

Cadastral Records in Serbian Land Administration

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Key words: Cadastral Data, Land Administration, LADM

SUMMARY

Well-structured and organized cadastral records are prerequisite for better services in land administration. Cadastral records in Serbia met numerous problems and issues in past years and attempts were made to overcome these problems. However, one of the main problems is still present and that problem is related to the way how data is organized and kept which affects the data integrity and it is unable to address user needs in timely manner. While the applicability of the Land Administration Domain Model specified in ISO 19152 to the Serbian cadastre has been widely analyzed with the conclusion that it fits to Serbian cadaster and the appropriate profile has been developed, the main problem remains how to transfer data from the system that is currently in use to the new standard based system. It needs to be assessed to what extent it is possible to migrate the data that have been recorded for decades, with what accuracy and what problems might occur during this process. This paper describes the method for translation from the existing data model for Serbian cadastre into a new standard based data model and describes its benefits. The paper also analyses the user requirements for cadastral data and the means of dissemination through dedicated Web portal or via Web services. Once established such system would provide centralized approach in cadastral data management, as opposite of current situation where each municipality is responsible for its own data. Such situation of isolated cadastral records created many problems, including inability to conduct centralized search for e.g. rights of a certain person. Finally, it is examined to what extent such data can contribute to Open Data initiative.

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1. INTRODUCTION

By the beginning of the reform of land administration in Serbia, and the adoption of the Law on State survey and cadaster in 1988, Land Cadastre was formed in the Republic of Serbia containing records on land, location, area, the use, the worthiness of the land, the amount of cadastral income and holders of land, based on the state survey that was performed for the entire territory of the Republic of Serbia. Another type of records was Land Registry and it had been established in Province of Vojvodina and in some areas of central Serbia, in total of 28% of the cadastral municipalities. This type of records contained rights on real estates and it was based on Austrian-German land registry system. In a few municipalities in Serbia also existed a book of deeds, where transfer of rights was performed by transfer of deeds (Tesla, 2011).

By the mid-eighties, land cadastre had been maintained manually in analog form. In the mid-eighties cadastrals in Serbia began improving the business processes, by the introduction of computers, forming a database of cadastral documents and converting alphanumeric data from analog to digital form. In the mid-nineties cadastral data of land and real estate cadastre is unified into a single database. Data from multiple sources had been converted to this unique system. During data conversion, a great number of errors in the data were detected. These errors partly occurred in the process of converting data from analog to digital form, and partly in the process of maintenance of the Land Cadastre and Real Estate Cadastre due to insufficient data control. During this period, cadastral maps were mainly in analogue form and as such are still in use in the process of maintaining state survey and Land Cadastre.

This state of land administration in Serbia, and the lack of property records for more than 2/3 of cadastral municipalities had led to the need for the formation of a unified registration of real estates, and rights and restrictions on them. This state was also contributed by the inability of registration of property rights, problems of nonconformity of existing data sets, the lack of completeness and timeliness of data on real estates registered in the Land Registry and Land Cadastre, the impossibility of efficient distribution of data on real estates to the end users, etc.

The legal framework for establishing unified records of real estates and rights over them for the entire territory of the Republic of Serbia by consolidating and upgrading of existing data from the Land Cadastre and Land Registry, was implemented in 1988 with the adoption of the first Law on Survey and Cadastre. According to this law, the real estate cadastre is defined as property records, based on the survey data.

Real Estate Cadastre consists of survey study, collection of documents and a database of the real estate cadastre. The database is a set of geospatial and other data real estates and real rights over them and contains information on the parcels, buildings, parts of buildings, such as apartments and

business premises, and holders of real rights on real estates, as well as restrictions. Beside geometry data, it also records land use data and visualize it using topographic symbols on cadastral maps. Finally, in 2009, the Law on State Survey and Cadastre enters into force, which in more detail governs this field, but the problems caused by such heterogeneous records still remain.

