

Development of Cadastral Metadata Service (Cadastral Metadata Database)

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Key words: cadastre, metadata, database, Web services

SUMMARY

Cadastre as the large-scale spatial data is the basis of spatial data infrastructure. This is illustrated by various countries which have the cadastre as part of the basic spatial data set. Coordinated management is of special importance in the case of cadastral data, since their processing is significantly more expensive than with any other type of data. One of the most efficient tools for managing spatial data in digital and analog form is metadata.

Digitization of the cadastral data in Croatia has been going on for a longer period of time. Its dynamics is closely linked to the development of computer technologies. The descriptive (alphanumerical) part of the data was digitized first, resulting in the cadastral records databases, and the introduction of the CAD program and first digitizers led to digitization of the technical (collection of map sheets) data. The cadastral records are mostly in digital form, while digitization of the cadastral maps is still going on. The result of new cadastral surveying, which have been intensified over the last few years, is a digital cadastre.

This paper describes the approach to the records and the transformation of the Land Cadastre into a Real Estate Cadastre, as well as the development of accompanying services. The existing state and types of the cadastral data in Croatia were analyzed, and the standard for metadata was chosen. Based on the standard, a prototype of the cadastral meta-database was created and developed, in order to monitor and manage transformation of the Land Cadastre into a Real Estate Cadastre. The paper describes the systematic computer watch of the transformation and the access granted to a wider user group through the metadata system. The service provides insight into the current state, and various dynamic analyses. These facilitate project planning and cost assessment.

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1. INTRODUCTION

Cadastral data as the large-scale spatial data is the basis of spatial data infrastructure (Cetl et al. 2003). This is illustrated by various countries which have the cadastre as part of the basic spatial data set (Cetl and Roić, 2005a). Coordinated management is of special importance in the case of cadastral data, since their processing is significantly more expensive than with any other type of data. One of the most efficient tools for managing spatial data in digital and analog form is metadata.

For cadastral data to be able to support E-government and E-businesses, they have to be produced, maintained and distributed according to appropriate standards at national level. Without cadastral data as the basis of spatial data infrastructure, a society cannot keep pace with sustainable development.

Digitization of the cadastral data in Croatia has been going on for a longer period of time. Its dynamics is closely linked to the development of computer technologies. The descriptive (alphanumeric) part of the data was digitized first, resulting in the cadastral records databases, and the introduction of the CAD program and first digitizers led to digitization of the technical (collection of map sheets) data. The cadastral records are mostly in digital form, while digitization of the cadastral map is still going on. The result of new cadastral surveying, which have been intensified over the last few years, is a digital cadastre.

Croatian cadastral system is currently in transition from an obsolete "Land Cadastre" to a modern "Real Estate Cadastre". Unfortunately no meta-database system exists to support this transition and also to improve functioning of the system itself. To make some improvements the State Geodetic Administration of Croatia (SGA) requested the Chair of Spatial Information Management of the Institute of Applied Geodesy at the Faculty of Geodesy in Zagreb to research and to develop a data and a system model for a cadastral meta-database system. Such system has to serve its primary purpose, to serve cadastral metadata to interested users but also to support the currently ongoing transition.

2. CADASTRAL SYSTEM IN CROATIA

The Croatian cadastral system is best described in terms of a classic system of land cadastral parcels, which is found in almost all European countries. The cadastre is concerned with technical records on the land and real estate, while ownership and other rights are stated in the land book.

The cadastral records, which are created for the area of a single cadastral municipality in Croatia, consist of the technical (cadastral map sheets, overall cadastral map sheets, and other documents) and the descriptive (alphanumeric) part. According to the latest data from the State Geodetic Administration (URL 1), there are 3322 cadastral municipalities in Croatia at the moment (Figure 1a), and the cadastral records are being monitored in 20 regional and 88 local cadastral offices (Figure 1b).



Figure 1a. Cadastral municipalities



Figure 1b. Regional Cadastral Offices

According to the technology of producing, storing and presenting cadastral data, they can be either analog or digital. The former are those originally produced on paper or other solid matter, while the latter are in a computer-readable form.

