

Cadastral surveys of construction areas

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Key words: cadastre, cadastral survey, construction areas

SUMMARY

This paper deals with the multi-year Cadastral survey program of construction areas in the Republic of Croatia for the period 2021 – 2030. The implementation of activities from the Cadastral survey program will provide up-to-date data on real property in construction areas in the Republic of Croatia and areas around construction areas that are important for the development of cities and municipalities, counties and whole Republic of Croatia. In construction areas there are more than 80% of economic activities depended of real property transactions, spatial planning and construction, for nature and environmental protection, sustainable development. Distribution of real property data through online services will enable citizens, public and private sector access to real-time data, but also contribute to the development of entrepreneurship and public administration that will use real property data available digitally.

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1. INTRODUCTION

In the territory of today's Republic of Croatia, a significant part (about 70%) of cadastral and land registry records dates from the time of the Austrian Empire, and then from the time of the Austro-Hungarian monarchy. These records are between 100 and 200 years old and generally do not meet the purposes of today's land administration system as well as the challenges facing the land administration system.

Throughout history, re-surveys have been carried out in Croatia over several periods, updating cadastral data and creating new cadastral operettas for individual areas. The latest re-measurements have been carried out in Croatia since 2000, when the law prescribed the replacement of the existing land cadastre with a real estate cadastre. The cadastral survey projects include a series of activities which together with the project participants form a complex project (Pivac et. al 2022).

In order to further improve the services of the land administration system in terms of efficiency, transparency and cost, and given the needs of continuous modernization of the cadastre and land registry, the State Geodetic Administration (SGA) conducts cadastral surveys which are the basis for renewal and competent municipal courts. A modern and efficient land administration system contributes to increasing legal certainty in the treatment of real property, encourages and accelerates investment processes and improves the functioning of the real property market.

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 (Vučić and Šantek, 2018).

2. CROATIAN LAND ADMINISTRATION

Spatial data and data on real property in Croatia are managed in multiple registers with lot of end users. Basic registers are 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 (Vučić et al. 2017).

In December 2018 the new Law on State Survey and Real Property Cadastre was brought into the force and introduced several changes in Croatian geodetic profession. The law introduced the Register of Buildings as a transitional register towards 3D cadastre, combining datasets from several existing sources and newly collected datasets. The scope of Register of Geographical Names and Register of Spatial units have been redefined. The Cadastre of Infrastructure (Utility line Cadastre) was returned under the jurisdiction of the State Geodetic Administration because previously it was under the jurisdiction of local government units. The process of cadastral surveys has been redefined and technical reambulation was abandoned as a methodology for partial improvement of cadastral map quality since its results were not satisfying in the past. Also this law regulates improved surveying methodology in the Republic of Croatia - this time each technical ordinance contains technical specifications that define the procedure in more detail (Vučić et al. 2022).

2.1 Historical background

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 70 % percent of Croatian territory, but in digital vector form.