2. CADASTRAL DATA IN SERBIA

Before the advent of information technology, the land administration system in Serbia was based on analogue registers and folders. Procedure updates of data were carried out by hand and in parallel in different state institutions, which resulted in inconsistent state of geodetic and legal records. First automatization introduced the information system to manage alphanumeric data, and processes in the area of law and the use of analogue maps for managing geodetic data. Since then, alphanumeric data of the real estate cadastre in Serbia is in FoxDbf tables in all municipalities except for the real estate cadastre in municipalities in Belgrade where data is stored in MS Access database. This data is controlled by the two applications. The first application is called *Unique Records* and it is a FoxPro application based on DOS, which has been in use since 1995. GeodIS-KN application represents an alphanumeric application and uses MS Access as the database (Đurović, 2009). The development of CAD tools enabled the digitization of analogue maps. In Serbia, for the transformation of analogue cadastral maps in vector format ArcGIS and a local solution called *MapSoft* are used.

Modeling is an essential means to facilitate the development of appropriate systems and provides the basis for significant communication between (parts of) the system. The data model represents an abstract model which formally defines data elements and links between elements from a particular domain. The conceptual data model determines the understanding of an entity, a way of understanding information about the entity. It is a comprehensive, consistent and without redundancy. The physical data model is based on the conceptual model and it is a description of the actual physical organization of data. The physical data model takes the form of a database schema. The most widely used model to model real world problems and dynamic management of the data is the relational data model. Data is organized into a set of tuples with relations among them. The relation is defined as a set of tuples with the same attributes, defined over the same domain from which it can take values. In a relational database, every relation must have defined primary key, which is the attribute which uniquely identifies each tuple, while relations are established using foreign keys.

In the current organization of cadastral data in Serbia two different databases with non-unified structure are used. The data model is not relational model, which means that there are no primary keys and no foreign keys between tables (Figure 1). Also, the model is based on the Law on state survey, cadastre and registration of real estate rights (1988) according to which the immovable property is defined as a real estate folio that consists of four sheets: A sheet (data on land), B sheet (data about the holder of the land), V1 sheet (data about the building and the holder of the building, V2 sheet (data on separate parts of the building and the holders of rights on them) and the G sheet (information about restrictions such as mortgages). The tables of the current data model are formed to represent parts of the real estate folio, while among the data on land parcels and buildings, there are only indirect relations (Figure 1). According to the law on state Survey and Cadastre (2009) the

real estate folio is defined as the collection of data on a single immovable property and its rights holders – real estate folio, or collection of data on immovable properties belonging to a single holder of rights - personal folio.



Figure 1. Data model in Serbia

Based on the aforementioned and the development of information technology, there is a need for innovation and integration of existing subsystems (alphanumeric and graphical) into a single, unifying data model that will be completely based on current legislation and standards in the field of geospatial data and cadastre, particularly ISO 19152.

Cadastral records in Serbia met numerous problems in previous years, such as the existence of different institutions responsible for the management of data on land and real estates; storing data in multiple places; data storage in analogue form; discrepancy in records in relation to the actual situation on the ground; separation of alphanumeric and geometric data; complex structure of the records caused as a result of inheriting data from different sources; poor performance of search and update of data; lack of a standard format for data exchange. Some of the problems have been resolved in recent years but there are many of those who have not. There exists problems relating to the lack of uniformity of the data model in all municipalities in Serbia, the use of different software solutions, which are mainly based on outdated technologies, the use of the concept of immovable property in software solutions as defined by the law of 1988, although the concept of real estate folio as well as real and personal folio are defined by the current law from 2009. The aforementioned problems can lead to data redundancy, re-implementing functionality and disturbed correctness of the data. The data model is the core of the system. In order to avoid problems and to achieve efficient access, sharing and exchange of cadastral data on the principles of interoperability, it is necessary to create a domain model according to current standards in the field of geospatial data and cadastre.

3. NEW DATA MODEL AND DATA MIGRATION

Conceptual data model for the real estate cadaster in Serbia based on current geospatial standards from the series ISO 19100, particularly based on Land Administration Domain Model (Lemmen, 2015; Oosterom, 2006) has been proposed by Radulović (2011, 2012, 2015). According to the proposed LADM profile for Serbia, LADM classes are extended in the following way: the class representing the real estate folio (*RS_RealestateFolio*) is a subclass of the LADM basic administrative unit (class *LA_BAUnit*). LADM basic administrative unit is defined as „administrative entity consisting of zero or more spatial units against which (one or more) unique and homogeneous rights (e.g. ownership right or land use right), responsibilities or restrictions are associated to the whole entity“, and as such corresponds well to the Serbian concept of the real estate folio. LADM spatial