Large amount of cadastral map sheets (about 75%) produced in 19-th century using the plane table and in mathematically loosely defined coordinate systems is still official. Efficient method that could be used for transforming these maps through the process of quality improvement was developed and tested (Roić 1998; Roić i Cetl 2002) but was only applied in the area of city of Zagreb. About 25% of cadastral maps (mainly urban areas) are produced by numerical land survey methods and in Transverse Mercator (Gauss-Krüger) projection. Also there are lot of area, mostly on the Adriatic coast where currently revenue cadastral survey is in process.

The descriptive (alphanumeric) part of the cadastral data is today for the entire territory of Croatia in several database management systems and is available for public access via Web service at (URL 2).

The legislative as well as the actual status of cadastre in Croatia is, at the moment, a bit confusing. A contribution to the cadastre modernization is the adoption of the "Real Estate Cadastre and State Survey Law" in 2000, which made prerequisites for the quicker and more

efficient cadastre base modernization. However there is still no clear vision on how it shall be implemented neither from organizational or technological point of view. There are very few bylaws or data models that would support it.

It is expected that once that the Real Estate Cadastre becomes operational its data model will be common for all parts and will be only administratively divided into cadastral municipalities.

3. CADASTRAL META-DATABASE

In the spring 2005 State Geodetic Administration of Croatia (SGA) requested the Chair of Spatial Information Management of the Institute of Applied Geodesy of the Faculty of Geodesy in Zagreb to research and to develop a data and a system model for a cadastral meta-database system. According to wishes of the SGA such a system will serve primary as a service for cadastral metadata to interested users but also as a support to the currently ongoing transition.

3.1 Metadata Profile

Metadata or "data about data" are generally a set of features (attributes) describing content, quality, availability, accessibility, conditions and other characteristics of data. In 2005, the standard ISO 19115 Metadata was accepted as official in Croatia under the title HRN EN ISO 19115:2005 en Geoinformacije – Metapodaci (Cetl and Roić 2005b).

Elements of metadata for this project were taken according to the standard, and a profile of metadata was created taking into account the project mission and metadata that are necessary for the description of spatial data. The original English names of the metadata elements were translated into Croatian, while the names of the data attributes were not changed, which enables subsequent distinguishing between the standard-defined data and those included to support the cadastre transformation. Besides the standardized metadata, there are other specific data included, which will primarily be of use in the cadastre transformation.

The transformation of the Land Cadastre into the Real Estate Cadastre, besides changes in the content and structure, is characterized by technological changes in the ways of preserving and maintaining the cadastral data. The basis is overall digitization of the data and shifting to computerized maintenance. The metadata describe complex data sets which have multiple use, and the meta-database store originally data about the digital data. A large number of the digital data was not such in its primary form, but was transformed from the analog data. There are many such cases in the cadastre. Thus, it is necessary to clearly define processes which produce digital data, so as to find the metadata elements more easily, e.g. origin, quality, etc.

Due to better organization, the data are divided into sets vertically and horizontally. Vertically, they are divided into the technical and the descriptive part of the cadastral records, and the main (land) book. Horizontally, the cadastral data are divided primarily according to

the cadastral municipalities. The technical data (cadastral map - working original) is further divided into sheets. The alphanumerical data are stored in the descriptive part of the cadastral record and ownership rights are stated in the main book. Based on what has been said, the data are divided into two groups: analog and digital. They are divided further into sets with characteristic features. The defined data sets which the metadata will describe are:

1. Cadastral records
2. Digital cadastral map
3. Descriptive part of cadastral records
4. Sheet of the cadastral map
5. Cadastral field sheet
6. Utility cadastre – technical part
7. Utility cadastre – descriptive part
8. Central register of spatial units
9. Regional register of spatial units
10. Digital ortophoto
11. Digital relief model
12. Supplementary network of permanent geodetic points

In this proposal of data sets, it is possible to change the extent of details, but the users' needs, as well as the costs of development and maintenance of the system should be taken into consideration.