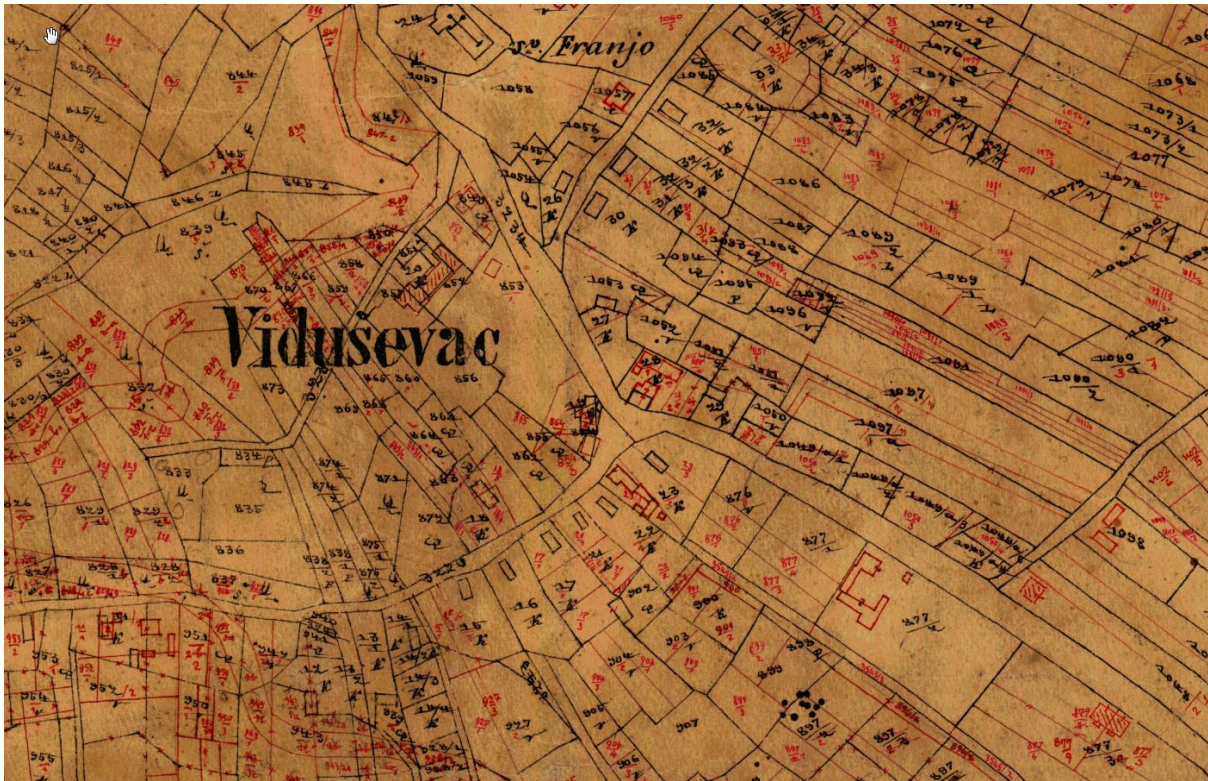


Figure 1. Old cadastral map - cadastral municipality Viduševac

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).

2.1.1 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 (Vučić and Šantek 2018).

2.1.2 Aerial photogrammetric survey

In late 1960s, a new perspective appears on the geodetic horizon - intensive use of 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 (Vučić and Šantek 2018).

2.2 Current status of cadastral data

The State Geodetic Administration Cadastre in Motion (www.katastar.hr) portal is connected with the Google Maps service and provides some information about buildings. This service contains cadastral maps data (Figure 2), register of spatial units data and digital orto-photo data. Also, this service has the ability to locate via GNSS device in a smartphone or tablet.

