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Review / Pregledni znanstveni članak

# Systematic Monitoring of Cadastral Resurveys

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*ABSTRACT. The cadastral system that was established in Croatia as early as the 19th century has been undergoing various reforms throughout history related both to documents as well as to data. The data have been updated through the processes of revision, reambulation, land consolidation and resurveys. Recent resurveys with the aim to replace the Land Cadastre with the Real Estate Cadastre started in the year 2000 and have been performed ever since within the scope of the projects of cadastral survey for the whole or a part of cadastral municipality. The paper presents an overview of the activities carried out within the scope of the project, as well as the analysis of available official documents on individual activities. The documents reveal the key metadata that make it possible to perform systematic monitoring of a project and of the duration of activities in individual projects. Based on key information provided by the available documents, the project duration has been determined and the state of completion of individual project analysed. The cadastral survey project is modelled by an activity diagram, and the results obtained from the analysis of started, completed or on-going projects are presented graphically and commented.*

*Keywords: land administration, cadastre, cadastral resurvey.*

## 1. Introduction

The definition of cadastre as land information service based on cadastral parcels and containing up-to-date data on land (real estate) and interests leads to the conclusion that the cadastre loses its value if the data are not up-to-date (Mader and Roić 2011b). In order to fulfil its purpose, the cadastre once established should therefore be maintained in accordance with the situation in the field. If the maintenance is not carried out regularly, it is necessary, apart from renewal the documents (lithographing, vectorising and homogenization), to update the data which includes revision or reambulation, and land consolidation, and ultimately, resurveys should be performed (Roić 2012, 2017). Depending on the differences between the situation in the field and cadastral records, the updating of data can be approached in various ways due to economic reasons. Should it be detected that

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more than a certain percent (mostly 50%) of data in cadastral records does not correspond to the situation in the field, new cadastral documentation are prepared based on the cadastral survey of the whole area, usually of a cadastral municipality. Otherwise, revisions or reambulation is carried out. The cadastral survey of previously measured area is also called resurvey (Llanto and Rosellon n.d.). Such method of renewal the data yields the results of the highest quality, however, it is carried out only in exceptional cases because of excessive costs and rather demanding conditions, and also only in a few countries in the world (Roić 2012). One of the countries where such method of data updating is used is Croatia. Namely, the updating of documents by lithographing and vectorising has been carried out in Croatia throughout history, but also the updating of data within the scope of revision, reambulation and resurveys. The most recent resurveys have been carried out in Croatia ever since the year 2000 when the replacement of the existing Land Cadastre with the Real Estate Cadastre was prescribed by law (Roić 2017). It is performed within the scope of cadastral survey projects (hereinafter referred to as: Project). These surveys include a part of or the whole cadastral municipality, or they may be carried out individually after the homogenization has been done for some cadastral municipality. The purpose of such activities is to establish an efficient real estate market with consistent cadastral and land register data with the records reflecting the current situation in the field (Cetl et al. 2012).

The project of cadastral survey is a complex procedure including a series of activities performed in a meaningful sequence by many participants. The public and all interested parties have access to official information on the project through official press, bulletins and official sites of public authorities (Pivac and Roić 2017). Official information should be a reliable source of data that may be used for systematic monitoring of complex tasks related to the reform of Cadastre. Given the complexity of the project encompassing of a lot of activities, this paper is focused on two key activities for which there are publicly available documents. These documents are the following: Decision on Cadastral Survey and Decision on Putting Real Estate Cadastre Documents into Use. These decisions reveal the key metadata that were used to perform the analyses of the projects initiated, ongoing and completed projects in the period from 2000 until the end of 2017. The paper also deals with the metadata contained in the other documents related to the project. The first part of the paper provides the overview of cadastral reforms in the countries in transition, general information related to the cadastral system in Croatia, and the historical overview of systematic updating of documents and data carried out so far in this area. The methodology includes the recognition of activities, as well as the identification and finding available documents related to cadastral survey projects, and modelling the projects whereby the Unified Modelling Language (UML) is used. The fundamental contribution of the paper is to be seen in the analysis and the illustration of the procedures and the accompanying documents related to the cadastral resurvey project in Croatia. The example of Croatia is used to present how publicly available decision, as well as other project documents can support the systematic monitoring of complex tasks in cadastre renewal.

## 2. Cadastre reforms in transition countries

By comparing the cadastral systems in individual countries that have been given a lot of attention in the world (Silva and Stubkjær 2002), it is possible to observe their diversity as a result of their historical development, geographic properties, the level of market economy development and various other factors. The cadastral systems worldwide should be continuously changed and adapted in order to meet the needs of information society and the development of the attitude of people towards land (Rajabifard et al. 2007). The manner of establishing cadastral systems, systematic or individual approach are the consequence of social, political and economic conditions in individual countries (Silva and Stubkjær 2002). Despite the similarity, the cadastral system of each country has different dynamics generated mostly by internal factors characterized by the state activities (Tan 1999). Even 75% out of 6 billion land plots worldwide have not been yet officially registered (Enemark et al. 2015). However, these estimations do not include the transition countries of Central and Eastern Europe where Cadastre and Land Book were established back in the 18th century. Radical social and political changes at the end of the 20th century caused significant changes in cadastral systems of these countries. They experienced great market and land reforms during the 20th century when the introduction of planned economy by communist administration changed the situation related to land (Roić 2012). After the fall of communist regimes at the end of the 20th century, the countries of Central and Eastern Europe switched again to market economy and have raised the importance of private ownership. In this process, they reorganised, i.e. renewed their land administration systems in terms of data, organisation and technology in order to provide cheaper, faster and more secure methods of land transaction (Dale 1997, Roić 2012, Ting and Williamson 1999, Williamson 2001). Silva and Stubkjær (2002) analyse in their paper the research carried out in the field of Cadastre. One of the research activities is focused on the re-establishment of Cadastre in the countries of Central and Eastern Europe whose economies have experienced the transition to private land ownership. In establishing and improvement of cadastral systems they have been supported by large organisations like the World Bank and European Union (Bogaerts and Zevenbergen 2001). Croatia is also one of the associated countries that makes great efforts and invest financial resources in order to modernise the land administration system as fast as possible, which would guarantee the security of property and real estate transactions (Cetl et al. 2012).

