# CONSIDERATIONS REGARDING VALUATION OF PRIVATE PROPERTIES USING THE AUTOMATED VALUATION MODELS BASED ON GIS

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**Abstract:** *The current paper deals with an issue of extreme novelty for the property assessment market from Romania: usage of automated valuation models in order to obtain the market value of real estate properties located in Romania. ANEVAR – Asociatia Nationala a Evaluatorilor din Romania in order to fasten the re-assessment of the guarantess owned by the Romanian banks introduces the Methodological Guide - GME 520 and its annexes opening for the first time the discussions about the opportunity of using mass property appraisal procedures and automatic valuation models for properties situated in Romania. The first chapter of the paper deals with the main instrument in mass property appraisal is considered to be the Automatic Valuation Model (AVM). The AVM is using different statistical and mathematical models: regression, neural networks, fuzzy, adaptive estimation in order to estimate the value of a singular property of the value of a set of properties with common characteristics. The annex 2 of GME 520 edited by ANEVAR(2014) considers that the creation of a Automatic Valuation Model (AVM) should be a solution for revaluation of the real estate's collateral portfolios held by banks. In the literature, there are a lot of different types of Automatic Valuation Model (AVM) based on statistical analyses. However the AVM cannot use the spatial and locational component of the real estate. Since the specialists suggest Geographical Information Systems can be used to improve the accuracy of the Automated Valuation Model (AVM) the second chapter of the paper constructs several elements of a GIS based Computer Assisted Mass Appraisal based on public information from the city of Oradea and tests them in order to obtain the best usage, comparative elements and correction prices for a property situated within the city. At the end of the article and assessment will be made regarding the usage of GIS based CAMA in Romania.*

**Keywords:** property valuation, ANEVAR, Automated Valuation Model(AVM), Computer assisted mass appraisal (CAMA), GIS

**JEL classification:** G32, G30, C31, C15, C63

## 1. Introduction

As Royal Institution of Chartered Surveyors - RICS (2015) considers valuation of property "as both an art and a science: an art, because of the need to make value judgments concerning the intangible features that attract certain buyers; and a science, because it is possible to establish trends and analyze how these are interpreted by buyers and sellers, including the value placed on particular property characteristics". Under these

circumstances usage of computer models to assist in the science of valuation is considered to be extremely important since the volume of data collected increased significantly in the last years and delivering to the assessors' excellent decisional instrument.
The valuation of properties in Romania has known a significant increase in importance in the last years. ANEVAR, the main body which regulates the valuation activity has done an increasing effort to bring the Romanian standards as close to international standards as possible. One of these efforts has been realized towards introducing mass property appraisal as a technique of valuation. 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).

These types of properties are considered to be:

- real estate such as: apartments, residential land, individual housing units;
- mobile goods such as: vehicles, trains, technological equipment;
- other types of goods which can be classified and organized as statistical populations.

Mass appraisal of the real estate properties is also 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 "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 values for individual parcels should not be based only on the sale price of a property; these standards suggest that valuation models should be applied to property data with the condition to be correct, complete, and up-to-date.
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".
The AVM is using different statistical and mathematical models: regression, neural networks, fuzzy, adaptive estimation in order to estimate the value of a singular property of the value of a set of properties with common characteristics.
The annex 2 of GME 520 edited by ANEVAR(2014) considers that the creation of a Automatic Valuation Model (AVM) should be a solution for revaluation of the real estate's collateral portfolios held by banks. In the literature, there are a lot of different types of Automatic Valuation Model (AVM) based on statistical analyses.
The AVM is applicable only in evaluation of the real estate in an active market with sufficient amounts of trading in order to use comparative methods.
A Computer-Assisted Mass Appraisal (CAMA) system is an automated system for maintaining property data, valuing property in order to ensure tax equity and uniform valuations. The Computer Assisted Mass Appraisal was very popular for tax purposes, and many municipal tax assessors have been using CAMA since 1980's.
Using CAMA the mass appraisal analysis must beg with the assignment of properties to use classes based on highest and best use, which normally equates to current use(IAAO, 2013). Zoning and other land use controls normally dictate highest and best use of vacant

land. In the absence of such restrictions, the assessor must determine the highest and best use of the land by analyzing the four components—legally permissible, physically possible, appropriately supported, and financially feasible— thereby resulting in the highest value (IAAO, 2013).
However the AVM or CAMA cannot use the spatial and locational component of the real estate. AVM and CAMA are trying to model the sale value of the properties. As the specialists suggest Geographical Information Systems can be used to improve the accuracy of the Automated Valuation Models (AVM).
The integration of spatial technology into traditional Automatic Valuation Model allows users to combine the locational effect on the value of the property with the statistical evaluation methods.
There are two basic types of econometric valuation used to estimate the price of a property: hedonic models and repeat sales models. Repeat sales model is based on the historical database of previous same property or similar properties over time. In Romania we do not have such a database therefore this model cannot be used.
On the other hand the hedonic pricing model calculates the value of a real estate property by decomposing into characteristics like number of bedrooms, number of stories; size of lot and summing the estimated the price per characteristics. These method was easily automatized but in this case two similar real estate properties with similar characteristics: distance to the centre, size of lot, building material, number of bedrooms, similar surface have closer value(Sibel 2008, Watcher 2005, Lisi 2013). Based on the hedonic model two similar properties situated at the same distance from the centre but one in a very good neighbourhood and the other in a zone with high criminality should have similar value. The hedonic model should be corrected by incorporating specific geospatial information. Therefore, introduction of GIS technology into statistical real estate assessment models has been considered to be highly efficient..

