# Cadastral survey - the best way of cadastre modernization

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**Key words**: new cadastral survey, land registry, cadastre

## SUMMARY

Different procedures for cadastral data improvement (lithography, tracing, cadastral map renewal, revision) carried out on the Croatian territory during the last 100 years have significantly contributed to the purpose of land administration in economy and agriculture. There are a total of 3370 cadastral municipalities in Croatia. Cadastral surveys undertaken for about 300 cadastral municipalities in the 1945-1990 period led to major improvements. Unfortunately, in 271 of those 300 cadastral municipalities cadastral surveys were only implemented in the cadastral system, and not in the land registry. This causes considerable difficulties in investments and real property transactions. The biggest improvement of cadastral data was achieved through completely new cadastral surveys carried out after 2000. This includes some 400 cadastral municipalities, in some of which the work has been completed, while in some cadastral municipalities public displays are still underway or the work is yet to begin. This paper presents some of the benefits provided by new cadastral surveys conducted to establish the real property cadastre.

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## 1. INTRODUCTION

In Croatia, registers of real property and applicable rights are (still) under the jurisdiction of different public authorities. Registration in the cadastre and land registry offering key data about the land management system is based on the civil code. The cadastre provides data about parcels, buildings and other structures and their features. Rights on real property registered in the cadastre are registered in land registry. The Croatian cadastre and land registry spring from the Germanic approach to managing registers of real property and related rights. The responsible public authority institutions are the State Geodetic Administration (for the cadastre) and municipal courts (for land registry).

New cadastral surveys aimed at establishing the real property cadastre have been conducted intensively in Croatia since 2000. Cadastral surveys are undertaken to put real property cadastral documentation in use and establish completely new land registry. Following a cadastral survey, land registry and cadastral data are harmonized 100% on the level of the entire cadastral municipality or a part of it – depending on the scope of the task. In view of the considerable age of cadastral and land registry records that Croatia inherited from the former Austro-Hungarian Empire, and the typically poor maintenance of cadastral data, new cadastral surveys are often the only solution for improvement and modernization of the land management system.

With regard to the effect of cadastre and land registry renewal (through new cadastral surveys) on the socio-economic development of local communities, Javoran and Bitanga conclude that such a claim would be presumptuous (Javoran and Bitanga, 2010), bearing in mind that cadastre and land registry renewal projects have been permanently improving in several ways (cadastral map vectorisation, digitisation, linking through the Real Property Registration and Cadastre Joint Information System etc.), thus affecting the situation in the local community, they assess. However, the following already can be derived and inferred from this effect: renewed cadastre and land registry positively affect the socio-economic development of local communities in several aspects: they improve the financial situation of local communities' budgets, raise the quality of living in local communities by making them more attractive for living and doing business, reduce the number of lawsuits, thus having a beneficial effect on the state budget, and create a qualify basis for local communities' spatial planning.

The paper is organized as it follows. The first section of the paper is introduction. The second deals with the cadastral system in Croatia, while the third section describes the land registry

system in Croatia. The fourth section deals with new cadastral survey in 21st century in Croatia. The paper ends with conclusion.

## 2. CADASTRAL SYSTEM

Spatial data and data on real property in Croatia are managed in multiple registers with many end users. Basic registers include the Cadastre and Land register. The Cadastre register maintains data on the position, shape, and area of real properties, while the Land register registers data on rights, restrictions, and responsibilities. Responsible institutions of public authority are the State Geodetic Administration (for the Cadastre register) and municipal courts (for the Land register). In cadastral offices (20 regional cadastral offices with their 92 branches as well as the Municipal Office for Cadastre and Geodetic Works of the City of Zagreb), real properties are registered based on their technical characteristics. The cadastral data on real properties (cadastral parcels) are the basis for the establishment, renewal, storage, and maintenance of land registers that are kept across 109 land register offices. In land registers, the data on cadastral parcel title holders are associated with the data on cadastral parcels defined by the cadastre. Real property in Croatian real property law is based on the *superficies solo cedit* principle, where a land surface parcel includes everything relatively permanently associated with the parcel on or below the land surface (primarily buildings, houses, etc.). A real property (LA_BAUnit in ISO 19152), in Croatian legislation, may consist of one or more land parcels registered in the land register in the same property sheet, hence they are legally combined in a single body (registered land unit). Grass, trees, fruits, and all valuable commodities provided on the surface of the land are parts of this real property until the land is divided.

