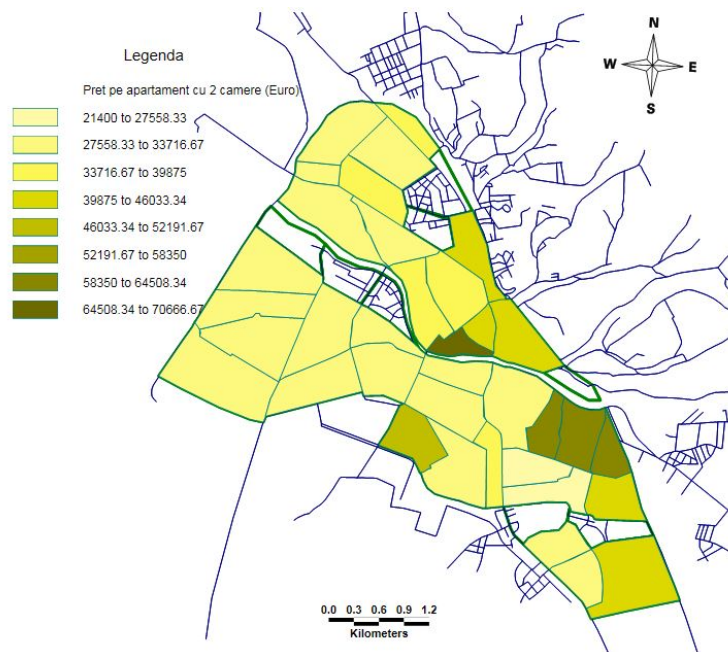


Fig 4. CAMA Generation – Average price for two room's apartment depending on the neighborhood - Generated by the author

As can be seen the GIS based CAMA for the two bedroom apartments is showing similar results with the results generated for the analysis of one bedroom apartments when

considering the highest average price: the city centre. The main difference is caused by high prices which are witnessed in the Nufarul Area especial in the area where were built new residential developments. On the other hand it can be seen that a large part of the city has similar prices for the two bedroom apartments, phenomenon which was not discovered in the analysis of one bedroom apartments or three bedrooms apartments. The main explanations can be considered the following:

- The loan programs, subsidized by the Government, for families which intend to buy their first apartment favor two rooms apartments for families without children or with no children
- Oradea is a city where are located four universities with a total estimated number of 22.000 students which all put a great pressure over the two bedroom apartments, the favorite choice for the students which do not prefer the student hostels.

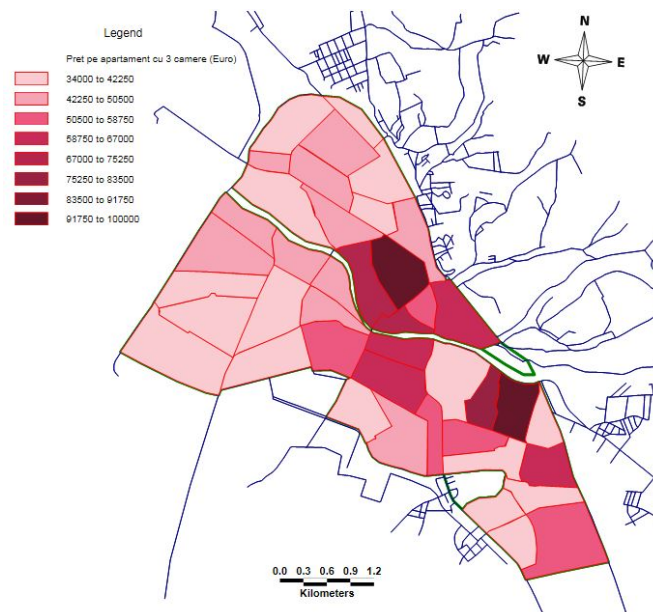


Fig 5. CAMA Generation – Average price for three room’s apartment depending on the neighborhood - Generated by the author

While analysing the three bedrooms apartments we can observe again the fact that the central area has the highest average prices but also we can observe that other two areas are having high average prices, as well. These areas: which are part of Rogerius and Nufarul neighbourhoods are having good infrastructure both physical and social: public networks, good transportation, leisure and commerce, good public schools, parks, markets, so on. These factors are influencing directly the prices for the apartments.

