INSPIRE as a support for development of spatial units valuation

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Abstract. The traditional division of official spatial information registers among several administrative bodies which manage them disables their quality and timely insight in spatial state. The establishment of modern automatic valuation systems enables more effective spatial management. In order for these systems to work, certain conditions have to be met. Spatial information is complex information which needs to be carefully modelled and by managing them in a digital form greater interoperability will be enabled. That enables the production of subsystems which use the information of the existing registers. In that way the system of mass real estate valuation would be based on official information of space information registers managed on national level. That would, with the help of familiar and clear methodology, through calculation transparency guarantee the justice of values determined by the system. The unambiguousness and adaptability of spatial information towards the systems of automatic management and information processing is best reached by application of certain norms. The infrastructure of spatial information prescribes those norms and gives guidelines for the development and improvement of spatial information. The infrastructure of spatial information in Croatia is supported by and prescribed through several laws, and all of them are in accordance with European directive for infrastructure of spatial information – INSPIRE. INSPIRE, among other things, has the goal to enable the exchange of information among different subjects and enable free combining of spatial information from different sources in whole Europe. The paper describes the combination of various sorts and sets of information of transport network which will, according to INSPIRE, be made within the national infrastructure of spatial information, and which will be used as factors of real estate valuation.

Keywords: mass real estate valuation, administrative boundaries, SDI

INSPIRE kao podrška razvoju vrednosti prostornih jedinica

Apstrakt. Tradicionalna podela zvaničnih registara prostornih informacija između više organa uprave, koji upravljaju njima, onemogućava njihov kvalitet i pravovremen uvid u stanje u prostoru. Uspostavljanje savremenih automatskih sistema procene vrednosti nepokretnosti omogućava efikasnije upravljanje prostorom. Da bi ovi sistemi mogli da rade moraju biti ispunjeni neki uslovi. Prostorna informacija je kompleksna informacija koja treba da se pažljivo modelira i da se njom pažljivo upravlja u digitalnom obliku kako bi se omogućila bolja interoperabilnost. To omogućava uspostavljanje podsistema koji koriste informacije postojećih registara. Na taj način sistem masovne procene vrednosti nepokretnosti bi mogao biti baziran na podacima zvaničnih prostornih registara kojim se upravlja na nacionalnom nivou. To bi, uz pomoć poznate i jasne metodologije, kroz transparentnost obračunavanja garantovalo pravičnost vrednosti određenih sistemom. Nedvosmislenost i prilagodljivost prostornih informacija prema sistemima automatskog upravljanja i obrade informacija je najbolje postići primenom određenih normi. Infrastruktura prostornih podataka propisuje ove norme i daje smernice za razvoj i unapređenje prostronih informacija. Infrastruktura prostornih podataka u Hrvatskoj je podržana i propisana kroz nekoliko zakona, a svi su u skladu sa evropskom direktivom za infrastrukturu prostornih informacija – INSPIRE. INSPIRE, između ostalog, ima za cilj da omogući razmenu informacija između različitih subjekata i omogući slobodno kombinovanje prostornih podataka iz različitih izvora u celoj Evropi. U radu je opisana kombinacija različitih vrsta i skupova informacijasaobraćajne mreže koja će, u skladu sa INSPIRE, biti napravljena u okviru nacionalne infrastructure prostornih podataka, a koja će se koristiti kao factor procene vrednosti nekretnine.

Ključne reči: masovna procena vrednosti nepokretnosti, administrativne granice, SDI

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1 Introduction

Although the fundamental reason for the establishment of the majority of cadastral systems is real estate taxation, in Croatia the determination of the amount of the real estate tax based on the cadastral income was abandoned in 2001 according to the Law on State Survey and Real Estate Cadastre in that time. [1] The abolishment of the system and the methods of cadastral classification signified the abolishment of the only system of agricultural land valuation on a national level.

