CONCEPTUAL GIS MODEL IN DETERMING MARKET VALUE FOR PROPERTIES

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Abstract:
Any property can be part of a transaction. This is the main premise to start the current study. As we know, the geographical information systems are used in many applications, respectively any spatial entity can be represented as a graphical feature. Why GIS applied in property valuation? The reasons are multiple, but between the main ones there are the following: this perspective is not being used at this moment in Romania; visualizing the property as a graphical feature containing the appropriate characteristics and its positioning with respect to the environment, no matter the nature of the environment (natural, economic, juridical, etc.); at the same time by creating a conceptual model, facilitating the spatial analysis of property is pursued, applied on its natural factors. The geospatial perspective in property valuation has as a purpose to determine the market value of the properties, a subjective value, with respect not only to real estate prices at the valuation moment, but also involving the geospatial factors in this process.

Key words: GIS, conceptual model, property valuation, market value

1. INTRODUCTION

GIS, used as an acronym for Geographical Information Systems, it's an important tool to create, to display, to manage and to analyze information spatially distributed through automated processes.

GIS is actually a system that has many types of elements informational spatially referenced, with respect to a coordinate system. The insertion, the storage, the management and the analysis of the components is made using a computer, the result, firstly, consists of visualizing complex information spatially referenced with respect to a spatial reference system, and secondary, there is the possibility to apply spatial analysis and complex correlations, impossible to be made through classic techniques. The functionality of the informational society it's based on the capacity to accumulate, to store and to use the information efficiently. The approached subject offers a working tool, respectively the geographic informational

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systems, for making the information management more efficient, starting from storing the data, moving on to the graphical display and spatial analysis.

Real estate market represents the interaction between the offers for properties to be sold and the requests made for this type of products to be bought. The actors in the real estate environment are the vendors, the buyers, the intermediate agencies for transactions and renting places, financial institutions, constructors, developers and others. The real estate market represents an economic category of goods production, in which all the buying/selling contracts find a meaning. It is seen as being an organic unit with respect to the relationships generated by it and connected to the space where those take place.

2. METHODOLOGY

The location property differentiates the majority of the markets considered to be efficient (a predictable behavior for buyers and sellers and the characteristics of the market products). The participants from the real estate market reply in different ways on market's products, their motivations and decisional criteria vary with respect to their position: final users, investors, speculators. They are well informed about market's conditions, its history, and the quality of products, the competition and the behavior of other participants. On the real estate market, the information is less transparent; many of the participants are not very familiar with the properties of the products traded on this market, because they don't deal frequently with real estate transactions.

The real estate rights are executed upon properties. These rights are registered into a formal document, such as a property title or a renting contract. This is the reason why the ownership is a juridical concept distinct form the term of property, which is a physical asset. The real estate rights cover all the powers, the advantages and the benefits related to the ownership upon properties. On the other side, the property includes the land itself, all the good that naturally make an entire with it, as well all the goods that are related to it, like buildings and land management.

What can we understand *the virtual image* of a property?

The context that the answer to this question will be explained is one from a spatial point of view, respectively representing the property spatially

referenced, containing its characteristics as attributes. *The virtual image* is built using the attributes of the property, from a geospatial perspective. The property has an area, perimeter, dimensions, complex
Through this method it is tried to estimate the difference the buyer infrastructures, etc. This type of a property image allows us to manipulate its characteristics; as well analytical methods can also be implemented on these characteristics.

Coming back to the real estate market, seen as a virtual environment for real estate transactions, its primary concern is the "virtual image" of the property, facilitating access to information on any type of real estate object.

Property valuation is the process of estimating a value type, for a type of property at a given time. Market value is the estimated amount for which a property should exchange on the date of valuation between a willing buyer and a willing seller in an arm's-length transaction after proper marketing wherein the parties had each acted knowledgeably, prudently and without compulsion. (IVS1 – Market Value Basis of Valuation)

All methods, techniques and procedures for measuring the market value, properly implemented, should lead to a common expression of market value. The manner in which property is traded on the real estate market, it can be distinguished the applicability of various methods and procedures for estimating the market value. "[...] *the estimated amount* [...]" refers to the price expressed in monetary terms (local currency), which can be paid for a property in an arm's-length transaction. Market value is quantified as the most probable price reasonably obtainable on the market at the valuation date, in correspondence with the definition of this value.