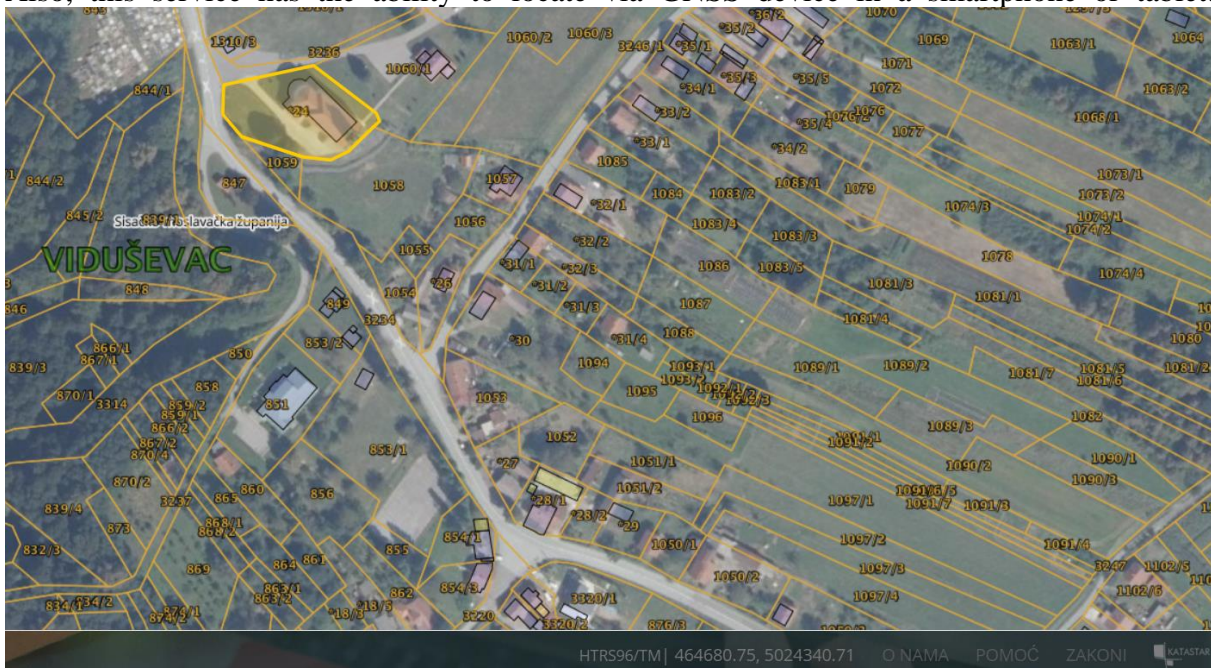


Figure 2. Digitized and homogenized old cadastral map for cadastral municipality Viduševac (still in used) on a service www.katastar.hr

The new Law on State Survey and Real Property Cadastre introduces the real property cadastre as a reliable and high quality product. Cadastral parcels which are registered in a real property cadastre were measured accurately, by aligning the actual situation in reality with cadastre and land book. Real property cadastre guarantees real property security. The cadastral parcel registered in the real property cadastre guarantees the same protection of trust such as land book data. One of the biggest novelties in abovementioned new law is the obligation that quality of field measurement data for boundaries of cadastral parcels and buildings must be determined by the level of confidence for horizontal coordinates with 95% probability standard positional accuracy up to 0.1 meter (Official Gazette 2018). The cadastral map producing in new cadastral survey (Figure 3) are made in conditions of this abovementioned new law. The public display of cadastral data is still in progress for cadastral municipality Viduševac.



Figure 3. The cadastral map produced in new cadastral survey - cadastral municipality Viduševac

2.3 Real property cadastre development

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 display of the cadastral survey or technical reambulation report (hereon:

public display) and the data transferred from the established or renewed Land Register. The public display 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 display. 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 display 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 (Vučić and Šantek 2018).

The following table shows the establishment of the real estate cadastre as of March 1, 2000, when it was first introduced into the Croatian legal framework (Table 1).

Table 1. Real property cadastre development in the Republic of Croatia from March 2000 to February 2022

PUK/ZK županija	Whole cadastral municipality	cadastral municipality zone	Public display	confirmed survey report	Survey report in process of review	Survey	Total number of cadastral municipalities
Bjelovarsko-bilogorska	5	2	2	0	0	0	7
Brodsko-posavska	13	0	2	0	0	0	15
Dubrovačko-neretvanska	14	0	11	10	0	0	35
Grad Zagreb	2	2	3	0	0	1	6
Istarska	7	0	4	11	0	0	22
Karlovačka	9	0	3	0	0	0	12
Koprivničko-križevačka	12	0	4	2	0	0	18
Krapinsko-zagorska	2	0	2	0	0	0	4
Ličko-senjska	3	2	2	3	0	0	8

Međimurska	9	0	1	0	0	0	10
Osječko-baranjska	33	0	4	5	0	0	42
Požeško-slavonska	18	0	2	2	0	0	22
Primorsko-goranska	20	5	9	17	1	0	47
Sisačko-moslavačka	15	0	2	0	0	1	18
Splitsko-dalmatinska	5	1	10	11	0	0	26
Šibensko-kninska	0	0	3	0	0	0	3
Varaždinska	11	0	2	0	0	0	13
Virovitičko-podravska	8	0	2	2	0	0	12
Vukovarsko-srijemska	6	0	0	2	0	0	8
Zadarska	32	0	19	16	0	0	67
Zagrebačka	25	1	5	1	0	1	32
TOTAL	249	13	92	82	1	3	427
	262						