units in Serbian cadastre are parcels, part of parcels, buildings and parts of buildings represented by classes *RS_Parcel*, *RS_PartOfParcel*, *RS_Building*, *RS_PartOfBuilding*, respectively. *LA_Party* is extended by *RS_Owner* which represents the holder of rights in Serbian cadaster. Rights are represented by *RS_Ownership*, subclass of *LA_Right*, while restrictions are represented by *RS_Restrictions*, subclass of *LA_Restrictions*. Cadastral municipality is represented by *RS_CadastralMunicipality*, a subclass of *LA_SpatialUnitGroup*. The class *RS_ChangeList* represents list of changes which is used in Serbian cadaster to keep track of history of changes over real estates and real rights, and it is connected to the real estate folio by two associations: new state and history (old) state. These classes represent the core model of the Serbian profile (Figure 2).

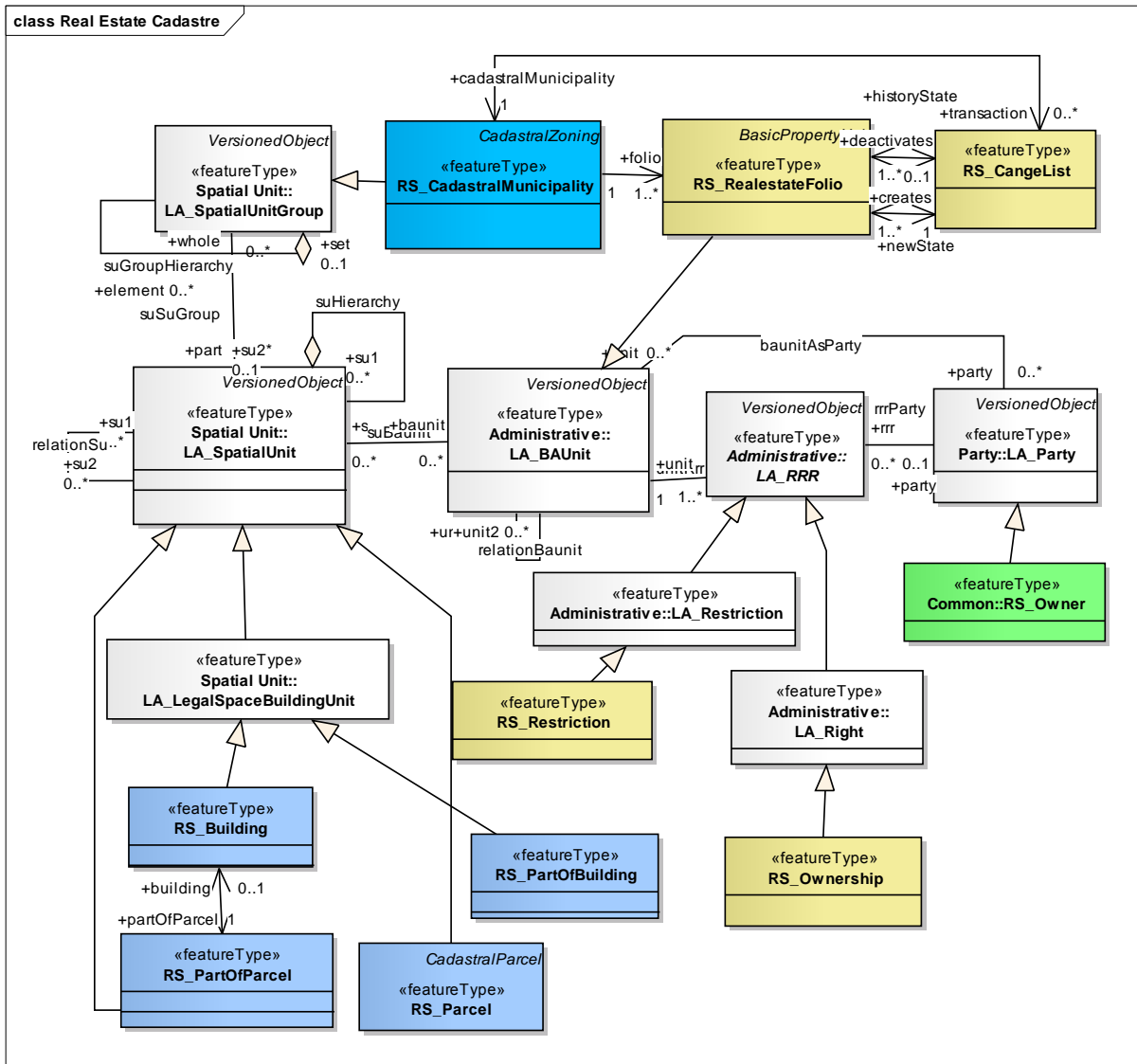


Figure 2. LADM based core model for Serbian cadastre

This conceptual model has been converted to the physical model and implemented as a database schema. Figure 3 shows the basic tables of the physical model. The central table is

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n_rs_realestatefolio which holds together rights, holders of rights and real estates, and therefore all tables contain foreign key to real estate folio. This table is related to the list of changes (*n_rs_changelist*) by two relations representing the old history state and the new state.