### 2.1 Historical and legislative framework

Croatian cadastral system is based on the Germanic model of cadastre primarily because of its Austro-Hungarian heritage. Croatian cadastral system is similar to those in Austria and Germany. Development of land data registration in Croatia is conditioned by different countries of which regions of Croatia were a part during the past. This is why land data is registered with different dynamics and according to different conditions depending on the social structures in these countries. Attempts to establish a land cadastre resulted in an unprofessionally made and hence short lived Josephine Cadastre. Formation of the land cadastre in Croatia region under Austria-Hungary began with proclamation of the Imperial Patent (Grundsteuerpatent) on December 23, 1817, ordering surveys, land classification, and preparation of the cadastral record in all lands of the Empire. This date marks the beginning of the Franciscan Cadastre. Basic principles of this cadastre remained in use over a hundred years. Present day land registers are founded in the period from 1880 to 1900 based on these data (Roić et al., 2005).
Land Register Law, not much different than Austro-Hungarian Grundesteuerpatent, is passed in the Kingdom of Yugoslavia in 1929, after World War I. In fact, this law was a translation of the Imperial Patent, so the cadastre merely continued to serve a tax purpose. Advancement of technologies in cadastral surveying, and especially development of numerical methods, sparked

in this time period enactment of a number of bylaws regulating these processes, some of which are used in practice even today.

After 1945 and implementation of radical changes in the social structure, attitude towards ownership and other real property rights also changed. The cadastre and land registry did not enjoy support in this time period, but were instead neglected and finally terminated when private ownership was abolished and everything became communal. For this reason, the cadastre was not updated all until 1953 when Land Cadastre Legislation was passed. Lack of funds in the treasury caused this legislation since new sources of funding the state budget had to be found. Cadastral office revived owing to this situation, and revision of the cadastral record, content of which has not been maintained in the last circa ten years, was initiated. Land registry, however, remained neglected. The cadastre obtained its role in society, but as an institution for registering land ownership in service of taxing income from agriculture. This resulted in mismatch between cadastral land data and ownership data in land registry, since land registry items corresponding to the cadastral items registered in the new cadastral record were not updated from 1953 to 1991 (Roić et al., 2005).

Croatian Parliament passed the Law on Sate Surveying and Cadastre of Real Property on November 5$^{th}$, 1999. This law defined the cadastre of real property as a register of land parcels, buildings and building parts, and other structures permanently on land or below the surface. This is the first time when the cadastre becomes a tool for registering real property as an object of law, and when it ceases to serve exclusively the tax purpose. Private ownership is in the foreground again as foundation for development of society, modern economy and overall progress. This law was in use for eight years when law of the same title is passed in 2007, however, with some changes in terms of defining the real property cadastre, state surveys, and national infrastructure of spatial data. Numerous bylaws were passed alongside the law from 2007 regulating the geodetic report, the Utility Cadastre, the Land Cadastre, the Real Property Cadastre, the administration of tasks regarding maintenance of state surveys and the real property cadastre, labels of country borders, execution of basic geodetic activities, etc. Alphanumerical and graphical part of the cadastral record for the whole Republic of Croatia is available at the internet address https://oss.uredjenazemlja.hr/public/index.jsp. Law from 2007 defines real property cadastre as a register of land parcels, buildings and other structures permanently on land or under surface, and of specific public rights and restrictions on land. Accordingly, one can notice that registration of building parts is omitted and public rights and restrictions are added as an entry in comparison to the law from 1999.

Cadastral maps originate from different time periods. First employable maps, most of which are in scale 1:2880, arise with proclamation of the Imperial Patent and preparation of the land cadastre in Croatia region under Austria-Hungary (Figure 1). Seven coordinate systems with different starting points had to be used as surveys were performed without projection in plane rectangular system (Borčić and Frančula, 1969). Instructions for cadastral surveying (Katastral-Vermessungs-Instruktion) with appended legends and topographic keys (ZeichenErklaerung) defined basics of sketch representation of cadastral data in 1820. Few labels and some colours were used to mark building units. Changes and data updates of the cadastral map according to Cadastre Maintenance Law from 1883 were executed by crossing out old and colouring new condition in red, causing clutter and illegibility leading to systematic upgrade at the beginning

of the 20th century in the Royal Lithographic Office in Vienna. This old cadastral maps are still in use on more than 75 % percent of Croatian territory, but in digital vector form.