In many countries, the improvement of the existing cadastral map data has been initiated after the digitalisation. In Austria, the digitalisation of the whole territory was completed in 2003. The quality was improved during the digitalisation process, but the positional accuracy was still in accordance with the accuracy of the analogue cadastral maps. Consequently, the method of boundary line visualisation has been developed and tested introducing new types of lines and lateral displacement. The method was applied in one of the cadastral map sheets, and after it has been presented to the respondents and proved useful, it has been recommended to continue with the analyses of the visualisation (URL 1). For the purpose of improving the positional accuracy of cadastral map, the research was conducted in Slovenia in which the membrane method has been tested along with additional measurements that provides more efficient improvement of heterogeneity of graphical land presentation (Čeh et al. 2011). One of the methods for

improving the positional accuracy that has been used in many countries is homogenisation (Roić 2012). After extensive research, Technical Instructions for the homogenisation of cadastral map have been prepared in Croatia (Roić et al. 2009). In 2017 and 2018, the homogenisation was carried out in altogether 400 cadastral municipalities.

### 3. Cadastral system in Croatia

The cadastral system in Croatia was established in the 19th century and it belongs to the systems of title registration, i.e. to the Central European or German group according to the organisation of documents. The position of Croatia in Central European cadastral systems is also reflected in the approach to cadastral survey in the process of preparing cadastral documentation. The characteristic of such systems is a systematic approach in the establishment of Cadastre where the cadastral survey project is carried out for the entire territory of a cadastral municipality (Roić 2012). In Croatia, just as in many European countries, there is a dual system of registers of land and interests on land. The properties are registered in Cadastre, and the rights to properties are acquired after the registration in Land Book. The State Geodetic Administration is the institution responsible for the Cadastre in the Republic of Croatia. It consists of the Central Office in Zagreb, and of regional offices located in the counties and of their branch offices. The City of Zagreb is an exception since the activities related to cadastral affairs on its territory are conducted by the City Bureau for Surveying and Cadastral Affairs. Judicial authorities are responsible for the registration of rights to properties and they act through municipal courts, i.e. Municipal Civil Court in Zagreb, with their land book departments (Mader and Roić 2011a). There are altogether 20 regional and 92 local cadastral offices, and 109 land book departments at municipal courts (Cetl et al. 2012). The number of cadastral municipalities is about 3300 that have cadastral records with about 5 656 140 hectares of registered land. Unregistered land relates mostly to common good – maritime domain.

#### 3.1. Historical overview

Considering the fact that certain parts of Croatia belonged to various states in the past, the cadastral system was developed under various social and political conditions and in different legislative framework (Roić and Paar 2018). Hence, the cadastral system has been developing in various periods of time and conditions, and the area of Croatia can therefore be divided into Austro-Hungarian, Yugoslav and Croatian cadastral systems. During the 19th century, when the territory of the Republic of Croatia was a part of Austro-Hungarian Monarchy, the first systematic establishment of Cadastre was initiated. It finally resulted in the establishment of Land Cadastre for the entire territory of today's Republic of Croatia that is also called Franciscan Cadastre. Just as in most European countries, the primary purpose of Cadastre in Croatia was also the survey and classification for taxation of land, however, land books were later on established on the basis of cadastral records. Although the primary purpose of Cadastre was related to taxation, the survey encompassed all land, which suggests that it was established also for other purpose of state administration. The survey was first performed for the

Austrian part of the Monarchy (the area of Istria and Dalmatia), and later for the Hungarian part (the Kingdom of Croatia-Slavonia). The data obtained within the frame of the Franciscan Cadastre are still official today for about 70% of the territory of Croatia.

The cadastral document once prepared need to be regularly maintained, or else, the documents or data should be renewed. Since analogue cadastral documents tend to be damaged when used over a longer period of time and become unclear and illegible after the changes have been entered, they should be physically renewed (Roić 2012). Systematic renewals of documentation performed in Croatia include lithography processes, vectorising and homogenization (Roić and Paar 2018). Intensive renewal of documents, especially of cadastral map sheets, was performed at the territory of Austro-Hungarian Monarchy at the turn of the 19th century by means of lithography, mostly in the royal lithographic office in Vienna. During the 20th century, the documents were mostly not renewed, and many plotted changes made cadastral map illegible. Technological progress and the application of computers in cadastral data processing led to an intensive renewal of cadastral records at the end of the 20th century, that time by their conversion to electronic form. All data are stored today in the repository of Real Property Registration and Cadastre Joint Information System and are maintained electronically. Apart from the renewal of documentation, in the course of history the data were updated in Croatia within the frame of reambulation/revision, land consolidation and resurveys. After passing the Decree on Land Cadastre in 1953, the revisions of Cadastre were made, and the largest number of land consolidation procedures was carried out in the 60s and 70s of the 20th century. The next chapter is focused on resurveys being the subject of the research.