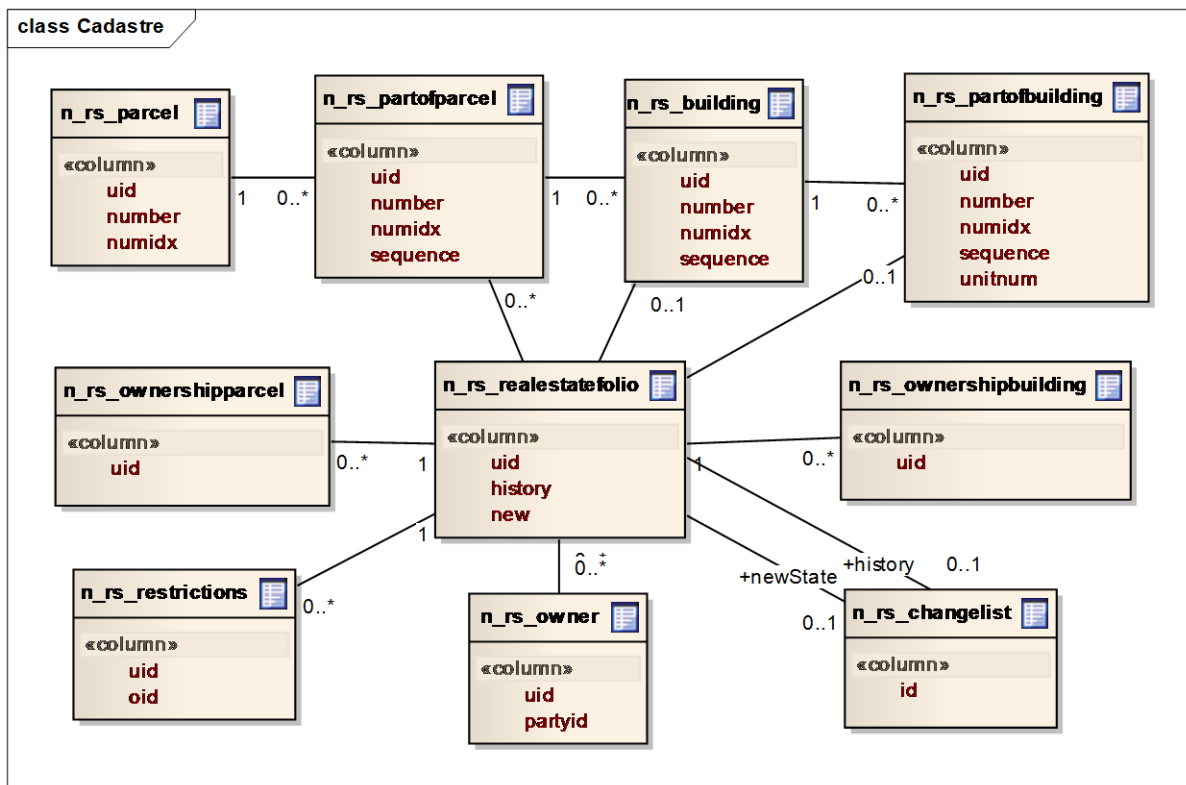


Figure 3. Relational data model

The process of data migration from the old system based on FoxDbf non-relational files to the relational database is complicated and error prone, not only because of implicit relations which are sometime very difficult to establish, but because of inconsistencies and errors in input data itself. Therefore the process of data migration has to be carefully performed with a lot of check procedures. For that purpose, special software was implemented by the authors, that process data parcel by parcel (together with belonging buildings and building parts, rights, restrictions and holders of rights), performs all the necessary check procedures and, if all the relations are set correctly, commit data to the database, otherwise the data is roll backed and the information about unsuccessful migration is written in the log file. After the entire process is finished, the operator that performs data migration must check the log file, establish all the errors and make necessary corrections, and then run migration software once again, but this time only for the data that did not enter the database in the previous cycle, so the process need less time to complete. This way, the data migration is executed in iterations.

Listing 1 show how real estate folios are formed and processed from the original datasets. First all the parcels for the specific cadastral municipality are selected from the table called A sheet. Then, each parcel is processed together with buildings, part of buildings, rights and restrictions from A, B,

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V and G sheet, and real estate folio is formed. When the complete process is completed and all the relations among parcel, buildings, parts of buildings, rights and restrictions and owners are set correctly and linked to real estate folio, than the entire process is committed to the database, otherwise if error occurs the process is roll backed.

```
List<Parcel> parcels = getParcels(number, numidx, cadmun);
for(Parcel p : parcels) {
    try {
        log.info("PROCESSING REAL FOLIO FOR PARCEL " + p.getNumber() + "/" + p.getSubNumber());
        result = processRealFolio(p, cadmun);
        if(result) {
            Auth.getInstance().getConnection().commit();
        }else
            Auth.getInstance().getConnection().rollback();
        log.info("FINISHED PROCESSING REAL FOLIO FOR PARCEL " + p.getNumber() + "/" + p.
getSubNumber() + " "+ result);
    } catch (Throwable e) {
        e.printStackTrace();