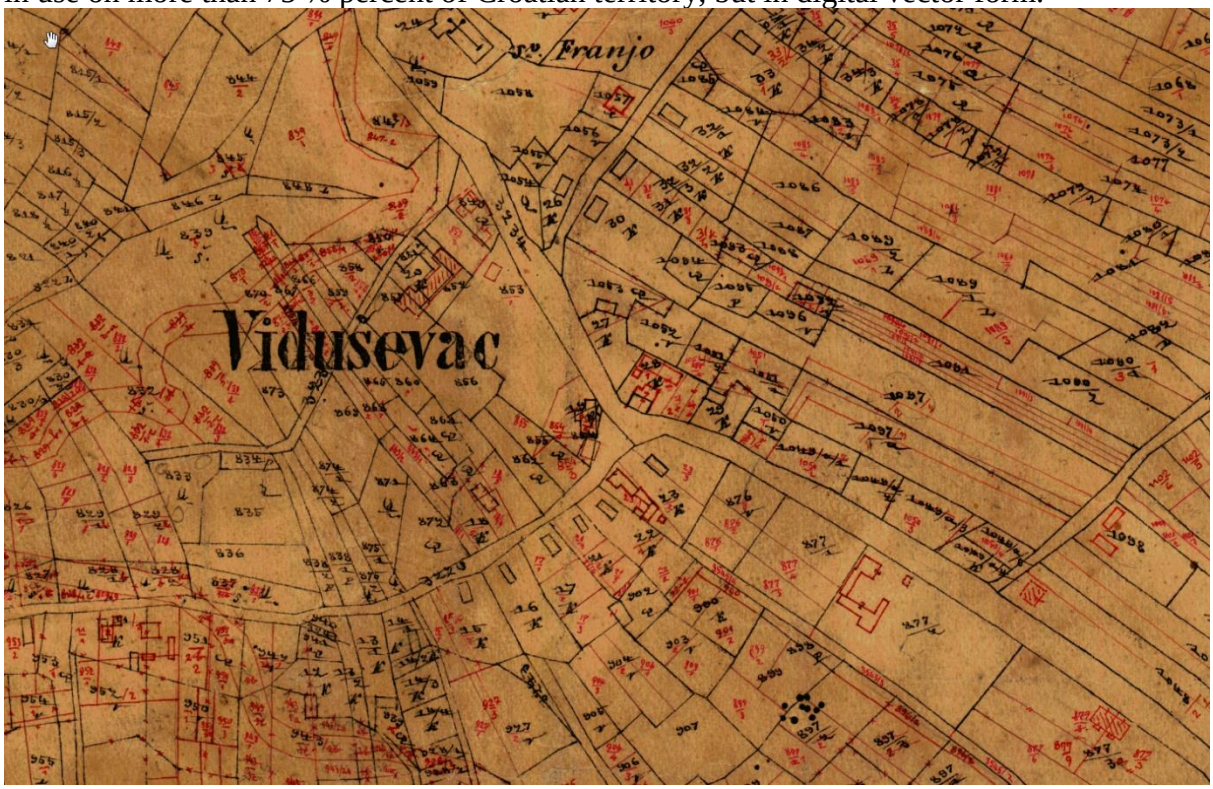


**Figure 1. Old cadastral map (cadastral municipality Viduševac)**

Kingdom of Yugoslavia introduces the Gauss-Krüger projection with maps now prepared in scales 1:500, 1:1000, 1:2000, and 1:2500. Technical purpose of the cadastral system during the Socialist Federal Republic of Croatia demanded preparation of the topographical and cadastral maps and introduction of the new real world features. Bylaw of Cartographic Signs and Collection of Cartographic Signs defined content of these maps in 1976. Collection defined 346 labels classified in different categories defining sketches as dependent on scale. Poor physical state of cadastral map pages and development of computer technologies stimulated preparation of scanned and vectorised (Figure 2) digital maps in the 90ties of the last century (Roić et al., 2005). All cadastral maps were digitalized for the whole Croatia by 2010.


**Figure 2. Digital cadastral map (cadastral municipality Glina) – vectorised**

## 2.2 New cadastral surveys in former Socialist Republic of Croatia

In 1953, Expert Council of the Geodetic Administration of the People's Republic of Croatia adopted conclusions on the issues important for development of the geodetic profession, reflecting both on its earlier development and the opportunities for developing state cadastral surveys in the future.

The then Expert Council gathered many of the most respectable and most experienced surveyors from the whole People's Republic of Croatia, defining the geodetic policy with respect to state survey and the land cadastre as based on the following:

1. intensive implementation of administrative reviews of land cadastre data;
2. rare and less successfully implemented technical reambulations of existing cadastral surveys;
3. renewal of graphical cadastral survey using numerical measurement methods (tachymetry and orthogonal);
4. aerial photogrammetric surveys starting from the late 1960s;
5. carrying out land consolidation 1956-1980.

2.1.1 Reviewing land cadastre data

Reviewing was carried out through campaigns organised based on special decisions by the Federal Government in Belgrade. Most geodetic experts participated in such campaigns throughout Croatia to fulfil this important task in optimal time. Their goal was to ascertain the actual state of land tenure and land culture, in order to keep the required level of updatedness of cadastral records. Municipal cadastre implemented changes in cases where there were up 10% of changes in the physical form of cadastral parcels. In cases where there were over 10% of such changes, this task was given to a special operational unit at the Geodetic Administration.