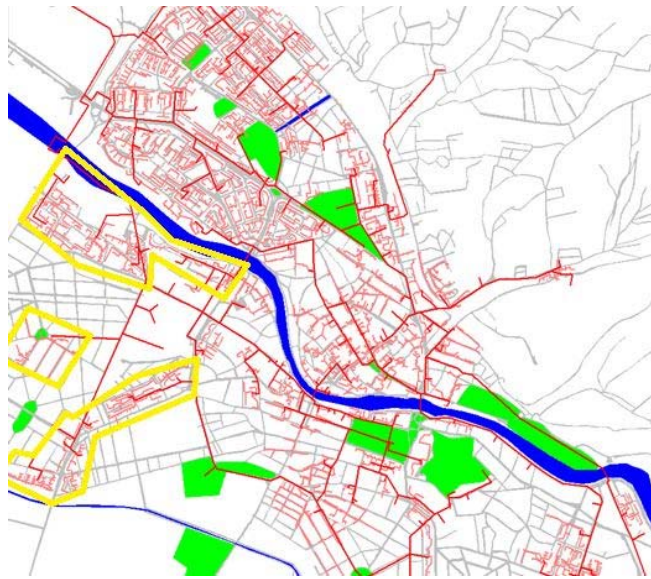


Fig 6. CAMA Generation – Impact over property valuation of infrastructure, public services -
Generated by the author

The last step of the study was to compare the results the GIS based CAMA with the GIS generated map containing the locational factors mentioned above (infrastructure, access, public services, leisure, education, pollution so on) for all three types of residential areas. The results were astonishing: the real estate market prices followed closely the locational factors which were generated by the GIS system proving without any doubt that GIS based CAMA can be an excellent solution for assessment of the property prices and also their evolution within the real estate market.

3. Conclusions

Usage of computer modelled statistical methods in valuation of real estate properties is considered one of the fastest rising trends in both the field of informational systems and also in the field of real estate valuation. Usage and AVM and CAMA is increasing considerably in the last years all over the world. In Romania this trend is still at the beginning and was introduced by ANEVAR through the *Methodological Guide - GME 520 – Valuation for ensuring guarantees for the loans* which is mentioning the fact that global assessment of properties can be realized only for properties which can be organized as statistical populations (ANEVAR, 2014). Under this context, the current article analyzed the applicability of geographical information system in property assessment, evaluating if the GIS automated models can be a solution for real estate valuation using a case study from the city of Oradea, Romania. The main conclusion of the case study were that the real estate market prices followed closely the locational factors which were generated by the GIS system proving without any doubt that GIS based CAMA can be an excellent solution for assessment of the property prices and also their evolution within the real estate market.

4. References

1. ANEVAR – Asociația Națională a Evaluatorilor Autorizați din România (2014) – *Standardele Naționale de Evaluare. GME 520. Anexa 2 Evaluarea globală a portofoliilor de garanții bancare București România*, available online: <http://nou.anevar.ro/sites/default/files/page-files/standarde-2014.pdf>
2. Droj L., Droj G.(2015) - *Considerations Regarding Valuation Of Private Properties Using The Automated Valuation Models Based On Gis*,
3. Droj L., Droj G. (2014) - *Usage of location analysis software in the evaluation of commercial real estate properties, Emerging Markets Queries in Finance and Business – EMQFB2014*
4. ESRI (2008) – *Assessing Fair Market value with GIS*, ESRI, Illinois, USA, <http://www.esri.com/library/reprints/pdfs/assessing-fair-market.pdf>
5. *International Association of Assessing Officers (IAAO) 2013 - Standard on Mass Appraisal of Real Property*, Kansas City, USA, www.iaao.org
6. *International Association of Assessing Officers (IAAO) 2014 - Guidance on International Mass Appraisal and Related Tax Policy*, Kansas City, USA, www.iaao.org
7. Lisi G, Iacobini, M (2013) – *Real Estate Appraisals, hedonic models and the measurement of house price dispersion*, *Journal of Economics and Econometrics* Vol. 56, No. 1, pp. 61-73, http://www.eeri.eu/documents/jee/JEE_2013_01_04.pdf
8. Wachter, S. Thompson M, Gillen, K C (2005)– *Geospatial Analysis for Real Estate Valuation Model – GIS in Business*, Idea Group Publishing, Hershey, USA <http://www.irma-international.org/viewtitle/18872/>