### 3.2. Cadastral resurveys

Resurvey as one of the procedures intended to update the data of cadastral records is carried out in few countries in the world. After the establishment of the Franciscan Cadastre in 19th century, resurveys were performed in Croatia on several occasions for the purpose of renewal the data of cadastral records. More intensive renewal of data by means of resurveys was made at the beginning and by the mid-20th century when Croatia was a part of Yugoslavia. In that period, the data were renewed within the frame of resurvey procedures for the total of about 25% of the Croatian territory (Roić and Paar 2018). The first resurvey was performed already during the period of Austro-Hungarian Monarchy from 1857 until 1862. However, further development and city building required new high-quality cadastral documents, which led to the second cadastral survey (resurvey) of the City of Zagreb that was carried out in the period from 1909 until 1913. It was pointed out that the purpose of cadastral resurvey was also related to various technical requirements imposed by the development of the city along with tax purposes. After the Second World War, the third cadastral survey (resurvey) was performed in the period from 1958 until 1965 due to rapid development and building of the city, as well as a consequence of poorly organised service of maintaining the earlier cadastral surveys (Ivković et al. 2012). The latest resurveys performed for the purpose of Cadastre and Land Book reform started in the year 2000.

### 3.2.1. Real Estate Cadastre and projects of cadastral resurvey

The establishment of Real Estate Cadastre in the Republic of Croatia is prescribed by the Law on State Survey and Real Estate Cadastre 1999 that specifies among other tasks also the cadastral surveys. The surveys may be performed for the purpose of maintaining cadastral documents in Land Cadastre or for the purpose of preparing the new documents of Real Estate Cadastre. The projects related to the development of Real Estate Cadastre and to updating of Land Book started in 2000 and are still in progress. They are carried out for the entire cadastral municipality or for a part of it, where the priority is given to the municipalities covered by the data originating from the Franciscan Cadastre. The project of cadastral survey is a complex task encompassing a series of activities and participants. All activities and the accompanying documents, as well as the participants in the project are elaborated in details in the chapter 3. The projects are carried out based on annual and multi-annual programmes. The funds are provided from the state budget of the Republic of Croatia, as well as from other sources like donations, the funds of local and regional self-governments, the funds provided by interested legal and natural persons, and other sources (Official Gazette 1999). In the period between 2004 and 2011, there was the total of 236 million HRK invested in cadastral surveys (Figure 1).

The largest investments were made in the period between 2007 and 2008. The financial investments are not included into this research because the data before the year 2004 and after the year 2011 are not available.

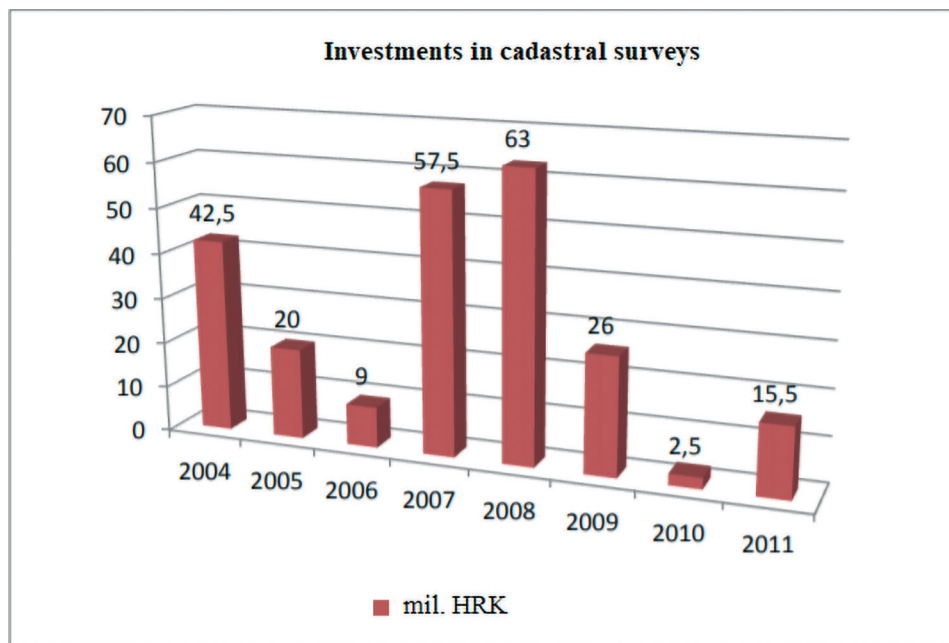


Fig. 1. Investments in cadastral surveys 2004–2011 (HKOIG 2014).



## 4. Methodology and data sources

Within the frame of the research, the resurvey projects carried out in Croatia ever since 2000 have been analysed. Some of them are completed, while the others are still in progress. The paper is namely focused on the period from the year 2000 until the end of the year 2017. The resurvey project includes a series of activities that make a complex unit together with the participants. The participants in the project are: Ministry of Justice, Central Office of SGA (CO SGA), the contractor, Regional Cadastral Office, holder of the right to property, and Land Book Department of the Municipal Court. Individual activities have been specified and mutually connected for the purpose of monitoring the project, and the publicly available documents related to a certain activity have been found (Figure 2).