2.1.2 Technical reambulations of existing cadastral surveys

Most graphical surveys were considered to be unsatisfactory and out of date, due to nearly 30 years of poor maintenance, and it was necessary to correct and supplement them with data captured by immediate geodetic measurements of all changes on land. For this reason, the following was carried out:

- "Red reambulation" (in Dalmatia and the islands, in particular) carried out when the original graphic survey was low quality, and changes and all other cadastral maintenance were marked in red ink;
- "Blue reambulation", in which land registry status was shown as recorded in land registry collections of deeds. These changes were marked in blue ink;
- "Green reambulation" for recording those land registry statuses that were typically not implemented on the ground, in cadastral maps, which was marked in special cadastral map copies in green ink.

As technical reambulation included costly and lengthy geodetic operations, this process was often avoided, and was not successful as such, either.

2.1.3 Renewal of graphical cadastral survey using numerical measurement methods (tachymetry and orthogonal)

In the very beginnings of using these methods in Croatia, significant numerical surveys in Croatia included the survey of the city of Zagreb (1910-1914) with cadastral map sheets in scale 1:1000. Until 1945, sporadic numerical cadastral survey of very modest scope were carried out in Croatia. The numerical survey method includes two methods: polar and orthogonal. In both of them, the cadastral map is created based on numerical survey data (angles and lengths). These methods started to be used due to structural development of measuring instrument, and the need to renew and maintain the established cadastre.. The positional quality of cadastral maps was greatly improved with the introduction of these methods. The 1958 Regulation stipulated the use of the polar method for surveying mainly undeveloped areas, while the orthogonal survey method was recommended for use in developed areas.

2.1.4 Aerial photogrammetric survey

In late 1960s, a new perspective appears on the geodetic horizon - intensive use or aerial photogrammetry as a surveying method, representing a veritable revolution in geodesy of the

time. Using numerical surveying methods and, later, aerial photogrammetry, 80% of municipal seats of the People's Republic of Croatia (PRC), later Socialist Republic of Croatia (SRC), was surveyed. Out of this, 60% cadastral municipalities were surveyed entirely, and the remaining 40% in parts. The biggest problem, still very much present in the society and economy today, was the fact that land registry unfortunately failed to register these changes in their records, as they should have.

Based on cadastral surveys carried out after the Second World War and prior to 2000, new cadastral municipal documentation was launched in operation but the land registers were not renewed on the basis of them. Therefore, in 271 cadastral municipalities in Croatia, land registers are still kept according to the state of cadastral map data no longer in official use because the resurveyed cadastral map has replaced it (Figure 3).