The establishment of modern automatic systems of mass real estate valuation enables more effective spatial management of a country, as a limited and valuable resource. Those systems can and are used for several purposes, for example: just taxation of real estate property, help in real estate market, and help in managing rural and urban land.

In order to regulate spatial relations according to modern technological findings, it is necessary to enable all necessary preconditions – integration of the attributes connected to space, which are traditionally divided among several administrative bodies. The majority of modern valuation systems are based on cadastral information as the basic information layer. The effective functioning of real estate cadastre, as the fundamental infrastructural system [2], helped by SDBMS (Spatial Database Management System) or GIS technologies, makes the procedure of planning and realization of economic and other activities connected to real estate easy, but it also makes real and justifiable goals of spatial development [3].

Real estate valuation is a complex procedure and it most often includes multicriteria valuation based on spatial information stored and divided among several administrative bodies. Without clear norms which define the procedures of collecting, maintaining and formation of metadata – information about information, it is rather difficult and hardly possible to unite all the above mentioned information about space and to use them in the systems of real estate valuation. The current Law on State Survey and the Real Property Cadastre from 2007 [4], among other things, gives a definition of National Spatial Data Infrastructure. In that way it establishes the goals of the making and improving the national infrastructure of spatial data. All articles of the above mentioned law are in compliance with the INSPIRE directive – European initiative for improving infrastructure of spatial data on a regional level. The goal of the above mentioned initiative is to establish and improve the infrastructure of spatial data on a European level, and the establishment of the norm sets of data with accompanying metadata, as well as discovery services and dissemination of data.

By joining the EU, Croatia will, along with challenges such as restoring land registers and keeping real estate cadastre up-to-date to the state on the field, be obliged to make the sets of spatial data according to INSPIRE directive [5]. That will enable the making of the mass real estate valuation system by using the existing sets of spatial data. One of more important factors of real estate valuation are transport networks, for which the metadata should have been prepared, and the complete harmonization and the preparation of transport network data should be done by 2017 at the latest [10].

2 Background and Methods

In most European countries there is a certain model of real estate valuation that evaluates some of the physical characteristics of real estates, i.e. cadastral parcels with accompanying building and other constructions. The mentioned systems evaluate the real estate value by dividing them on agricultural and buildable cadastral parcels (built or non-built), which are mostly taxed jointly with one tax on a real estate. The evaluation of agricultural land takes into consideration agricultural abilities of the land: the quality of the soil, the water regime, the elevation and climate influence and economic conditions for production – infrastructure and alike. For built and non-built land one of the three valuation methods: Cost Approach, Sales Comparison Approach and Income Capitalization Approach.

2.1 Real estate valuation methods

Real estate valuation assessment is the prediction of the real estate value based on experience, and the valuation of its spatial and other features. It inevitably includes dependence on market factors. The mentioned methods are mainly used for individual assessments of the value of non-built or built buildable land. They include the appraiser, which makes the procedure longer and more expensive, and enable the dependence of the appraised value on the subjective impression of the appraiser.

Mass valuation is a procedure which, based on the objective factors, appraises the value of a large number of real estate by statistic methods. In order for the appraised value to be just and correct, it is necessary to have enough information on each real estate. It is possible, with limited certainty, to predict the value of a certain factor used in the further procedure of the calculation of the final value [6],[7], i.e. appraised value got based on mass valuation information, taking into consideration market factors, by statistical methods.

Valuation appraisal of things is strictly monetary, and its function will be the measure of value and price [8]. Depending on the purpose and on the used method, the determination of the real estate value is a complex procedure that involves quantitative valuation of qualitative factors of a real estate. By implementing market factors in the calculation, we can talk about

prediction of the market value of a real estate, which is the most often determined. However, it is necessary to distinct between the market value and the price. The sale price does not necessarily have to be the measure of the market value of a real estate. We need to take into consideration all factors connected to sale–the conditions, deadline, relation of the participants or some other factors.