        log.error("ERROR PROCESSING REAL FOLIO FOR PARCEL " + p.getNumber() + "/" +
p.getSubNumber(), e);
        try {
            Auth.getInstance().getConnection().rollback();
        } catch (Exception e1) {
            e1.printStackTrace();
        }
    }
}
```

Listing 1. Processing real estate folio for the parcel

4. CADASTRAL DATA DISTRIBUTION AND OPEN DATA

Once collected, data is available to the public and can be accessed on-line via web application called *knweb*. With current organization of data it is not possible to obtain information that is up-to-date. That is because data needs to be collected from all cadastral offices and imported into a single database. This is done periodically. This problem will be solved by adopting aforementioned relational data model and using central database where data will be replicated.

A solution accessing this central database has been developed by the authors and it is called eCadastré. The technologies used to develop the application are HTML 5.0, JavaScript (jQuery), and Java Server Pages (JSP), controllers, services, and beans. Deployment of components is shown in the Figure 4. JSP allows the dynamic creation of HTML pages in response to user requests and include the jQuery JavaScript library, through which it generates dynamic components on the page using AJAX technology and JSON format for the exchange. Controllers allow navigation from one page to another and manage session and request attributes, while services execute SQL queries. Cadastral data are stored in Oracle Spatial database. Controllers, services and beans are implemented within the Spring framework for the development of web applications.

eCadastré enables users to view data about rights on real estates in a real estate folio on the basis of one of the search criteria. These search criteria include: the name or personal number of a person,

the number of parcel, the number of real estate folio, etc. Obtained search results show personal folios and real estate folios. Figure 5 shows the web interface of the application.

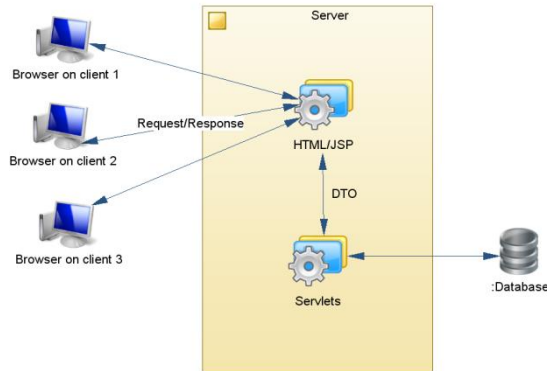


Figure 4. Web application of the component diagram

The application also comprises WSDL Web services that deliver a requested real estate folio, personal folio, statement of ownership, and other data and documents. Based on the principles of Service Oriented Architecture (SOA), these Web services enable automatization of the process of retrieval of the required documents in real estate transactions, and cross-organization collaboration through service chaining.