3.2 Meta-Database Model

The final aim of creating the meta-database is to grant public access to a part of the data, and to support the SGA's monitoring and transformation of the Land Cadastre into the Real Estate Cadastre. Therefore, creating an efficient database model has been a complex task which required an appropriate approach.

In order to correctly develop the data model, but also the model of the system, one should recognize every possible type of interaction that users could require (Figure 2).

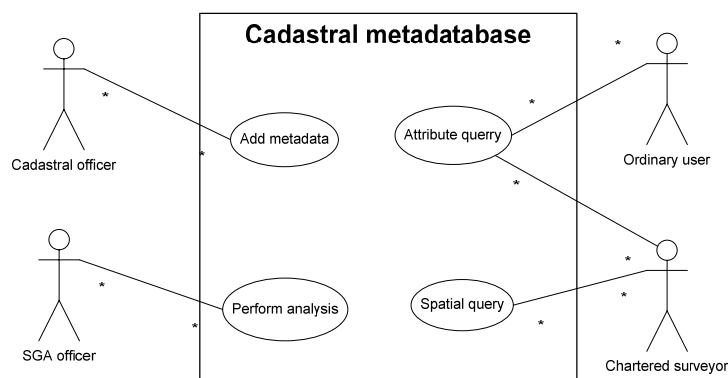


Figure 2. Use case diagram for the cadastral meta-database

Generally several types of actors can be involved in the interaction with the meta-database system (Roić and Matijević 2006). First of all there are cadastral officers working in regional and local cadastral offices who are in charge of maintenance of the data. So, they are using the system in order to add, update and in some cases delete the data. Deletion should of course here be taken symbolically because it only means changing state from valid to historic. Once the data is stored it can be accessed. Chartered surveyors, who are the next actor here, may on the other hand need more specific information. For instance, when performing or preparing a subdivision or any other action on cadastral parcel, it is important to be aware of existence of multiple cadastral maps for the same location. One type of actors, here called "Ordinary user" often needs information about status, type and location of the data about their or other peoples parcels. Finally, a special type of actor using the database system is the SGA officer. When performing various analysis of work done on renewal of cadastral data, or for instance when selecting areas of special interest for some future period of system's lifecycle, he must be able to perform sophisticated and specialized spatial and non-spatial queries.

The basis for creating the data model was the data sets defined in the previous subchapter. Since the cadastral records are made and maintained for the area of a cadastral municipality, and the data about them are officially kept in the Central register of spatial units (CRSU) in the SGA, a table RPJ_veza was made, as a link to the CRSU database. The cadastral municipality with the original CRSU geometry was taken as the basic spatial unit for support of the geometry in the meta-database prototype. Table 1 displays general characteristics of the meta-database.

Table 1. General characteristics of the cadastral meta-database

Name:	CadastralMetadata
Topic:	Cadastre
Language:	HR
Character set:	UTF-8
Standard:	HR EN ISO 19115 Metapodaci
Description:	Information needed for land management, e.g. purpose and use of land, cadastre, ownership.

The data about the spatial data sets are stored in two tables: PODACI and LISTKP. The basic difference is that the first stores digital sets relating to the area, while the other contains the rest (sheets of the cadastral maps, etc.). An overview of the tables and relationships between them points to heterogeneity of the cadastral data (Figure 3).