3. CASE STUDY KOPRIVNIČKO – KRIŽEVAČKA ŽUPANIJA

From the experience and perspective of one of the authors of this article (Unger) as a longtime head of the cadastral office of the Koprivnica-Križevci County, the following conclusions emerge:

- cadastral surveys have proven to be long, arduous and expensive processes, but for most areas inevitable and therefore cost-effective
- the performed measurements cover only 15% of the area of the county, but the importance and effect of the work done means much more than the stated percentage
- the experience gained over the past ten years shows a difficult but successful tracing of the paths to be taken
- although it is not possible to realize such projects without money, it is not enough. Good regulations, motivation and political will of all participants (population, local and state authorities) and readiness and synergy of all experts in the implementation of the project (cadastre, court, authorized persons) are needed.

- a positive public atmosphere has been created in the county, which should continue to be supported and disseminated, which is why cadastral surveys are successfully conducted here.

The following figure shows the preparation of the real property cadastre in Koprivnica-Križevci County (

Figure 4) from 2000 to 2022. The real property cadastre differs from the land cadastre by greater accuracy and the quality of the owner's registration. Also in the real property cadastre, the situation on the field corresponds to the situation in the cadastre and land registry records.

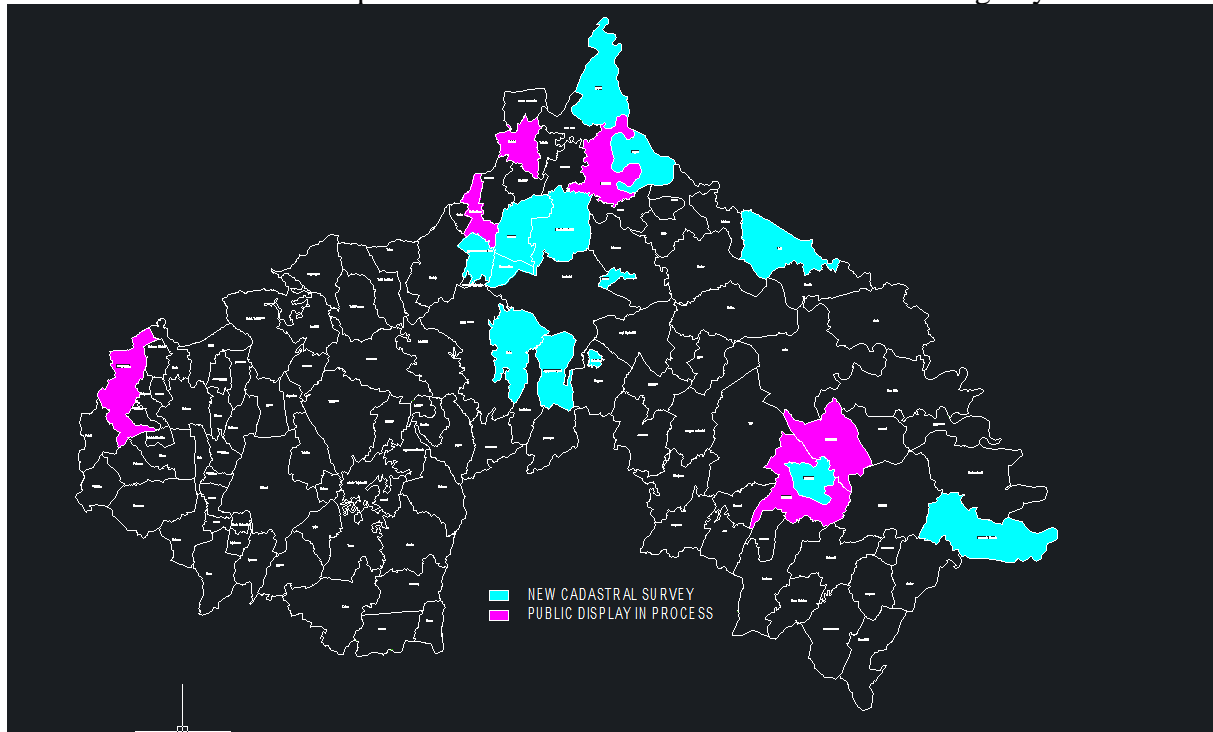


Figure 4. New cadastral surveys in Koprivničko-križevačka county

The table showing data on cadastral surveys in Koprivnica-Križevci County shows that the number of cadastral parcels after the cadastral survey is lower, while the number of registered buildings after the survey is higher (Table 2).

Table 2. New cadastral surveys in Koprivničko-križevačka county - parcels and buildings

Cadastral municipality	Area (ha)	Number of parcels before survey	Number of parcels after survey	Number of buildings before survey	Number of buildings after survey
Bakovčica	109	679	295	286	434
Đelekovec	1751	8034	4105	1091	2514
Đurđevac I	829	4767	4084	852	7440
Đurđevac II	2129	7820	3688	202	605
Đurđevac III	1998	2603	1766	205	425
Gola	1965	6459	3566	820	2820
Gorica Nova	646	2234	1307	220	384
Gornja Rijeka	1761	8542	8106	658	1237
Jagnjedovec-grad	1373	5953	3053	940	2600
Koprivnički Ivanec	2009	9417	3626	1164	1824
Kunovec	1320	7929	3467	636	1201
Kunovec Breg	474	4067	2500	762	1510
Kutnjak	913	6165	3377	465	994
Legrad	3332	9813	5350	765	2367