The cadastral survey project, as one of the tasks related to Real Estate Cadastre, is carried out based on annual and multi-annual programmes. Annual programs are approved by the decision of the Government, and multi-annual programmes by the Croatian Parliament, and published in the Official Gazette. The Central Office of SGA analyses the situation in cadastral municipalities and proposes the Programme to the Government with the prior approval of the Ministry of Justice. The Programme specifies the areas to be surveyed, the sources of funding the Programme, and the deadlines for the execution of planned activities (Official Gazette 1999). The head of SGA and the minister responsible for justice affairs establish by mutual agreement the commission for the execution of the Programme. The next step is public tendering opened by SGA as ordering party calling for tenders, and all interested bidders may submit their offers.

The ordering party is obliged to publish Tender Notice, as well as the Procurement Documentation. The Procurement Documentation refers to any documents prepared by the ordering party where the elements of the procurement are described, including call for tender, technical specifications, descriptive documents etc. (Official Gazette 2001). After the arrival of bids sent by interested bidders and after the expiry of the time limit for the submission of bids, the bids are opened in public, and the ordering party is obliged to draw up the Minutes on Public Bid Opening. After opening, the ordering party examines and evaluates the bids based on the requirements specified in the procurement documents, and then draws up the Minutes on Examination and Evaluation of Bids. Should none of the bids be valid or other requirements are not fulfilled, the public tendering procedure is cancelled, and the Decision on Cancellation passed. Otherwise, the bid is chosen based on the lowest price and the ordering party makes the Decision on the Selection of Offer. According to the Law on Public Procurement 2016, the bid selection is made based on most economically advantageous bid. After the selection, the contract is signed, and the Contract Award Notice is published. SGA then passes the Decision on Cadastral Survey according to the programme that is published in the Official Gazette.

After completing the procedure of public tendering and signing the contract, the cadastral survey report is made that includes field measurement. The field measurement, i.e. the preparation of the report is made by the contractor, and the holder of the right to property delineates and marks the land boundaries. The Regional Cadastral Office conducts the supervision of the whole survey procedure and provides expert assistance to the right holders. After the completion of survey and data processing, the contractor prepares and then delivers the cadastral

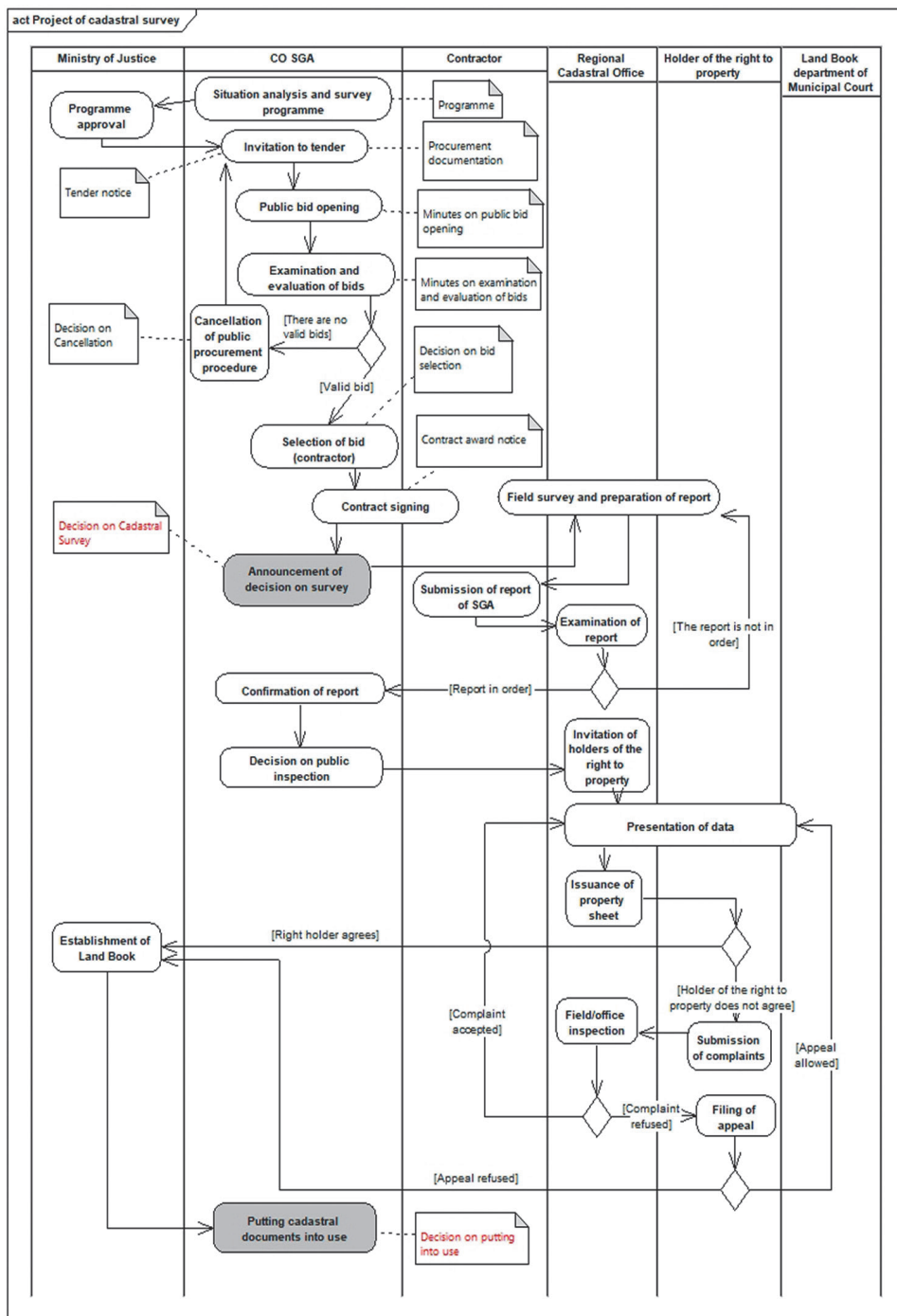


Fig. 2. Activity diagram of the Project.