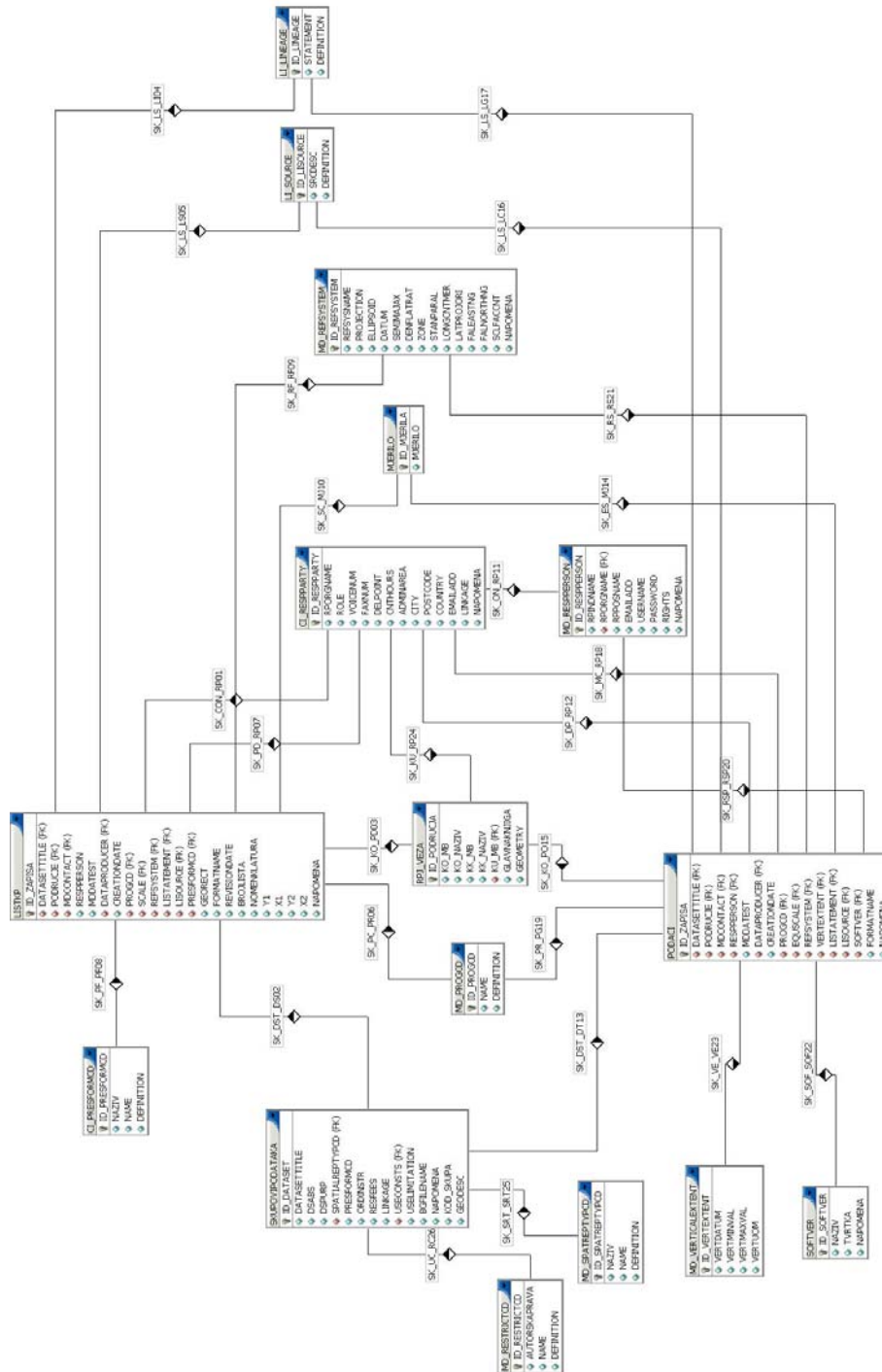


Figure 3. Tables and relationships

This prototype of the meta-database model was successfully implemented and tested on the Oracle 10g database (commercial software) and the MySQL database (free software). For the purposes of implementation and testing, metadata about the cadastral data of the island of Hvar were initially stored into the base (Roić et al. 2005).

4. SYSTEM OF MANAGEMENT AND USE

The system of management and use of the metadata was made as a three-tier structure with employment of the JSP/SERVLET and JDBC program logic technologies, connecting the middle tier with the meta-database and the HTTP which is accessed through a Web browser. (Figure 4).