2.1 ASSESSMENT METHODS AND TECHNIQUES

2.1.1 COMPARATIVE METHOD

This method relies on the following premise: estimating the market value by analyzing the market is to find similar properties and then comparing these with the properties of assessment. Major premise of this method is that the market value of a property is directly related to prices of comparable and competitive properties. Comparative analysis focuses on similarities and differences between properties and transactions that affect the value. As a limitation of this method, it is rarely applied to special purpose

properties, because there are only few properties alike sold on the market. However, this limitation is not applicable to the scope of mortgage and/or real estate, where properties on the market are traded with the destination of residence.

2.1.2 COST METHOD

perceives between the property assessed and a new building constructed with optimal utility. An estimated cost its computed to build a replica or a replacement for an existing structure, which to use then to decrease the depreciation of property valuated, estimated on valuation date. The foundation of this method is the substitution principle (no buyer will pay more for a property than the cost of acquiring land and a building immediately with a similar utility and attractiveness). Cost method is important in estimating the market value of new buildings or relatively new, since in such cases the cost and market value are usually close.

2.1.3 INCOME METHOD

The property is considered as an income generating investment. Revenue-generating properties are purchased for investment and from the investor's point of view; the ability to make profits is a key element influencing the property value.

2.1.4 NOMINAL ASSET LAND VALUATION METHOD

Property values reflect the ability to perform a function. With respect to the properties, the functional qualities may include: influence of location (access to points of interest), physical attributes (size, shape, age and circumstances), legal factors, planning factors and economical standards.

A data model is considered conceptual when it permits direct mapping between real-world perception and its representation through the concept of modeling. The dimension of data modeling is an area of representation of the real world that focuses on specific classes of phenomena, such as data structures, space, time, and multi-representation. Modeling dimensions are considered orthogonal if, when building a database

scheme, choosing a given dimension does not depend on choosing other dimensions. For example, it is possible to register a source location on a river (a spatial element inside a space dimension) without considering whether the source, inside the data structure was modeled as an independent object or as an attribute of the object *river*. Orthogonality highly simplifies the data model and its use, but in the same time is increasing its expressive power, such as the ability to represent all phenomena of interest.

The conceptual model assumes to be a way of solving spatial problems. Representation model attempts to describe the objects in the environment, for example buildings, rivers and forests. The creation of these models of representation is executed in a GIS, stored in data sets called layers. The spatial analysis can be applied on raster formats or vector formats. The representation model tends to capture the spatial relationships between objects and other objects in the environment, such as for example, the shape of a building and the distribution of other buildings. During the establishment of spatial relationships, a GIS representation model is able to model objects and attributes.

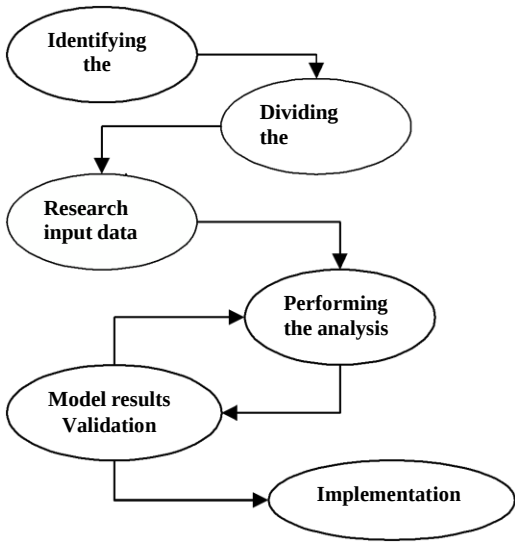

Figure 1. Conceptual model for solving spatial problems

Processing models attempt to describe the interactions between objects in the representation model. Relationships between them are modeled using spatial analysis methods. Process modeling can be interpreted as a cartographic modeling. They are used not only to describe the processes but also in forecasting events. Each function and spatial analysis operation can be considered a model for processing.

Identifying the problem

With the purpose of solving spatial problems, first we have to identify the problem that has to be solved and also the purpose we want to achieve.

Dividing the problem

By dividing the problem, all steps necessary to perform the modeling process are identified and also to establish data used for processing, as well setting goals to achieve that purpose.

Research input data

It is important to understand spatial relations and the relations between attributes of individual objects in the environment, and also the major relationships between these objects. To understand them, we have to examine the input data. This aspect, currently, it can't be done with any GIS software.

Performing the analysis

This step in identifying all the methods that must be used to complete the model.

Model results validation

Depending on the model used, the results are checked to determine whether changes are needed in the parameters, or if there have been created several models, we have to determine which of these is most appropriate.

Implementation

We can say that space problem is solved when the results of a model achieves the established purpose in the preliminary stage.

Thus, using the steps listed above, using a conceptual model can be solved any spatial problems. All the factors within a spatial modeling are represented either by graphical primitives, such as point, line or polygon, or raster format.