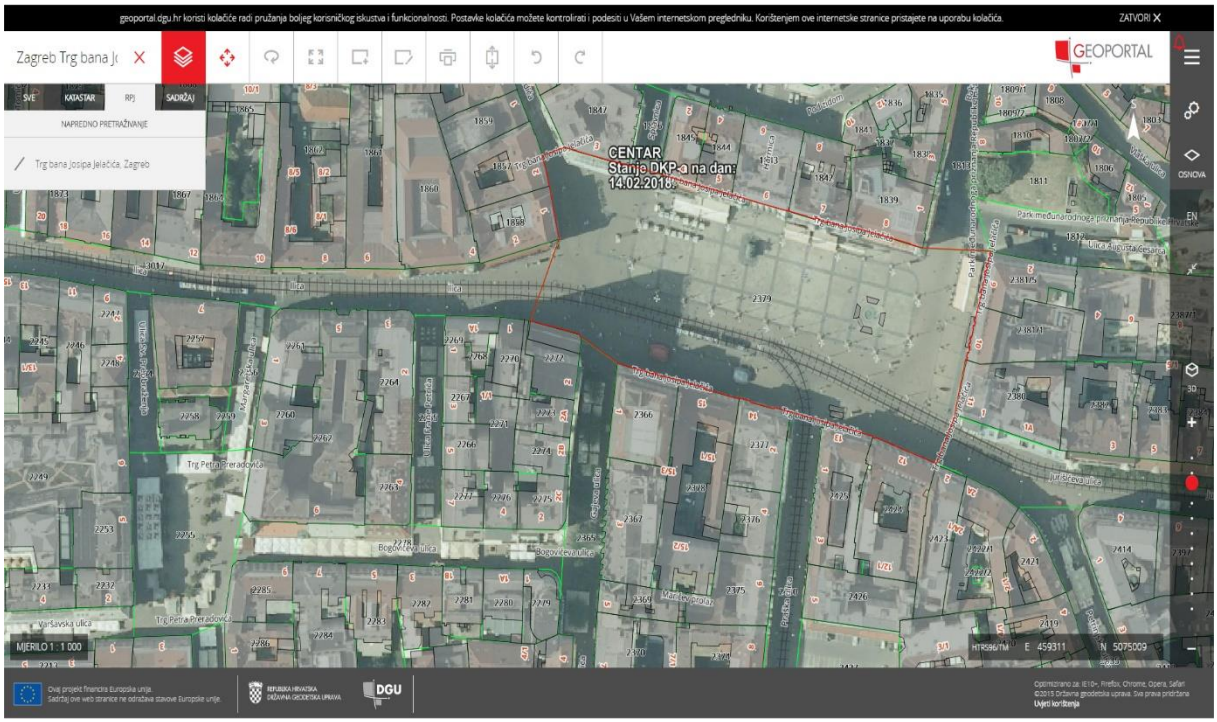


**Figure 3. Cadastral map Zagreb (cadastral municipality Centar), source: URL 1**

### 2.1.5 Land consolidation

In late 1954, the Land Consolidation Act came into effect, aimed at grouping land possessed by state-owned agricultural organisations. Another important factor for carrying out land consolidation was the great need for hydro-technical melioration operations. In the then Socialist Republic of Croatia, over 650.000 hectares of land was consolidated between 1956 and 1980 in 420 consolidation blocks, mainly in the area of Eastern Slavonia and Baranja.

## 3. LAND REGISTRY SYSTEM

Land registry in present Croatia region have a long tradition. Imperial order was issued in 1850 initiating formation of land registry in the Kingdoms of Hungary, Croatia, and Slavonia. Key legislations in this 160-year period are "Gruntovni red"(land registry law) from December 15th, 1855, Law on Interior Design, Formation and Correction of Land registry from 1930, and Land Registry Law from 1996. First attempts to establish land registry were unsuccessful, but they were successfully established after land descriptions were transcribed from the cadastre. Land registry are in present day available public registers of legal status of real property. Purpose of land registry is to enable simple, fast and safe legal transactions of rights registered on real property based on legal regulations. Land registry are managed in specific departments of municipal courts. Land registry for the Republic of Croatia may be found on the Internet address: https://oss.uredjenazemlja.hr/public/lrServices.jsp?action=publicLdbExtract.

### 3.1 Functional connection of land registry and cadastres

In Croatia, there are number of activities aimed at improving data, business processes, and the organization of land administration, and all of these fall under the National Real Property Registration and Cadastre Program known as Organized Land. One of the project's key objectives is to realize and implement a Joint Information System (JIS) to combine both the land register and a cadastre. The JIS is a unique system which will replace the current different databases, cadastral data models, and associated applications in the cadastral offices of the State Geodetic Administration, as well as the land register databases and applications in the offices of the municipal courts. The SGA implemented the JIS in all cadastral offices in Croatia by November 2016. Today, the JIS provides support for the implementation of all regulated business processes and tasks, as well as transparent monitoring and data reporting from the cadastre and land registers. This system has special values in its administration and functionalities, and is hosted in a highly secure environment (Vučić et al. 2017).

## 4. NEW CADASTRAL SURVEYS IN 21st CENTURY

In the independent Republic of Croatia, the State Geodetic Administration, the Government and the Croatian Parliament adopted several programs for new cadastral surveys, into which intensive efforts have been invested.

Given the wartime events, there were fewer cadastral surveys in the 1991-2000 period. Following the adoption of the State Survey and Real Property Cadastre Act in late 1999, cadastral surveys were launched throughout Croatia. Since 2000, cadastral surveys have been are being carried out for 408 cadastral municipalities (Figure 4) as follows (status as of 24 November 2017):

- 189 cadastral municipalities have been put in use;
- 38 cadastral municipalities are in the process of cadastral survey being carried out;

- 12 cadastral municipalities are in the process of geodetic reports being reviewed;
- 90 cadastral municipalities have been reviewed and are in the process of waiting for public display;
- 79 cadastral municipalities are in the process of public display being carried out.

The total area covered by the cadastral surveys aimed at creating the real property cadastre is 378.707 hectares.