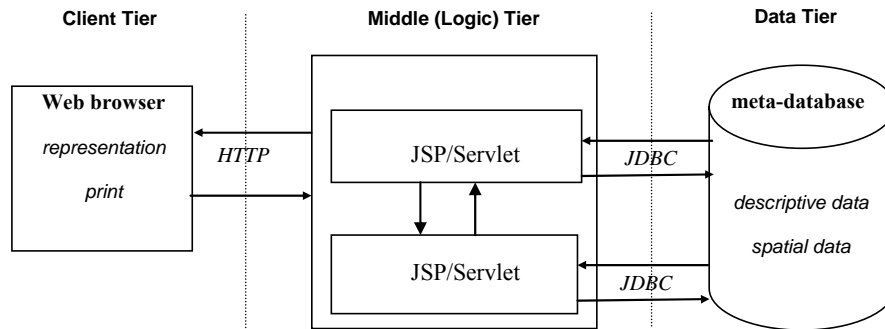


Figure 4. Concept of access

Public access to the meta-database prototype is granted to all interested users through a trial interface (Figure 5).

Republika Hrvatska
Državna geodetska uprava

Pretraživanje po koordinatama(HTRS96/TM):
y= x= Prikaz

-- POKUSNO SUČELJE --

izvoditelj projekta: Geodetski fakultet, Zagreb

Klik na prikaz daje metapodatke

Pretraživanje po: Nazivu kat. općine Upit

Metapodaci katastra

Napomena: Ovo sučelje je napravljeno za potrebe ispitivanja prototipa baze metapodataka katastra, izrađene u okviru projekta "PODRŠKA EVIDENCIJI I UPRAVLJANJU PREGRAŽE KATASTRA ZEMLJIŠTA U KATASTAR NEKRETNINA" koji Geodetski fakultet izvodi za Državnu geodetsku upravu.

Podaci nisu službeni ni provjereni!

Naziv: MetapodaciKatastra
Tema: Katastar
Jezik: Hr
Znakovni sustav: UTF-8
Norma: HR EN ISO 19115 Metapodaci
Opis: Informacije koje se koriste za upravljanje zemljištem npr. namjena i uporaba zemljišta, katastar, vlasništvo

Skupovi podataka:
[Katastarski operat](#)
[Digitalni katastarski plan](#)
[Knjižni dio katastarskog operata](#)
[List katastarskog plana](#)
[Skica katastarske izmjere](#)
[Katastar vodova - grafički dio](#)
[Katastar vodova - knjižni dio](#)
[Središnji registar prostornih jedinica](#)
[Područni registar prostornih jedinica](#)

Figure 5. Interface for access to the cadastral metadata (URL 3)

The left side of the interface enables searching, and on the right there is a description of the database and a list of the data sets about which metadata are kept. Clicking on a particular set, an overview of the metadata about the set becomes available. Searching can be done in the following ways:

- by clicking on the graphic image, which opens the list of data available for the defined item;
- by entering the name or the unique number of the cadastral municipality;
- by entering the numeric coordinates in Croatian state reference system.

After the query has been made, on the right side appears the list of the existing data about which the metadata can be listed in a short or detailed version – all metadata (Figure 6).