Any spatial problem can be interpreted in a GIS perspective. Depending on the complexity of the issues, the main 'actors' must be

identified in the modeling process. Conceptual model comes as a help in solving spatial problems.

The main thing to realize is determining the market value of a property. Thus, achieving this purpose, the factors that influence this value must be identified.

Property assessment is quite difficult in terms of identifying the participants in the decision-making process.

The market area. The zone. The value of a property can be influenced, or even modified, by various social factors, economic, administrative and environmental. Within a zone of influence, there are acting factors which determine the property value. Area of influence and, more comprehensive, the market area is the perimeter characterized by certain factors, where the valuated property compete with other assessed properties to attract attention of buyers and sellers on the real estate market.

Market areas are defined by a combination of factors: physical, demographic and socio-economic characteristics of residents or tenants, condition of building (age, degree of maintenance, high vacancy, etc.) and trends in the use of properties.

Analyzing the market area will fix the framework or context in which to estimate the property value. A market area may include a neighborhood, a local area or wider areas - groups of settlements, where the influence factors of property value are identical. For the delineation of market areas perimeters, contribute the following: transportation ways (highways, main roads, railways), water formations (rivers, lakes and other waters) as well the odds changing landforms (hills, mountains, valleys, gorges, etc.). These can be important landmark borders.

Predominant in the market area definition remains the type of land use, but counting too the physical characteristics of the environment, architectural styles and practices in terms of infrastructure. It is possible that the boundaries of market areas overlap with those of maps, identified by: zip code, or numbering constituencies' reviews. Market area should be identified strictly in order to assess properties. In analyzing the market area, changes likely to be seized, area development trends, possible phase transition from one land use type to another type.

The change and the transition can affect different properties and may lead to positive effects, but negative effects upon the value. The change may take more or less, but the transition is usually permanent.

The basic tool used in the current study is the application ModelBuilder, included in the ArcGIS Desktop package. ModelBuilder is the application in which are created, edited and administrated the models.

The models represent the manner in which the work is automated. When the model is created, the set of tasks or functions applied to data is stored; this set can be accessed several times. By creating a model using ModelBuilder instruments are interconnected, the output data of an instrument is being interpreted as the input data for another tool.

The model created is added in ArcToolBox as a *model tool* that can be executed directly by accessing the function, or by Command Line window. In ArcToolBox, this conceptual model created has the following structure:

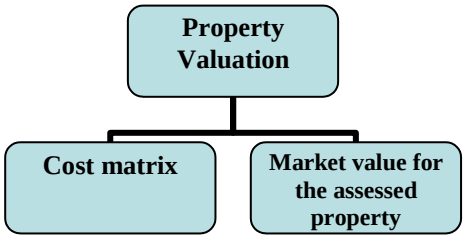

Figure 2. *Model Tool* structure

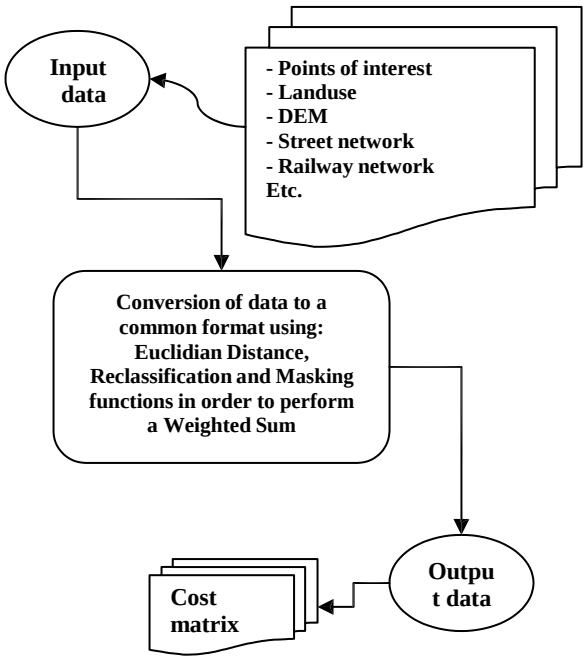

Figure 3. A conceptual model for a cost matrix

The model tool developed is composed of two main parts:

1. Cost matrix - calling this function created using conceptual modeling, the output result is a cost matrix, for the calculation of this matrix, a number of factors are involved, with the associated weights. *Weighted sum* function was used for the final calculation of the matrix, but up to this step, a series of functions have to be applied in order to transform the data in raster format.
2. Market value for the assessed property – There are many characteristics of properties involving difficulties in the evaluation process. Providing a comprehensible explanation to the owners of how their property was assessed is a challenge for evaluators, due to complexity of assessing properties.