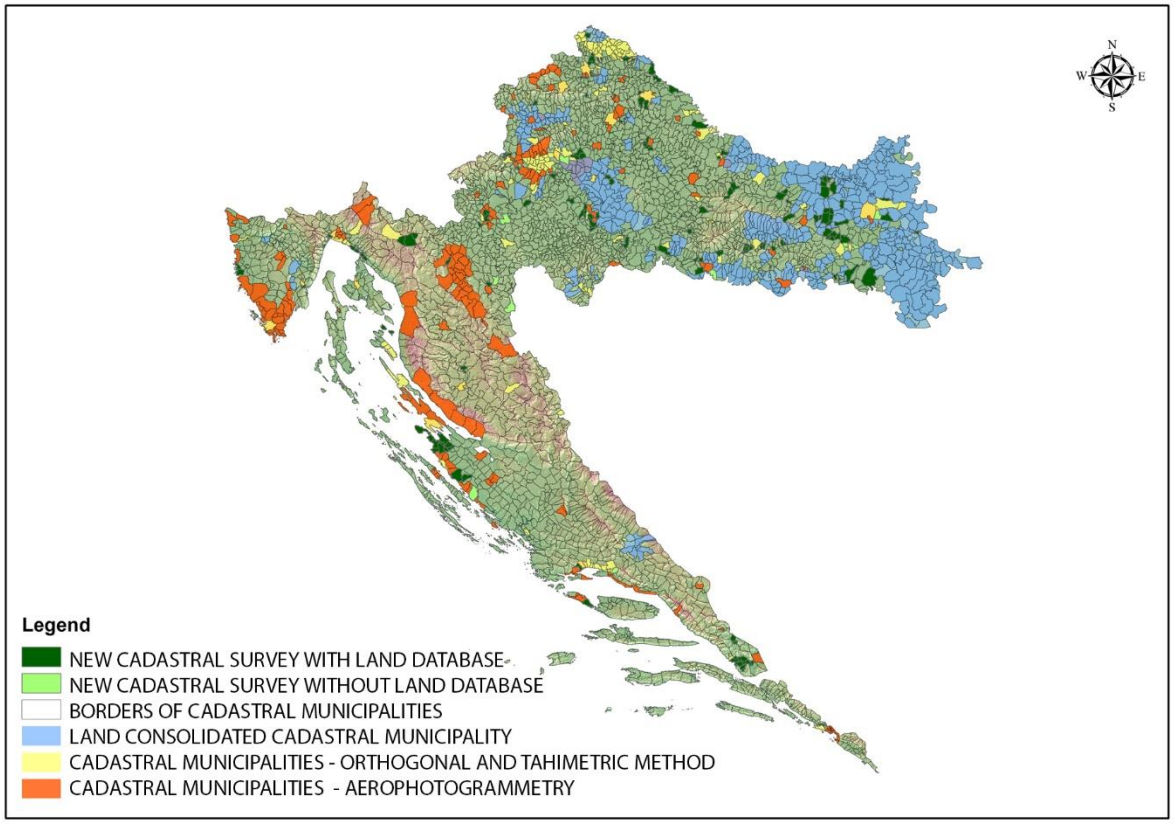


**Figure 4. Map of cadastral surveys in Croatia from 1948 to 2018**

## 4.1 New cadastral survey procedure

When real properties (land parcels, cadastral parcels) registered in the cadastre and land registry do not correspond to the actual situation in the field, this situation can be changed on the basis of an appropriate geodetic report. For historical reasons, this lack of harmonisation is present in large areas, and the State Geodetic Administration has launched a comprehensive program of organising the cadastral and its harmonisation with the actual situation in the field. This program is financed from the state budget and the county, city and municipality budgets.

Furthermore, legal and physical persons who are real property title holders can also provide financial resources. The cadastral surveys make the basis for this program.

Municipal cadastral documentation refers to the total cadastral records kept for a cadastral municipality. Cadastral survey is the gathering and processing of all necessary data in order to form cadastral parcels, record buildings and other structures, record special legal status of the land and the land usage as well as the creation of the cadastral documentation of the Real Property Cadastre.

The State Geodetic Administration, in agreement with the Ministry of Justice, conducts the cadastral survey for a cadastral municipality or a part of it, and specific works within the cadastral survey are conducted by licensed private geodetic companies. Licensed geodetic companies are selected at public tenders. Since the cadastral survey is conducted for a specific area, all persons affected by the survey on that area must be notified about it. As stipulated by the law, a Decision on the cadastral survey is passed by the Director-General of the State Geodetic Administration, and such Decision must be published in the Official Gazette. Along with the above-mentioned, the information on the cadastral survey implementation is also published in the local media (newspapers, radio). All local government units where surveys are conducted organize public meetings for citizens where the survey procedure is explained and instructions given regarding the marking of land borders with visible and permanent (boundary) markers. Along the roads passing through the area under surveying, boards are placed which mark the worksite.

When the cadastral survey is conducted in a cadastral municipality, the land title holders are obliged to mark, using visible permanent markers, the borders of the land they own, hold other rights or manage, at their expense and within the time period stipulated by the Decision on the cadastral survey. The title holders receive a written notification on the delineation. The title holders are provided with professional assistance, free of charge, in the delineation process. The delineation is conducted for all breakpoints of a cadastral parcel, and depending on the type of terrain, can be conducted with a concrete pillar, iron wedge, ceramic pipe, plastic marker with an iron core, or by carving a cross in a solid rock. Those cadastral parcel breakpoints that are clearly recognisable in the field, such as fences, houses, etc., need not be specifically marked.

When all of the necessary data are collected and processed in a cadastral survey, a cadastral survey report is produced. Along with all other parts, a cadastral survey report must include the cadastral map and evidential sheets. The cadastral map shows cadastral parcels with their boundaries, as well as the buildings constructed on them and the numbers of cadastral parcels (Figure 5). The cadastral map also shows the house numbers and borders of different land uses on the cadastral parcel. The evidential sheets show all of the collected and processed written data on the cadastral parcel, data on the real property title holders collected on the basis of available documents (land registers and cadastre), as well as the statement of the interested parties.