2.2 Base of the mass valuation system

The universal model of mass real estate valuation appraisal on the territory of a country has to be functional, practically applicable, consistent and adaptable to real conditions and trends on the real estate market. It also has to recognise the relevant factors that influence the real estate price in each spatial unit [9]. The overview of the influence of the environment on the value of a real estate in it, as well as describing the given environment by sufficient number of attributes in the function of determining the connection between the value of these attributes and the average price of the real estate in that spatial unit, is one of important assignments in the formation of a model of mass real estate valuation.

2.3 Factors of mass real estate valuation

The problem of mass real estate valuation appraisal can be divided into two subsystems. The first one would be the model of spatial unit valuation, i.e. the model that should include all external factors and joint positional features within a spatial unit, i.e. the settlement it is in, in the values of the appraised real estate (Figure 1).

The other subsystem would be in charge of real estate valuation from the aspect of appraising its market value within the frame of a spatial unit it is in – valuating internal factors, based on the relevant characteristics which affect its value (Figure 1). Integrating these two subsystems could create the final mass real estate valuation model that could recognize all important characteristics of each real estate within the frame of a subject spatial unit, and also value individual characteristics of each individual real estate.

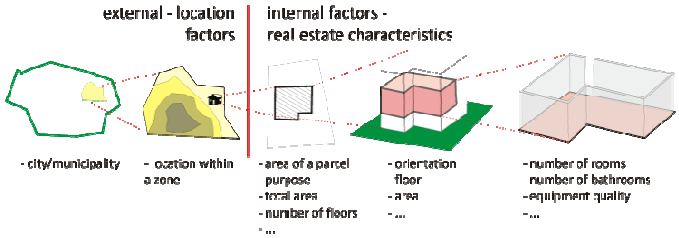

Figure 1. External and internal valuation factors [14]

2.4 Administrative units in the Republic of Croatia

In order to determine the maximal spatial frame for which the internal, spatial factors will be valued, it is necessary to find a spatial unit which is a compromise between two demands. One demand is for better adaption of a spatial unit to a real estate that share similar conditions of economy and the other one is for more simple practical application of a model. Mass valuation is a process that most often includes the use of already finished spatial sets of information, as well as statistic information, and the clear use of the boundary between local and territorial self-government – taken from the registers of spatial units, is the only solution that satisfies the practicality condition.

The regional self-government units in Croatia are counties, and there are twenty of them plus the city of Zagreb (Figure 2). These spatial units coincide with NUTS 3 division of statistical spatial units for the Croatian area. In Croatia there are total of 429 municipalities and 127 towns.

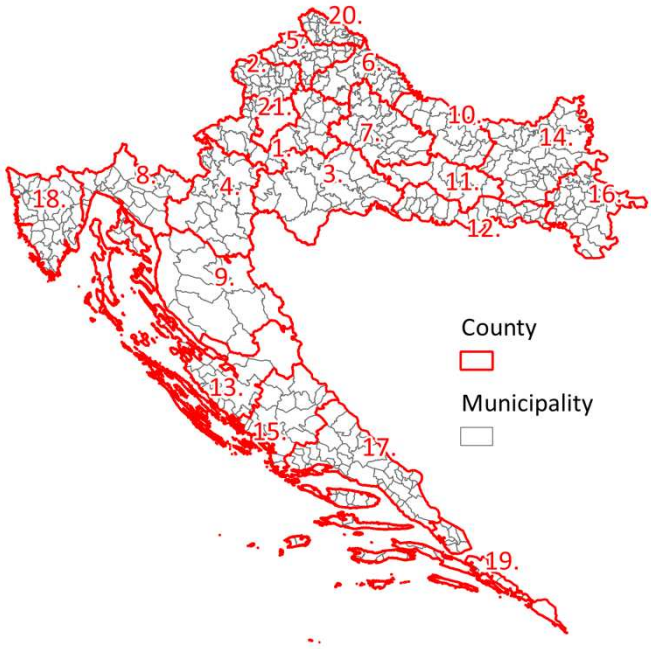

Figure 2. Municipalities and towns boundaries

The smaller spatial units that can be used, and whose information is managed in official registers, are the settlement boundaries (currently there are 6756 settlements in Croatia), that can encompass a settlement (Figure 3), part of a settlement or a city block. A settlement is s spatial unit that consists of a buildable area and an area for other purposes, and it has its name and its own system of marking the buildings.