survey report to the Regional Cadastral Office to be examined, and if the report is all right, the Regional Cadastral Office draws up a report to be further confirmed by the Central Office of SGA. The examined and confirmed report is submitted for public inspection. The beginning and the place of inspection is announced by the Central Office of SGA together with the municipality court in charge. The right holders are invited in writing and they receive the cadastral survey data presented. A verified copy of property sheet being a part of cadastral survey report is issued to each of them (Mader and Roić 2011b). The data are submitted for public inspection by cadastral and land book commission. If a party does not agree and refuses to sign the property sheet, he/she can fill a complaint that is followed by field or office inspection. If the complaint is well founded, the data in the report should be corrected and submitted again to public inspection. If the complaint is rejected by the administrative decision, it is allowed to lodge an appeal. After all complaints/appeals have been settled or if there are none, the Land Book for a cadastral municipality can be established, thereafter the minister for judicial affairs informs SGA. The director of SGA passes then the Decision on Putting the Cadastral Documents into Use by which previous Land Cadastre documents are invalidated and archived. The project of cadastral survey is thus completed.

Apart from the activities, it is extremely important to identify publicly available documents mentioned in the chapter 5, together with the accompanying metadata. Out of all available documents related to resurvey project, the Decision on Survey and the Decision on Putting into Use were used in this research and analysis, and the metadata that could be used for further research were identified for the other documents. The reason for that is in the fact that the mentioned decisions are available for the selected period, while the other documents are unavailable for the whole period. Based on the metadata in two decisions observed, the period between their publications was determined. There were altogether 228 Decisions on Survey found in the Official Gazette for the period from the year 2000 until the end of the year 2017. The decisions on putting cadastral documents for individual cadastral municipalities into use were found on the official sites of SGA, and there are altogether 142 of them available.

There was a database created with the metadata entered into it that were found in the available decisions and that were previously systematized. The database was used for further monitoring of individual projects. Since more cadastral municipalities are mentioned in the Decision on Cadastral Survey, each municipality presents a separate project in the database, i.e. one entry. It is important to point out that more projects may be related to one cadastral municipality when a part of this municipality is included in one project, and the other part in another project. The gathered metadata were entered as attributes assigned to each project. After all decisions have been entered into the database, the total number of cadastral survey projects is 397. After that, the number of started and completed cadastral surveys was analysed based on metadata from available decisions, as well the period between their publication and the area of the territory included in the projects. The number of projects conducted by individual contractors was also analysed. The obtained results and analyses are presented in the chapter 6.

## 5. Metadata for systematic monitoring of projects of cadastral resurveys

The projects conducted presently in the Republic of Croatia may last for many years. In order to make systematic monitoring of completed and not completed projects possible, the metadata resulting from individual activities have been identified. Metadata or “data about data” are generally a collection of attributes that describe the contents, quality, access to data and other characteristics of data. The identification of metadata makes it possible to determine the timeline among individual activities with the possibility to determine the point of slowdown in the whole project. In this research, the metadata were identified in the following available documents: Programme, Tender Notice, Procurement Documentation, Minutes on Public Bid Opening, Minutes on Examination and Evaluation of Bids, Decision on Bid Selection/Decision on Cancellation, Notice on Contract Award, Decision on Cadastral Survey and Decision on Putting into Use (Table 1).

After the Law on Public Procurement (2001) was changed, the manner of publication, as well as the quantity and the contents of available documents have been changed on several occasions. The Law on Public Procurement 2007 stipulated the announcement of public procurement procedure in the Electronic Public Procurement Bulletin of the Republic of Croatia (Bulletin). Over the years, the number of available documents in the Bulletin has been increased. Since 2008, the Tender Notice, Procurement Documentation and the Notice on Contract Award have been available, since 2012 the Minutes on Examination and Evaluation of Bids and the Decision on Selection/Cancellation, and since 2016 the Minutes on Public Bid Opening. All documents are listed that were announced in any period. The metadata contained in each document are related to the date of its announcement. It is thus possible to determine the timeline between individual documents and the points of slowdown in each project.

The documents used for detailed research and analyses, Decision on Cadastral Survey and Decision on Putting into Use, are the subject matter of performed analyses. Only these two mentioned documents are publicly available for the whole period involved in the research. The Decision on Cadastral Survey is official and it is passed by SGA in agreement with the Ministry of Justice, government and local self-government (Pivac and Roić 2017). It is available in the Official Gazette and in other official publications in order to inform the holders of the rights to properties at the territory included into the Project. The first item of the Decision contains the name of the cadastral municipality involved in the project. The decision may have one or more cadastral municipalities specified, however, the project may cover the whole or only a part of the municipality. In order to distinguish such cases, additional metadata have been introduced that enable the distinction between the survey of the whole municipality and of a part of it and that may assume two values: 0 – the survey of the whole municipality, 1 – the survey of a part of municipality. The next item refers to the contractor of cadastral survey, i.e. the authorized company or consortium of companies that participate in the performance of project tasks together with the government officials. The decision also indicates the regulation based on which the decision was made. The last identified metadata are related to the date of decision.

The Decision on Putting the Cadastral Documents into Use is also an official decision that used to be announced on official sites of SGA until 2018. After the Law on State Survey and Real Estate Cadastre (2018) was passed, the name was

Table 1. Documents with the accompanying metadata for systematic monitoring of Project.