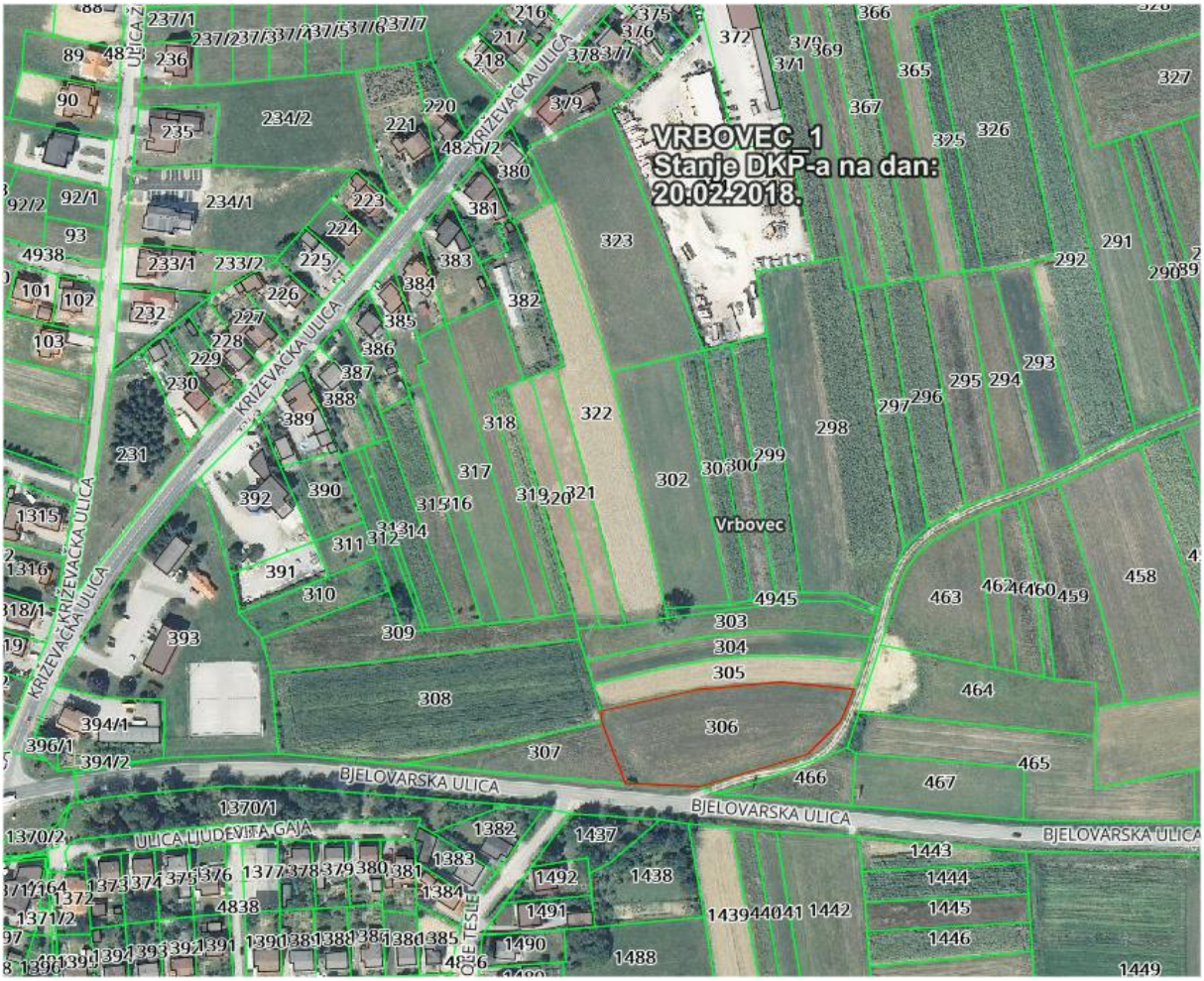


**Figure 5. New cadastral survey (cadastral municipality Vrbovec 1), source: URL 1**

The cadastral documentation for the Real Property Cadastre is made on the basis of the data gathered and processed through cadastral surveys or technical reambulation, the data gathered during the public review of the cadastral survey or technical reambulation report (hereon: public review) and the data transferred from the established or renewed Land Register. The public review is carried out by a State Geodetic Administration commission appointed by the Director General at the same time and in connection with the establishment or the renewal of Land Registers. During the public inspection process, persons shown as the real property title holders in the cadastral survey and technical reambulation report will confirm in writing that they were shown the cadastral survey and/or technical reambulation data and that they agree with the state of the gathered data. A registry of complaints is kept during the public review. Field inspections are compulsory upon the receipt of a complaint. If it is necessary on the basis of the carried out field inspections to change the data contained in the cadastral survey or technical reambulation report, the changed data will be on public review again. Unfounded complaints will be rejected

through a decision passed in an administrative process. Appeals are allowed against a decision to reject a complaint.