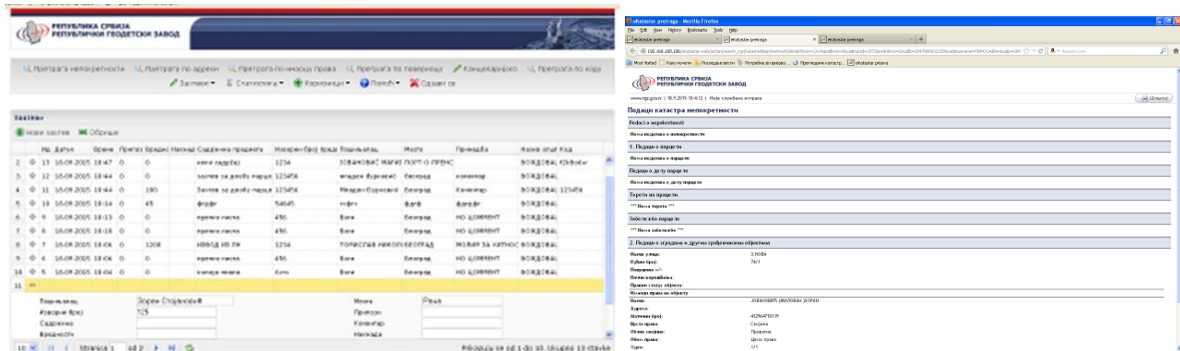


Figure 5. eCadastrе Web interface

Services such as eCadastrе enable public access to the cadastral data and make such data more transparent. Benefits of such services have been analyzed by Borzacchiello (2013). This provides more security in real estate transactions and lowers the risk of fraudulent transactions which have been very common in the past years. This is a step forward to opening the government data to the public which has been very active in recent years through the development of e-Government in Serbia. However, it cannot be considered as Open Data, since only part of a dataset is available freely, and the data is not machine readable, nor downloadable.

5. CONCLUSION

This paper describes the state of cadastral data in Serbia and the softwares and data models used. It also describes the method for translation from the existing data model for Serbian cadastre into a new standard based data model and describes the benefits of adopting the new data model. The paper also analyses the user needs for cadastral data and the means of dissemination through dedicated Web portal or via Web services. Once established such system would provide centralized approach in cadastral data management and maintain data integrity, as opposite of current situation where each municipality is responsible for its own data and errors are common. The whole system will be more robust and the service toward end users will improve both in accuracy and timeliness.

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BIOGRAPHICAL NOTES

Ph.D Dubravka Sladić is an Assistant Professor at Faculty of Technical Sciences, University of Novi Sad, Serbia. She has published 5 paper in ISI journals and more than 20 papers in international and national journals and conferences. She has also participated in several research projects and projects including design and implementation of cadastral information systems in Republic of Srpska in Bosnia and Hertzegovina, Montenegro and Serbia. Her domain of interest are Geographic Information Systems, Spatial Data Infrastructures, Service Oriented Architecture, Cadastral Systems, etc.

Ph.D Aleksandra Radulović is an Assistant Professor at Faculty of Technical Sciences, University of Novi Sad, Serbia. She has published several papers in international and national journals and conferences. She has also participated in several research projects including GIS (geoportal) for the Ministry of Environmental Protection and Ecology of Serbia, Information system of the real estate cadastre for Republic Geodetic Authority of Republic of Srpska, Information system of the real estate cadastre in Montenegro and Information system for user requests submission in the cadastral system in Republic of Serbia.

Ph.D Miro Govedarica is a Full Professor at Faculty of Technical Sciences, University of Novi Sad, Serbia. His practical and theoretical results belong to disciplines such as object-oriented software engineering, databases, database with spatial extensions, development of service-oriented information and geoinformation systems, photogrammetry, laser scanning, remote sensing, global navigation satellite systems. Special attention in his work is dedicated to the development of software components and implementation of GIS systems and research and development of cadastral systems.

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