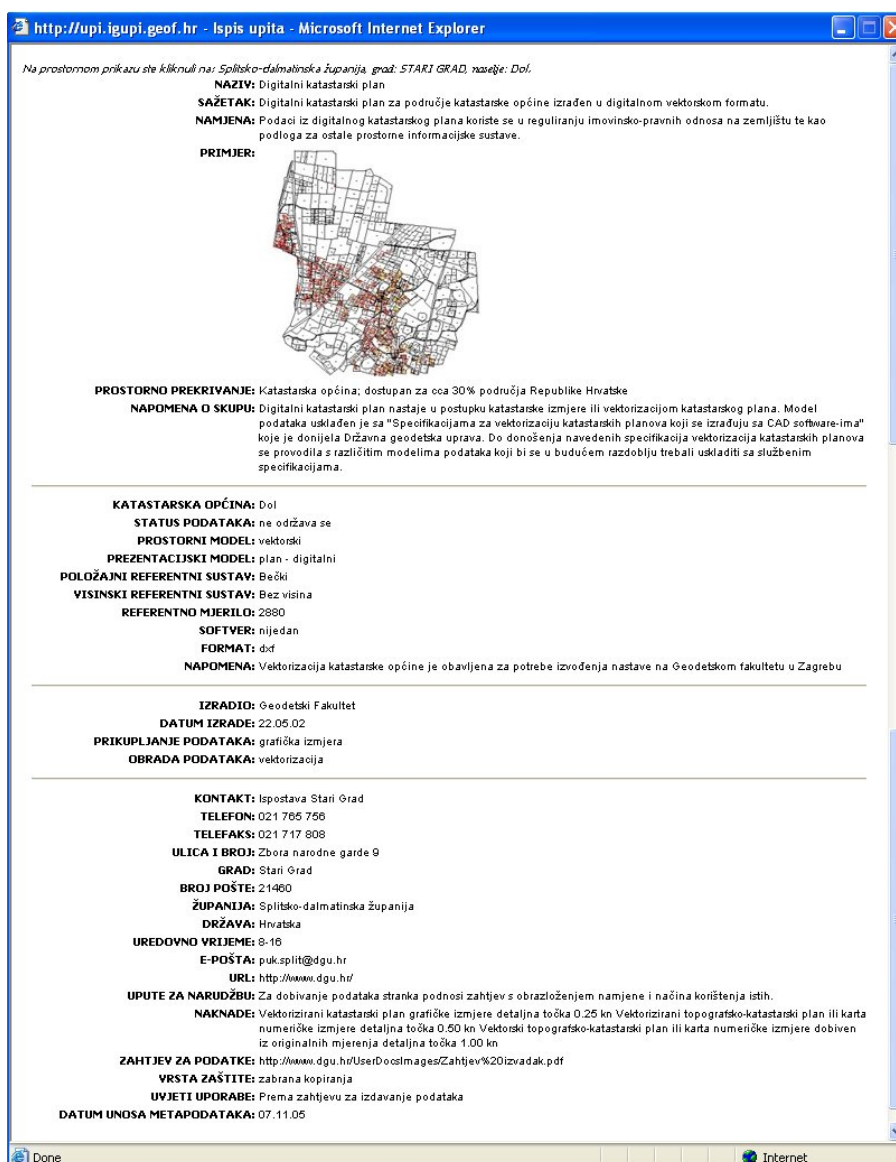


Figure 6. Detailed listing of the metadata

Input and maintenance of the metadata, as well as the database itself, is done also through the Web interface. This is allowed only to authorized persons, which is checked through their user name and password. For authorized users from regional and local cadastral offices, input is limited to the area covered by the respective office. The database administrator registers the authorized persons.

Support for the transformation of the Land Cadastre into the Real Estate Cadastre is primarily seen through queries posted on the base by registered users from the SGA. The content and the structure of the cadastral meta-database enable various queries (Figure 7).

Figure 7. Query interface (with translation on English language)

Queries can be made by all the available features (Data set, Cadastral municipality, Contact, Data Producer, Production Date, Data Condition, Reference Scale, Reference System, Data Acquisition, Vertical Reference System, Data Processing, Software, Format), specifying their parameters. Queries are also possible by any combination of the preceding features.

Results of queries are displayed as a list of records (hyperlinks) and also as a visual representation of their spatial characteristics (Figure 8).