Podravske Sesvete	3231	9007	5603	507	2203
Reka	1826	5251	2540	971	1921
Subotica Podravska Nova	638	5008	2041	770	1553

4. MULTI-ANNUAL PROGRAM OF CADASTRAL SURVEYS OF CONSTRUCTION AREAS FOR THE PERIOD 2021-2030

The State Survey and Real Property Cadastre Act (Official Gazette 2018) stipulates that the State Geodetic Administration is responsible for real property cadastre activities and that real property cadastre activities are performed on the basis of multiannual and annual program. The multi-annual and annual program in the part related to the real property cadastre is proposed to the Government of the Republic of Croatia by the State Geodetic Administration, with the prior consent of the ministry in charge of justice. The multi-annual program was adopted by the Croatian Parliament in October 2021, and the annual programs will be adopted by a decision of the Government of the Republic of Croatia.

Multi-Annual Program of Cadastral Surveys of Construction Areas for the Period 2021-2030 determines the areas in which cadastral surveys will be carried out, real property cadastre

activities and tasks and renewal or establishment of land registers, manner and deadlines, holders and participants in the implementation, methods of their financing and other issues important for the implementation of the program. The main goal of the program is the establishment of the real property cadastre and renovation or establishment of land registers based on cadastral surveys for real property in construction areas in the Republic of Croatia (Official Gazette 2021).

This program determines the activities and tasks to be carried out, the areas in which they will be carried out, the deadlines for execution, the holders and participants in the execution, and the ways and sources of financing. Jobs and tasks from the program are realized through the implementation of four sub-programs, as follows:

- Sub-program A) Renewal of cadastre and land registers for construction areas in the Republic of Croatia
- Sub-program B) Completion of the started procedures of cadastre and land registry renewal
- Sub-program C) Harmonization of areas and boundaries of cadastral municipalities
- Sub-program D) Ensuring the functioning of integrated information systems in the function of the spatial management policy of the Republic of Croatia.

The following table (Table 3) shows the activities and resources of Sub-program A) for actual year (2022) - Renewal of the Cadastre and Land Registry for Construction Areas in the Republic of Croatia (URL 1). The prices in the table are expressed in EUR at the exchange rate of 1 € is 7,564582 HRK.