Name of document	Metadata
<i>Programme</i>	Date of Programme adoption Total area of all Projects encompassed by the Programme Financing Amount of financing
<i>Tender Notice</i>	Date of invitation to tender Name of ordering party (SGA) Designation and number of procurement Name of the responsible person of the ordering party Evaluated value of the service Deadline for submission of offers
<i>Procurement Documentation</i>	Name of one or more cadastral municipalities Identification number of cadastral municipalities Area of cadastral municipalities [ha] Number of cadastral parcels Number of buildings Project financing
<i>Minutes on Public Opening of Bids</i>	Date of bid opening Procurement registration number Number of participants at the opening Number of received bids Name and surname of recording clerk
<i>Minutes on Examination and Evaluation of Bids</i>	Date of examination and evaluation of bids Procurement registration number Number of participants (members of commission) Total number of valid bids Name of all bidders Total point value for each bidder Prices of all bids
<i>Decision on Selection of Bid/ Decision on Cancellation</i>	Date of decision Evaluated procurement value Name of the selected Project contractor Responsible person of the ordering party The regulation on the basis of which the Decision was passed
<i>Notice on Contract Award</i>	Date of Notice publication Name of the selected Project contractor Total value of the contract
<i>Decision on Cadastral Survey</i>	Date of Decision Name of one or more cadastral municipalities Name of the selected Project contractor The whole municipality (0) or a part of municipality (1) encompassed by the Project The regulation on the basis of which the Decision was passed
<i>Decision on Putting into Use</i>	Date of Decision Identification number of municipality Name of cadastral municipality The regulation on the basis of which the Decision was passed

replaced by the name Decision on Putting Cadastral Documents of Real Estate Cadastre into Use, and it started to be announced in Official Gazette. It is also the last document used to complete the Project. The Decision always specifies one cadastral municipality with the identification number for which the cadastral documents of Real Estate Cadastre are put into use. There is also the date of putting into use specified, which also indicates that the project is completed. The other metadata have not been used in the analyses, but have only been listed with the accompanying explanation (Table 1).

## 6. Analysis and results

After the gathered metadata have been entered, the cadastral survey projects have been analysed with respect to their duration and covered areas. Although the documents are poorly structured, and sometimes not publicly announced, the missing data have been reconstructed by reconstructing the sequence and repetition of data. The representative data set has been thus obtained for the purpose of making the analyses. The metadata have been gathered and reconstructed for 396 initiated projects with the Decision on Survey being available for 349 projects, and for 47 projects only the Decision on Use. The projects for which the Decision on Use is available are defined as completed, and there are altogether 142 such projects.

In the observed period, the projects for about 12% of the area have been initiated, and the projects have been completed for about 3% of the area of the Republic of Croatia (Table 2).

Table 2. Total area of the Republic of Croatia encompassed by the projects.

Status of the project	Initiated			Completed	Not initiated
	Available Decision on Survey	Unavailable Decision on Survey	$\Sigma$		
Number of projects	349	47	396	142	
Area [ha]			661.403,74	154.034,86	4.994.737,08
Percentage in the total area of the Republic of Croatia			12%	3%	88%

The projects for 9% of the area are still in progress, while the renewal within the scope of survey projects has not yet started for about 88% of the territory (Figure 3). Out of all initiated projects, 396 of them, the total of 36%, have been completed, and 64% of them are still in progress.

The number of initiated and completed projects in each year in the period from 2000 until 2017 can be seen in the graph (Figure 4a). The first project of cadastral

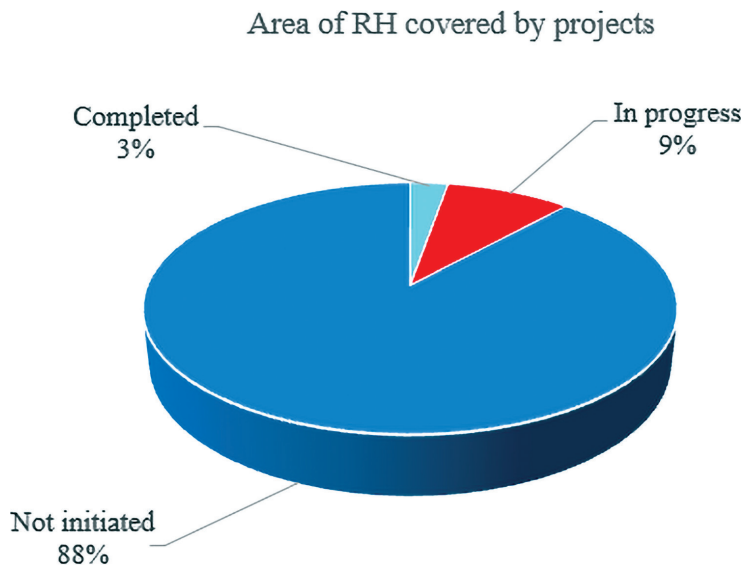


Fig. 3. *The area included in projects.*

survey was completed in 2004. The largest number of Decisions on Cadastral Survey was announced in 2008, which corresponds to the financial investments of 63 million HRK in the same year (Figure 1). The year 2003 stands out with a large number of Decisions on Cadastral Survey because in this year 8.2 million US\$ were invested in cadastral surveys from the World Bank loan (HKOIG 2014). The next graph (Figure 4b) was made based on the projects for which only the Decision on Cadastral Survey was available, while the Decision on Putting into Use was not available. The duration of the projects in each year is presented with the final selected date being 31.12.2017. Since the Decision on Putting into Use presents the end of the project in the research, these projects have been defined as not completed. There are altogether 254 projects with the most of them, 35, lasting more than 10 years. The average duration of the projects not completed until the end of the year 2017 is about 7 years.