Figure 3. Settlement boundaries

Except for the shown administrative spatial units, in the central and regional registers of spatial units, the information is managed on the boundaries of cadastral municipalities, other statistical spatial units, delivery areas for delivery offices and streets, stores and buildings with their house numbers.

3 The role of standardizing spatial information

Improving infrastructure of spatial information, highly necessary for establishing derived geoinformation systems manifests itself mainly through standardization of the sets and establishment of metadata. For newer generations of spatial information infrastructure, the improvement process has never been finished, and the emphasis is more on the services of spatial information, network services and technologies, treaties on joint use, access, and mechanisms for coordination and supervision. INSPIRE – Infrastructure for Spatial Information in the European Community, is a frame directive. Further technical features are defined by implemented rules and technical specifications. INSPIRE is based on the existing infrastructures of spatial information of member countries and does not require new collecting of information, but it demands the harmonization of existing information. The goal of INSPIRE is to enable the exchange of data among various subjects and enable smooth combining of spatial data from various sources in the whole Europe [10]. The information contained in the INSPIRE directive encompasses 34 topics of spatial information arranged in Annexes I, II and III. Those are the information owned by the state institutions and information that state bodies use (Table 1).

Table 1: INSPIRE themes

Annex 1
1 Coordinate reference systems
2 Geographical grid systems
3 Geographical names
4 Administrative units
5 Addresses
6 Cadastral parcels
7 Transport networks
8 Hydrography
9 Protected sites
Annex 2
1 Elevation
2 Land cover
3 Orthoimagery
4 Geology
Annex 3
1 Statistical units
2 Buildings
3 Soil
4 Land use
5 Human health and safety
6 Utility and governmental services
7 Environmental monitoring Facilities
8 Production and industrial facilities
9 Agricultural and aquaculture facilities
10 Population distribution and demography
11 Area management / restriction / regulation zones & reporting units
12 Natural risk zones
13 Atmospheric conditions
14 Meteorological geographical features
15 Oceanographic geographical features
16 Sea regions
17 Bio-geographical regions
18 Habitats and biotopes
19 Species distribution
20 Energy Resources
21 Mineral Resources

The transport network theme consists of transport network data, their infrastructure and connectivity. The information is mainly used for network analysis of transport network.

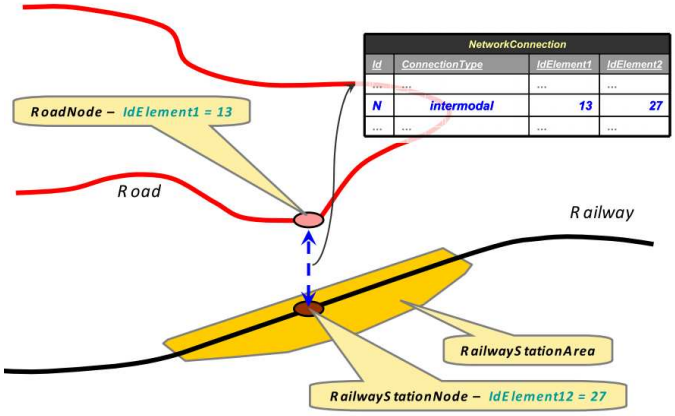

Figure 4. An example of relationships within a transport network

Every linear segment of a model has certain attributes and their values, which have to be within predefined value domain which an attribute can hold..

4 Results

In Croatia, there is momentarily no system of mass valuation, nor is the information on real estate transactions collected with the purpose of establishing mass real estate valuation system. For the need of the research, Chair of Spatial Information Management at the Faculty of Geodesy, University of Zagreb, has written several papers on mass real estate valuation which prepare spatial information and develop methods for automatic mass real estate valuation.