After the State Geodetic Administration commission has conducted a public display of all cadastral parcels, and the land registry office commission of the municipal court has compiled all land registry units for a cadastral municipality, a land register is opened through a decision passed by the Minister of Justice, and with the opening of the land register, a correction procedure is opened according to the Land Registration Act. On the day the land register is opened, the new cadastral data (new cadastral documentation) is put in official use, on the basis of the decision passed by the State Geodetic Administration Director-General, and the old data is no longer in use.

Indicators for an average costs of cadastre survey are defined per hectare of survey respectively by number of cadastral parcels. The final price is influenced by three factors: area, number of parcels, and number of buildings, taking into account whether the whole cadastral municipality is measured or built area only. In 2017 the average price of cadastral surveying offered on public procurement, based on the twenty-two local government units, and published by State Geodetic Administration was 219 € per hectare (excluding VAT) respectively 95 € per cadastral parcel (excluding VAT).

There are lots of positive aspects of the new cadastral surveys, and only one negative which occurs periodically. The negative aspect is a long waiting period for public display (Figure 6) of the data collected by the survey.

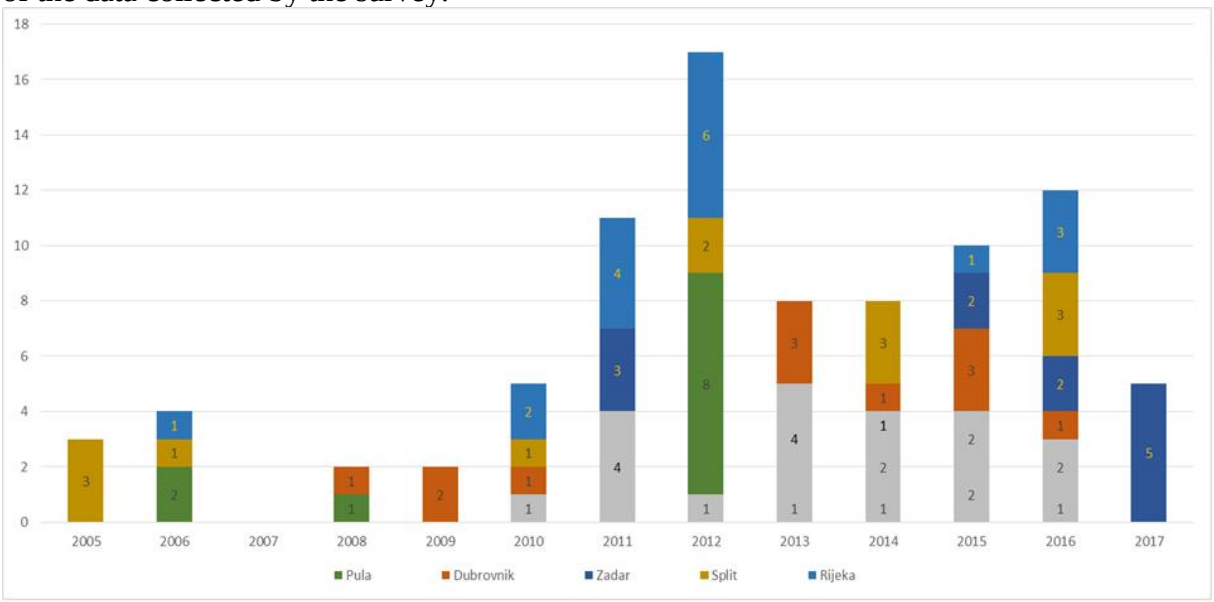


**Figure 6. Number of cadastral municipalities which are waiting for public display**

## 5. CONCLUSION

From the financial point of view, cadastral surveys are demanding projects. However, investing into new, geodetically accurate and legally safe cadastral and land registry records means making a pledge for the future of any surveyed area. The age of the existing records, mainly resulting from a lack of systematic maintenance for over two centuries, requires new, modern ones to be produced. Another important reason for the records being out-of-date is the 45 years of communism, when the land registration system was largely ignored, from both public institutions and the very owners, who failed to register changes on land for various reasons (complicated regulations on social ownership, high real property transaction taxes etc.). One particularly pronounced problem is the 271 cadastral municipalities where new cadastral documentation based on surveys carried out after the Second World War, but prior to 2000, was put in official use without renewing the land registers (in these cadastral municipalities, cadastral data differ from land registry data in cadastral parcel numbers, cadastral municipality names, and many other parameters). As these 271 cadastral municipalities are located in bigger Croatian cities (Zagreb, Rijeka, Split, Dubrovnik etc.), allocating funds for carrying out new cadastral survey or their harmonisation with new municipal cadastral documentation should be a priority. Goal of the new cadastral surveys is to develop the real property cadastre. This cadastre contributes to legal security in real property transactions, simplifies property registration and renewal of land registry.

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## BIOGRAPHICAL NOTES

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