Referring to the known values – date of Decision on Survey and the Decision on Putting into Use, it is possible to determine the period between two activities for the projects for which the Decision on Survey is available and are completed. Figure 5a shows the number of projects [n] related to the duration of the projects expressed in years [year]. The largest number of projects, 21 of them, last 3 years. The shortest period of duration, one year or less, is related to altogether two projects. Such projects are namely not of short duration, but they include technical reambulation (renewal) of cadastral data. Some projects may last longer than 10 years, which can be seen in the graph where the total of 11 projects last 10 and more years. According to the research made, the average duration of individual project is 5.5 years.

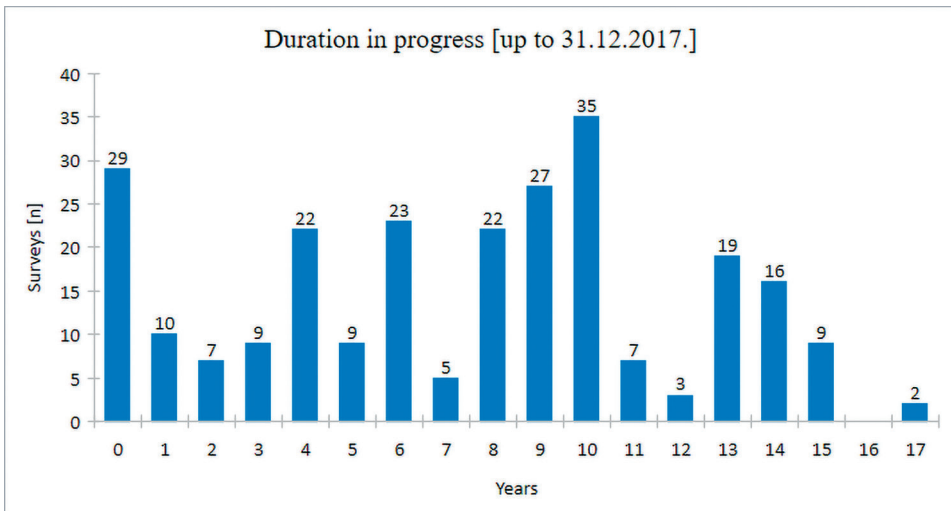
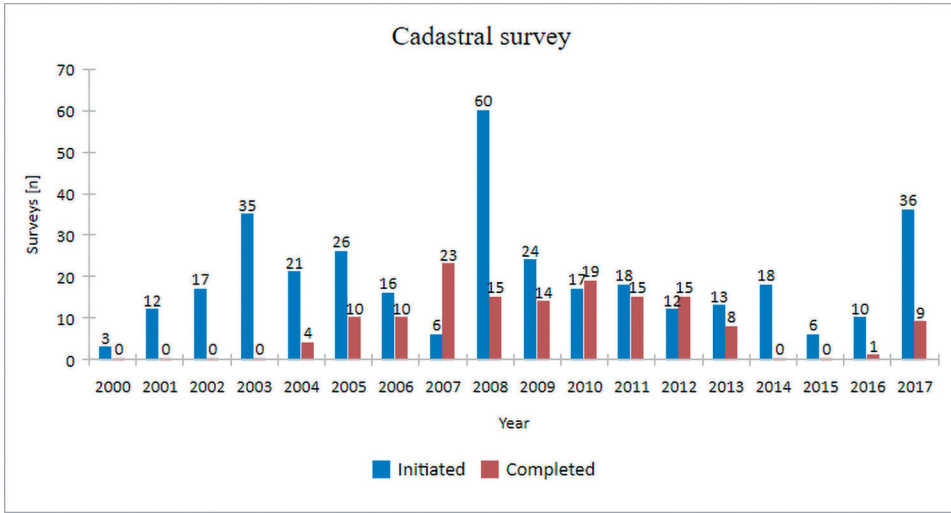


Fig. 4. Number of initiated and completed (a) projects, and of projects in progress (b).

Apart from the project duration, there was also the number of projects by single contractors analysed (Figure 5b). The Decision on Cadastral Survey contains the name of contractor, however, it has not been indicated in some decisions. There were altogether 30 contractors participating with 23 companies and 7 consortia of companies marked with ID from 1-30. When the contractor was not known, the value 99 was chosen for ID. Figure 5b shows the number of projects by single contractor/consortium with ID of the contractors indicated in order to preserve anonymity. The contractors that participated in at least 5 projects were selected for the presentation. The contractor with ID 22 and 8 participated in the largest number of projects, the total of 53 contractors.