## 2. Case study – construction of a GIS based CAMA for the properties located in Oradea, Romania

The geographical informational system is used to improve the efficiency of the real estate statistical valuation models in different ways. Cadastral maps as part of GIS are very useful in correcting the hedonic models or in Computer assisted Mass Appraisal. A GIS permits graphic display of location, neighborhoods, land usage, utilities, risk zones, dynamic of the area and market trends. In a GIS based CAMA information like inspection dates, assessed values, sale price can be geocoded and displayed graphically. Such a map can show the difference between the assessed value and final sale price in order to identify potential area with big difference between valuation and final price. In addition, a GIS permits high-level analysis of nearby sales, neighborhoods, and market trends. These types of thematic map are crucial to improve the model.

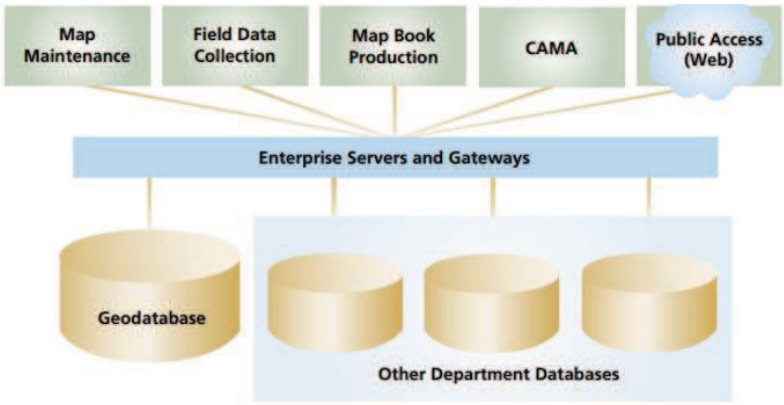


**Figure 1 - Sistem Arhitecture for Gis based CAMA (source ESRI, 2008)**

Integrating GIS and CAMA allows to create and maintain more accurate and complex database useful not only for valuation purpose but for a fair tax valuation. In this case, GIS provides a single geodatabase functioning as a repository of parcel geometry, descriptive data and mass appraisal input(ESRI, 2008).

The data collection for analysis supposes several steps: a physical inspection is the best way to obtain initial property characteristics data and, at a minimum, should include a comprehensive exterior inspection. However, there are several other data collection options(IAAO, 2014):

1. Use of previously captured data (data conversion)
2. Field canvasses
3. Targeted inspections (properties with building permits, sold properties, properties under appeal)
4. Imagery (e.g., aerial, oblique, and street level photography)
5. Returns submitted by property owners or taxpayers.

Physical inspection should be performed either by valuers or by trained data collectors. Depending on the data required, an interior inspection might be necessary. In some cases owner-provided property information can be used.

After the initial data collection a CAMA can be established and operated. The main criteria (RICS, 2015 and IAAO, 2013) which should be used for modeling selection are considered to be the following:

- Property Type
- Living area(number of rooms, bedrooms, bathrooms)
- Architectural style
- Construction quality or key components thereof (foundation, exterior wall type, and the like)
- Effective age or condition
- Building design or style
- Secondary areas including basements, garages, covered porches, and balconies
- Building features such as bathrooms and central air-conditioning
- Public parking
- Significant detached structures including guest houses, boat houses, and barns
- Lot size
- Available utilities (sewer, water, electricity)
- Location (e.g. geographic co-ordinates or allocation of a ‘locality’ identifier)
- Market area

- Submarket area or neighborhood
- Site amenities, especially view and golf course or water frontage
- External nuisances, (e.g., heavy traffic, airport noise, or proximity to commercial uses).

Since all these elements are included in a Geographic Information System based on CAMA, in the next part of the article, we will present the influence of each of the indicators over the value of commercial properties: buildings or land within the city of Oradea, Romania. First we will present the initiation phase: the raster containing the 3D model of the city.

***Figure 2 – 3D Model of Oradea city***
Source: Generated by the author

The 3D model allows a more suggestive analysis over the aspect of the area and it highlights the slopes, the landscape and the sunlight with direct influences over the property value.