Table 3. Sub-program for actual year - proposal - in the process of adopting by the Government of the Republic of Croatia

Number	Activities and tasks	Complete the activity	Financial resources (€) 2022.	Financial resources (€) 2023.	Financial resources TOTAL (€)	Source of financing
1.	Public information campaign on Program activities	Continuously till 31.12.2023.	297.439	261.085	558.524	State budget (SGA)
2.	Education of persons authorized to perform professional geodetic works	Continuously till 31.12.2023.				
3.	Preparation of the Agreement on the implementation of cadastral surveys with local and regional self-governments	Continuously till 31.12.2022.				

4.	Preparation of project documentation for initiating procurement for the implementation of cadastral surveys and technical supervision over the implementation of cadastral surveys	Continuously till 30.04.2022.				
5.	Implementation of public procurement and contracting of cadastral surveys and technical supervision over the implementation of cadastral surveys	Continuously till 30.06.2022.				
6.	Implementation of cadastral surveys and implementation of technical supervision over the implementation of cadastral surveys	Continuously till 30.06.2023.	13.412.846	20.119.268	33.532.114	State budget (SGA)
7.	Renewal of cadastre and land books	Continuously till 31.12.2023.	1.806.561	2.709.842	4.516.403	Local self-government units
TOTAL			15.516.846	23.090.195	38.607.041	

5. CONCLUSION

The implementation of activities from the Program will provide up-to-date data on real property in construction areas in the Republic of Croatia and areas around construction areas that are important for the development of cities and municipalities, counties and the whole country. Distribution of real estate data through online services will enable citizens, public and private sector access to real-time data, but also contribute to the development of entrepreneurship and public administration that will use real estate data available digitally. This activities will provide fit for purpose Land Administration and social, economic and economic activities related to it.

Given the state of cadastre and land registry records, it is essential to create new ones because in certain areas these records are in a state that certainly needs to be improved, and a new survey has proven to be the best solution.

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BIOGRAPHICAL NOTES

Nikola Vučić graduated in geodesy from the University of Zagreb, Faculty of Geodesy. In 2015, he received a PhD from the University of Zagreb for the thesis “Support the Transition from 2D to 3D Cadastre in the Republic of Croatia”. He was employed at the cadastral office in Glina from 1999 to 2004. He was the Head of the Department for Administrative and Professional Supervision at the State Geodetic Administration of the Republic of Croatia. He was the Head of Sector for Cadastral Programs and Special Registers at the State Geodetic Administration of the Republic of Croatia. He was the Head of Division for Special Registers at the State Geodetic Administration of the Republic of Croatia. Currently he is the Head of Sector for cadastral surveys and infrastructure at the State Geodetic Administration of the Republic of Croatia. His main research interests are land administration systems, 3D cadastres and geoinformatics. He is a member of the Croatian Geodetic Society and the Croatian Chamber of Chartered Geodetic Engineers.

Damir Šantek is director general at the State Geodetic Administration of the Republic of Croatia. In 2015 he received a PhD from University of Zagreb for the thesis “Application of GNSS RTK in the cadastral survey with increased accuracy and reliability of measurements”.

He was employed at cadastral office in Glina and cadastral office in Sisak. He was deputy - director at the State Geodetic Administration of the Republic of Croatia from 2008 to 2012. He is a member of the Croatian Geodetic Society. He is chartered geodetic engineer at Croatian Chamber of Chartered Geodetic Engineers. His main research interests are land administration systems, cadastres, geoinformatics, GNSS measurements and data digitization.

Jelena Unger graduated in geodesy from the University of Zagreb, Faculty of Geodesy. She was employed at the surveying division of food factory Podravka. From 1990 to 1995, she was employed at the Koprivnica-Križevci County, cadastral office Koprivnica, as a cadastral officer. From 1995 to 2000, she was employed at the Koprivnica-Križevci County, cadastral office Koprivnica, as the Head of office. Since 2000, she has been the Head of the Regional Cadastral Office in Koprivnica. Her main interests are land administration systems, improvement of cadastral data and geoinformatics.

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