4.1 Previous papers on the Chair of Spatial Information Management

Previous papers made by the Chair of Spatial Information Management at the Faculty of Geodesy at the University of Zagreb, have modelled and considered the factors and their influence on the value of a real estate, and finally, functions that automatically calculate the influence of certain factors have been made. [11][12][13]. In the doctoral dissertation [14] the possibilities of use and modelling of information have been tested in Oracle 11g database with the purpose of calculating all mentioned factors based on the vector spatial model, and for the need of real estate valuation in an urban area. The problem of multicriteria analysis and optimizing real estate valuation criteria, with the purpose of applying it on the formation of the real estate valuation model according to joint characteristics of individual spatial units in which the real estate is located has been discussed in the doctoral thesis under the title: Mass real estate valuation model as the basis of mass real estate valuation appraisal [15]. With the goal of applying valuation model on spatial units in the Republic of Croatia, several master thesis have been made that should prepare the information for automatic valuation of spatial units.

4.2 Test system information

The test system consists of administrative units boundaries register information in a digital form, stored in PostgreSQL spatial-relational database, which are received from SGA (Croatian State Geodetic Administration) for the needs of lecturing and research work at the Chair. Along with the above mentioned, by doing a master thesis, information has been collected which enable to establish a bond for spatial units valuation based on the transport connectivity: the information on roads and highways and entrance and exit points, information on railways and railway stations, and information on airports and heliport have been collected and modelled.

4.2.1 Transport connectivity valuation

Within the master thesis, the information on road transport have been modelled in such a way that makes it possible to use them in the procedures of automatic spatial units valuation, for example information on road transport – highways (Figure 5).