The cells from the output raster files after running the model, in order to determine the market value for properties are defined as a multiplication

between the weighted sum of the physical characteristics and the area of the property valuated, according to the following formula:

$$V_i = S_i * \sum_{i=1}^{n} (C_i * p_i)$$

where V_i is the market value , S_i - property area, C_i - physical characteristics of properties and p_i - the weights.

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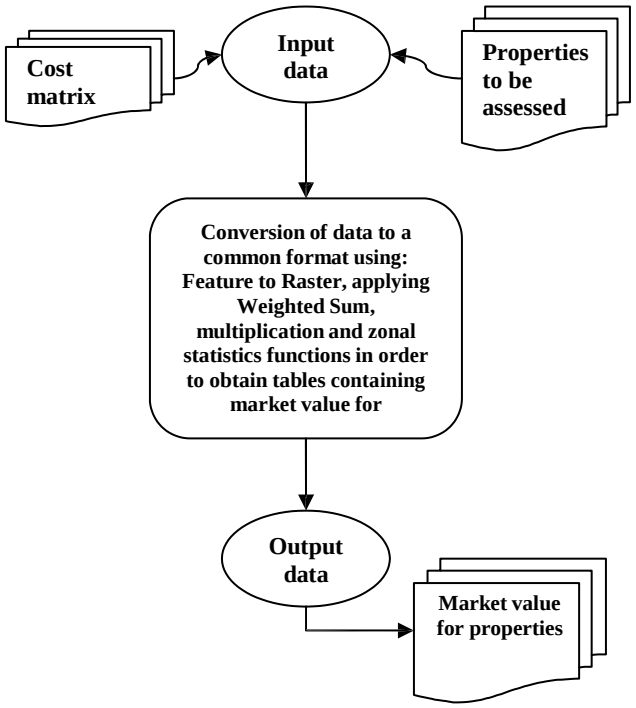

Figure 4. A conceptual model for determining the maket value for real estate properties

3. RESULTS

Land valuation is to identify the factors, with associated weights. The result is an opinion of market value assessment based on these factors and the relevance of this value on a sample of properties. Number of factors involved in the assessment of property is quite uncertain. Because of this fact, precise value of property can not be determined easily. Real value of buildings is almost impossible to determine, for which the estimated value is accepted

After running the first set of functions, from which the final result is a cost matrix, in this second part of the evaluation process, there is involved a number of individual features for properties, features that make the difference between them, and also there is assigned a subjective interpretation for the resulting values from the second conceptual model.

4. CONCLUSIONS

The conceptual model represents an abstract part of the real world and it is describing the logical structure of data in a database. Each database has its own conceptual model, through which are named and described all logical units in the database, with links between them. The logical units are concepts such as those which the database users are operating with, and as well use then for modeling their applications. A conceptual model includes the descriptions of all entities of a database, with the relationships between them. An entity is an independent content, an objective reality that exists by itself.

Property valuation, when realistic, leads to a good orientation for an economy that unlocks the credit movement, contribute to hardening investment, and promote development of property, of the industrial business and of all other kinds. Visualizing the way that a GIS can be used in property valuation, applying nominal asset land valuation method, this purpose was achieved using geospatial modeling methods and functions, all these combined into conceptual models.

REFERENCES

1. Haidu I., Haidu C. (1998), *S.I.G. - Analizã spaţialã*. Editura *H*G*A*, Bucureşti.
2. *International Valuation Standards (IVS)*, IVSC – International Valuation Standards Committee, Eight edition, 2007. *IVS1 – Market Value Basis Of Valuation*
3. Mihăilescu I.A.M., *Cadrul international al activitatii de evaluare a proprietatilor imobiliare.* RevCAD – Revista de cadastru
4. Yomralioglu T., Nisanci R., (2004), *Nominal Asset Land Valuation Technique by GIS.* FIG Working Week 2004 Athens, Greece, May 22-27
5. French N.S., *The Valuation Specialized Property: A review of Valuation Methods.*
6. Nyarko J.O., Lemmen C.H.J., *Improving Land Value Information Process Through the Use of Geo-Information Technology*. The International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences. Vol. XXXVII. Part B4. Beijing 2008
7. Curs de informatică - *Modelarea Conceptuală a Datelor*
8. El-Gohary M., (2004), *Property Valuation Model - Effect of Traffic Noise on Property Value*. ECE 557 PROJECT
9. *ArcGIS Desktop Help*, ESRI - Environmental Systems Research Institute