The second step constitutes to introduce in the CAMA information regarding zoning, neighbourhood information, access to public transportation, leisure areas which have a direct influence over the price of a particular property. As can be seen the property selected for valuation is marked with green and it is compared with all other similar properties. In this stage is analysed also the functionality of the property compared to best possible usage. Also information regarding number of rooms, bathrooms, etc. is provided

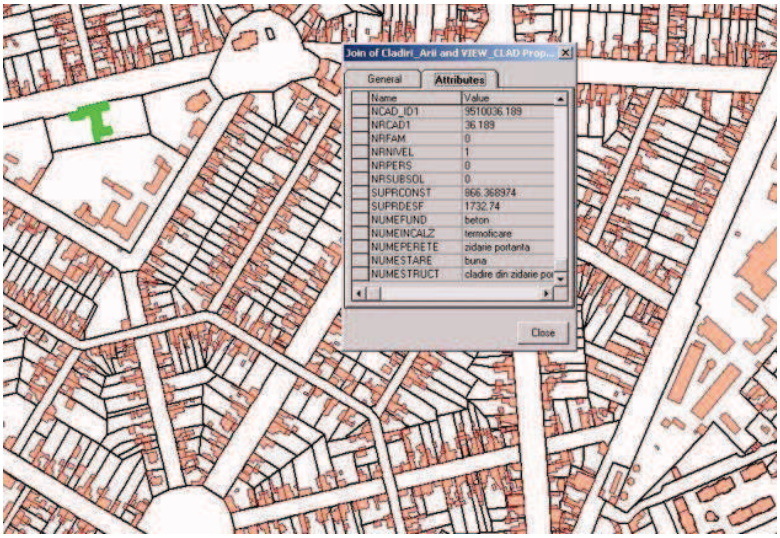


***Figure 3- CAMA Generation - Visualization of cadastral information regarding a specific property situated in the city of Oradea***
Source: Generated by the author

The third step of the analysis is to introduce information regarding the building itself: Construction quality and effective age or condition which are analyzed.


**Figure 4- *CAMA Generation* - Visualization of the construction quality and effective age**
Source: Generated by the author

An important factor in assessing the value of a property is given by the impact of the environmental hazards such as floods areas or possible land sliding areas.

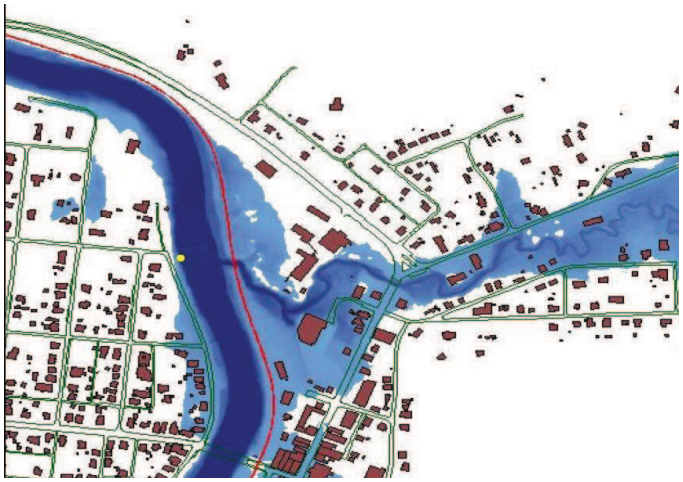

Figure 5 CAMA Generation – Impact over property valuation of the flood and land sliding areas in Oradea
Source: Generated by the author

Other important factor in CAMA are for Oradea are considered to be access to central heating network(red color), gas network(light red color) and thermal water networks(yellow color). For certain properties presence of these public infrastructure elements are essential to the final price of property.

Figure 6 CAMA Generation – Impact over property valuation of the central, gas and thermal heating
Source: Generated by the author

As can be seen, in the generation above a CAMA system based on GIS can assess similar properties in a faster way. These assessments can allow fast and accurate usage of the data in order to reassess properties in a large scale. However a hybrid GIS – CAMA system should be used in order to allow to the valuer to correct discrepancies of the AVM. It cannot be denied that a prime influence over its value can be directly considered to be the function of the building: residential, industrial or commercial and its compliance with the zoning of the city.

## 3. Conclusions

ANEVAR – Asociatia Nationala a Evaluatorilor din Romania in order to fasten the re-assessment of the guarantess owned by the Romanian banks introduces the Methodological Guide - GME 520 and its annexes opening for the first time the discussions about the opportunity of using mass appraisal procedures and automatic valuation models for properties situated in Romania.

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A GIS system permits graphic display of location, neighborhoods, land usage, utilities, risk zones, dynamic of the area and market trends. In a GIS based CAMA information like inspection dates, assessed values, sale price can be geocoded and displayed graphically.

The main conclusion of the paper is that: a CAMA system based on GIS can assess similar properties in a faster way. These assessments can allow fast and accurate usage of the data in order to reassess properties in a large scale. However a hybrid GIS – CAMA system should be used in order to allow to the assessor to correct discrepancies of the AVM. It cannot be denied that a prime influence over its value can be directly considered to be the function of the building: residential, industrial or commercial and its compliance with the zoning of the city. However a careful analysis should be realized periodically over the correction of the data composing the CAMA, since the market, urban, social and the environmental conditions can change significantly over time.

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