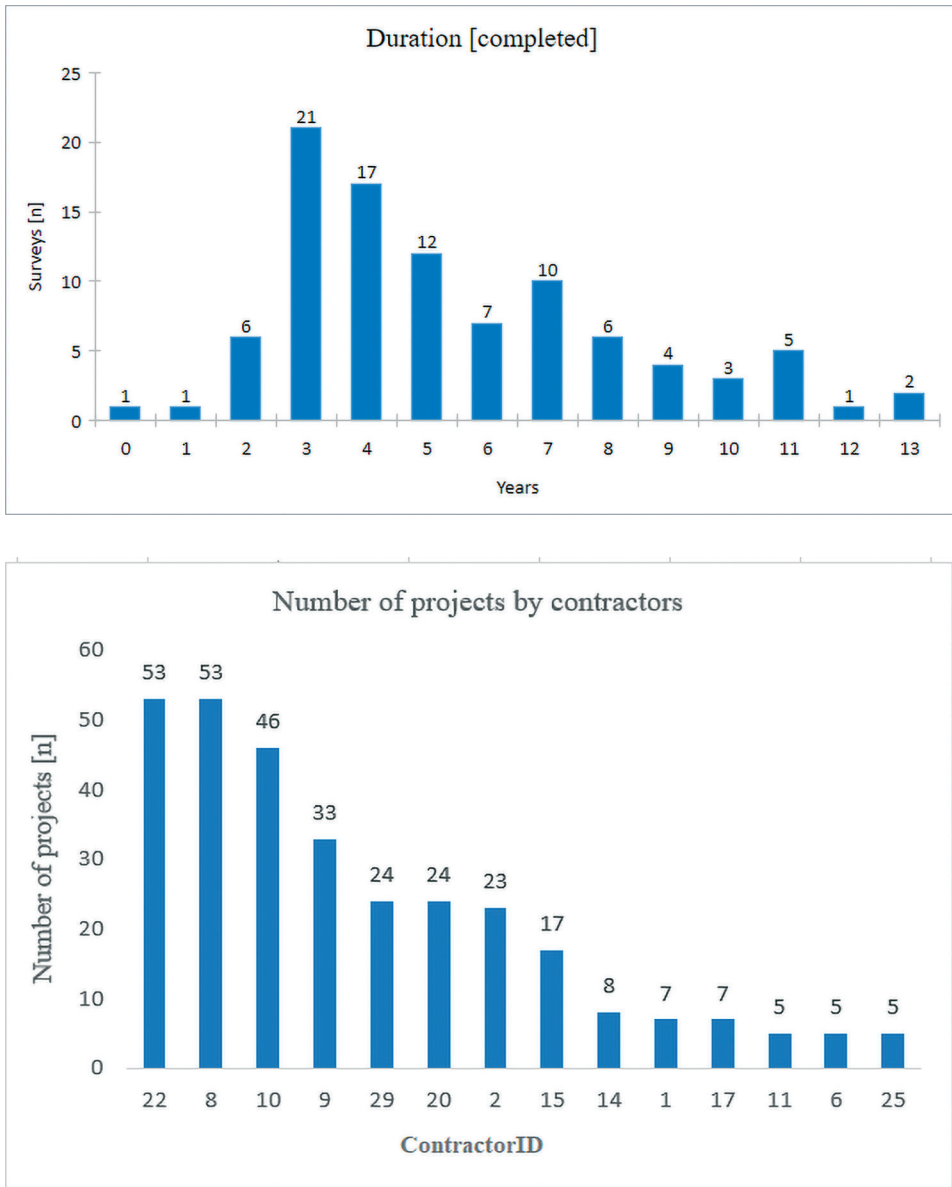


Fig. 5. Duration of cadastral surveys (a) and number of projects by contractors (b).

## 7. Conclusions

For the systematically established Land Cadastre, the renewal by means of cadastral resurveys was initiated in the 19th century, and Real Estate Cadastre was created in 2000. Resurveys are carried out based on official decisions in the form

of projects for the whole of a part of cadastral municipality. It can be concluded from the analysed key activities and the data related to these activities that the projects are implemented slowly. The replacement of Land Cadastre with the Real Estate Cadastre by means of resurveys was made for about 3% of the territory of the Republic of Croatia in the period from 2000 until 2017, although the time limit prescribed by the Law was 10 years. There were the projects initiated for about 12% of the territory, but a lot of them are still in progress. The average duration of renewal project is 5.5 years. Unfortunately, there are still some uncompleted projects lasting already more than 10 years, which will further deteriorate the unsatisfactory situation related to the duration of projects. It suggests that it is necessary to review and improve the model of Cadastre renewal by means of cadastral resurveys.

The other identified data can be used for further research related to systematic monitoring of individual parts of the project. The documents contain, as a rule, the time component, e.g. date of announcement that can be used in analysing individual activities of the project. In this way, it is possible to determine the point(s) and reasons of project slowdown. This will help in the processing and improvement of individual processes in order to provide the performance of resurvey within a reasonable time.

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## Sustavno praćenje katastarskih reizmjera

*SAŽETAK. Katastarski sustav, koji je u Hrvatskoj uspostavljen još u 19. stoljeću, tijekom povijesti izložen je raznim obnovama, kako dokumentacije tako i podataka. Obnove podataka provodile su se postupcima revizije, reambulacijama, komasacijama te ponovnim izmjerama (resurveys). Najnovije reizmjere, s ciljem zamjene Katastra zemljišta Katastrom nekretnina, započele su 2000. godine, a provode se projektima katastarske izmjere za cijelu ili dio katastarske općine. U radu je dan pregled aktivnosti koje se obavljaju tijekom projekta, kao i analiza dostupne službene dokumentacije o pojedinoj aktivnosti. U dokumentaciji su prepoznati ključni metapodaci pomoću kojih je moguće sustavno praćenje projekata i trajanje aktivnosti u pojedinom projektu. Na osnovu ključnih informacija iz dostupne dokumentacije određeno je trajanje projekata te analizirana dovršenost pojedinog projekta. Projekt katastarske izmjere je modeliran dijagramom aktivnosti, a rezultati analize o započetim, završenim te projektima u tijeku prikazani su grafički i komentirani.*

*Ključne riječi: upravljanje zemljištem, katastar, katastarska reizmjera.*

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