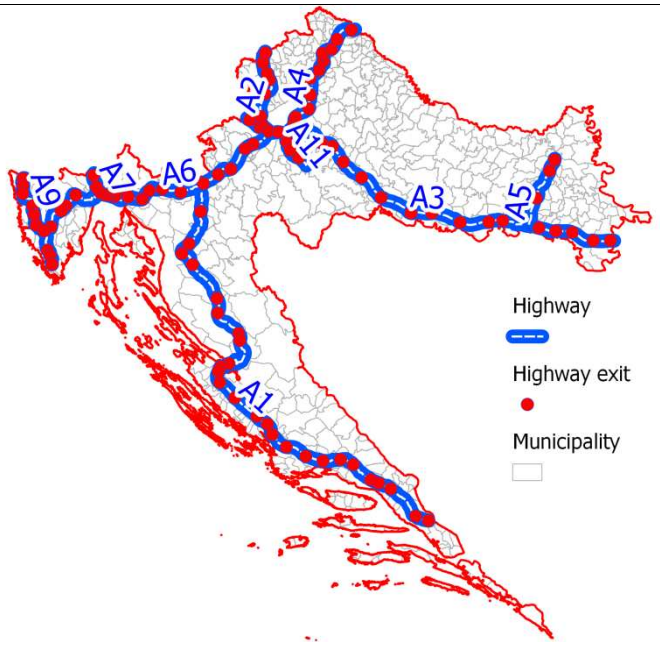

Figure 5. Road transport – highways

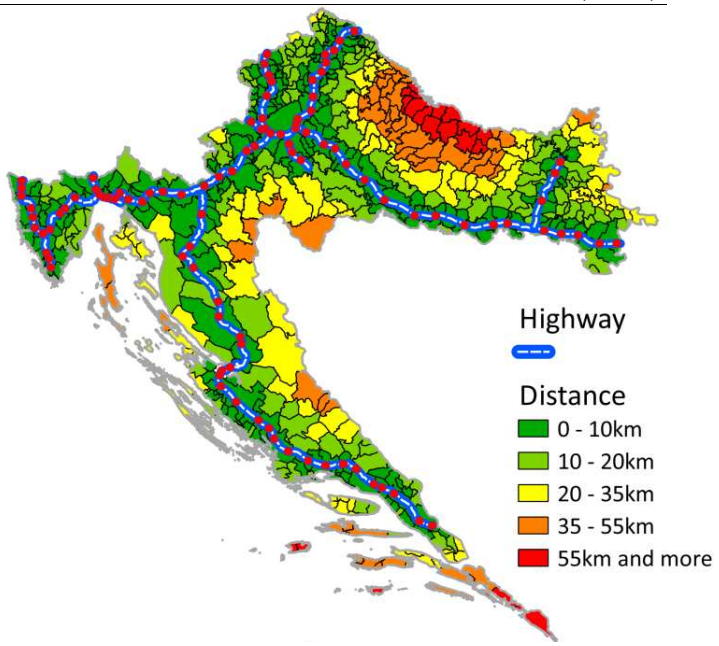

Figure 6. The distance of municipalities to the nearest highway entrance

The information is stored in Croatian official HTRS96/TM datum and it is only possible to use them together with division information on spatial administrative unit. For each feature, the information on unambiguous identification of each road element, i.e. entrance/exit on the highway is determined. From the above mentioned, it is possible by spatial analysis to determine the distance of a certain municipality to the nearest entrance on the highway (figure 6), which can, along with other information on transport connectivity, be used as one of the factors for real estate valuation.

With the above mentioned, the information on railway and air transport is modelled and included in the unique database (Figure 7) which can be used in test purposes until the preparation of official information from the utility managers and other NSDI subjects, which will, according to the INSPIRE directive be prepared for use according to prescribed norms.

Figure 7. A part of the test model

The model uses the unique identification prescribed by the Ordinance on the registers of spatial units or the ones taken or derived from the body in charge of managing the administrative spatial units layer. In that way, the municipalities are numbered by five digit number (shown with black colour on Figure 7, for example 02208 the town of Kutina), out of which the first four digits are unique municipality number of a town within a country, and the fifth digit is the control number. According to INSPIRE, identification should be

unique also within the regional infrastructure of spatial data – on European level. That will be achieved by adding a unique identification for the country in front of the unique feature identification on a national level.

4.2.2 Analysis of the test model

Based on the created model, it is possible to value the real estate valuation factors by automatic procedures. As the basic units for spatial characteristic valuation all unites defined by the ordinance on the registers of spatial units, which are managed for the area of the whole country, can be used. It is important to emphasise that the modelling of spatial information and combining all information into one system has just started the formation of the mass valuation system and all technological conditions are achieved so that it will be possible to model all information in a way that it can be processed by a computer. Standardizing spatial information is an extremely challenging process – spatial information that are in its nature complex, and the relations among them, out of which many are many-to-many relations, which are not (natively) supported in a relation model [16], have to enable unambiguous and simple implementation in the system. The above mentioned is simply not possible or rather difficult to achieve without the quality information model, especially in geoinformation systems based on the spatial information stored in the distributed databases.

Drawing conclusions out of in such a way modelled information is a task which can only be dealt with by a team of multidisciplinary experts which can, each from their own point of view, try to determine the influence of an individual valuation factor. In certain cases it is necessary to derive complex combination of valuation factors in regard to the planned zone of the purpose, actual rights and alike.

5 Conclusion

The test model proposes the use of the information of land administration and other related registers with the purpose of mass real estate valuation. The proposition is in accordance with the INSPIRE initiative and the methodology because it relies on the use of the existing information which will, by joining the EU, have to be modelled in accordance with implementation rules and available for use in the valuation procedures.

The first step in establishing the valuation system is establishing spatial unit valuation system, which can value positional characteristics shared by all real estate on a certain area. Establishing sets of information according to INSPIRE initiative will make possible the valuation of spatial units based on the official information managed by a state. The clear methodology of valuation and the use of official information should enable the highly necessary transparency as a guarantee for the justness of the valuation system.

All information defined by INSPIRE norms are intended for use in the system of spatial relation databases, which enables further spatial analysis and deriving geoinformation systems.

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