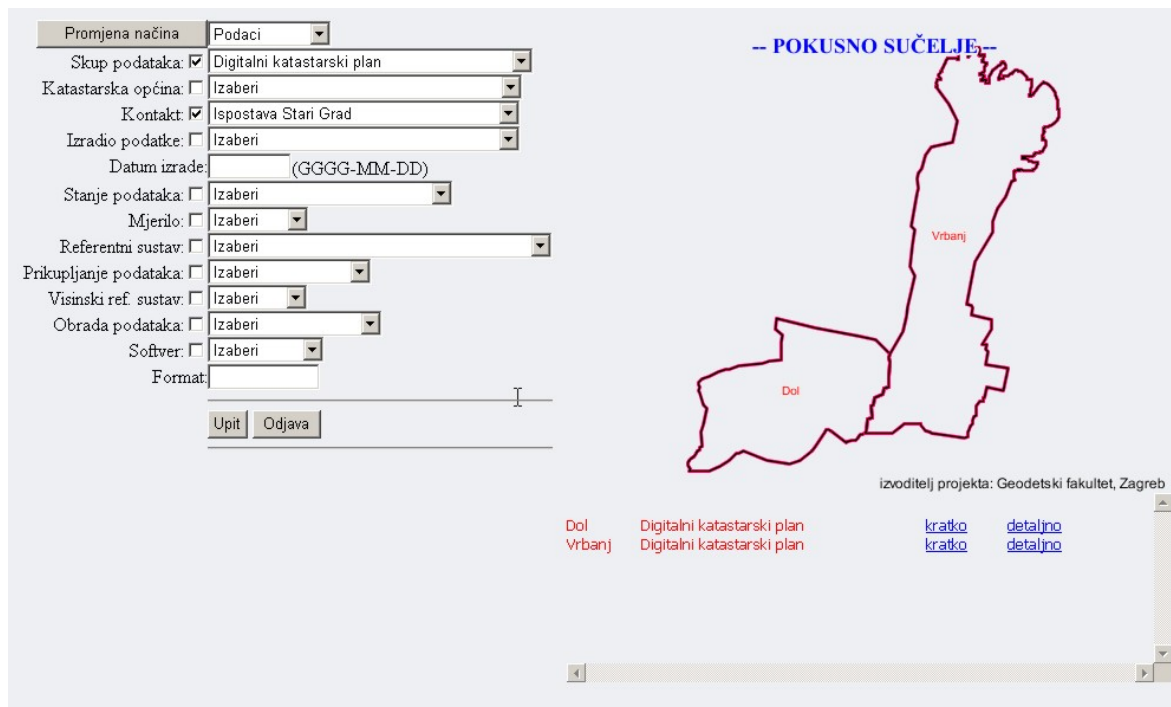


Figure 8. Results of a query

The official data are displayed in black colour while others are displayed in red. The results are the basis for continuous monitoring and assessment of the cadastre transformation process, and for further analysis, which is today, when the purpose of the cadastre has been drastically changed and restated, of the great essence.

5. CONCLUSIONS

The project analyzed the existing data about the analog or digital data, e.g. about the cadastral municipalities, which were transformed into digital form, about the completed cadastral surveys, etc. The structure of the management strategy was also analyzed, to ensure an integrated Internet registration supporting a multi-layered safe access for various groups of users.

On the basis of the analyses, a concept of cadastral data management was made, including the important factor of the cadastral meta-database. The database prototype includes all the cadastral data sets, but only part of the most important features was chosen to ensure quick results of the service. Full application of all parts of the standard HR EN ISO 19115 was not possible due to heterogeneity of the existing data and the access to its production. The approach chosen here is a solution which will point to those issues and induce application of the necessary rules (norms, standards...) in the field of cadastre.

Further input of metadata, should provide the most important cadastral metadata for the whole area of Croatia. It would facilitate data availability to the users, and at the same time

enable exact data analyses, which are basis for the efficient transformation of the Land Cadastre into the Real Estate Cadastre. Further development of this cadastral meta-database, with introduction of a multilingual service, is a step in the right direction towards improvement of the existing national spatial data infrastructure, and towards support of E-Government and E-Society.

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BIOGRAPHICAL NOTES

Vlado Cetl is university assistant on Spatial Information Management/Cadastre at the Faculty of Geodesy in Zagreb. The main fields of his research work are geoinformatics, spatial data infrastructures, real estate cadastre and land management. He received MSc in 2003 with thesis "Role of the Cadastre in the National Spatial Data Infrastructure" from the Faculty of Geodesy in Zagreb. Currently, he is a PhD student. He has participated on several projects and has published several papers.

Miodrag Roić is a professor at Spatial Information Management/Cadastre at the Faculty of Geodesy in Zagreb and a national delegate to FIG Commission 3. Currently he is Vice Dean of the Faculty. He leads and participates actively in numerous projects at international and

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Mario Mader is university assistant on Spatial Information Management/Cadastre at the Faculty of Geodesy in Zagreb. Currently, he is a PhD student. His main research interests are real estate cadastre, land management and DBMS technology in spatial data handling. He has participated on several projects.

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