

## Digital Geodetic Elaborate System (SDGE)

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### SUMMARY

The digitalisation of public administration has been one of the key objectives of Croatia as the member state of the European Union. There are already many digital services published from public authorities towards citizens and external stakeholders, but there are few or no web services at which external stakeholders (private companies authorized for specific area) are directly involved in maintaining of the official registers. One of the first systems in Croatia that allows direct involvement of the external stakeholders in the process of maintaining and updating the official registers is the Digital Geodetic Elaborate System.

Digital Geodetic Elaborate System (*in Croatian Sustav Digitalnih Geodetskih Elaborata - SDGE*) is a modern Web GIS application that provides geodetic surveyors full support in creation and assessment of the geodetic elaborate using digital solution.

Considering that today, two years since the system integration, more than 75% of all elaborates in Croatia are processed and submitted digitally through the SDGE, the tendency is to reduce the number of analogous elaborates to a minimum.

Taking into account the economic potential of a real estate market, the SDGE became one of the indispensable links in the chain of access to geodetic data, implementing changes to spatial data via web and updating the national real estate cadastre database. The system availability and stability, ease of the use and the intuitive user experience are the factors that contribute to the rapid growth of the system usage. The high level of interoperability of the SDGE system requires continuous upgrading in order to further develop support to the process of DGE in accordance with updated legal regulations and the needs of end-users determined through the Customer Support.

The SDGE is the best example of a successful digital transformation of a complex business process that directly affects the economy in Croatia.

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## 1. INTRODUCTION

The real estate market is one of the backbones of the economies of modern countries, which reflects the economic situation of the country, influencing its dynamics on economic growth, production and consumption, and the rate of gross domestic product (GDP). By the decision of the Government, and through the Ministry of Justice and the State Geodetic Administration, in 2003, the Republic of Croatia (RH) launched the National Program for Arranging Land Registers and Cadastre, abbreviated as Regulated Land.

Considering the development and implementation of numerous services within which the registration of the real estate in the cadastral and land registry system was accelerated, the level of legal certainty in real estate transactions was raised, both systems were streamlined, and business processes were simplified (URL 1), the duration of Regulated Land elaborate was prolonged until the 2020 when the completion was expected. The elaborate harmonized the data from the two systems and improved customer relations and the speed and quality of service delivery.

Since cadastral plans from the 19th century are still used in 70% of the territory in Croatia, the development of digital and coordinate cadastre has imposed itself as a necessary precondition for the development of the Republic of Croatia and thus become one of the development priorities through the Regulated Land project, which is significantly speeded up by the development and implementation of SDGE.

SDGE was released in production on September 1, 2018. It is available at the link <https://sdge.dgu.hr>, and can be used by all individual or legal persons who have the consent to perform professional geodetic work issued by the decision of the State Geodetic Administration (authorized persons) (URL 2).

About 60,000 geodetic elaborates are prepared annually at the level of the Republic of Croatia, and the application of SDGE contributes to significant simplification and standardization of the business process of preparation of elaborates, paves the way for free access to data online, and shortens the time of preparation, submission and review and confirmation of geodetic elaborates.

Two years after the establishment of the SDGE service, we can analyse the contribution and importance of SDGE to the above business processes. This paper presents SDGE with its significant functionalities and an overview of system usage through statistical analysis.

## 2. SDGE – Digital Geodetic Elaborate System

SDGE is an application solution based on Web technologies, in order to be available via the Internet to all authorized surveying contractors using the basic Web browser. The system is owned by the State Geodetic Administration and developed by IGEA Ltd. The main purpose of the SDGE application solution is to provide a quality tool for digital geodetic elaborates that supports the entire process from downloading official digital data, preparation and production of geodetic studies to submission of digital studies to review and confirmation. SDGE consists of several modules (see Figure 1).



Figure 1 Initial GUI of SDGE service

SDGE system supports the entire process from digital spatial data download, geodetic surveys data preparation and submission to digital examination and validation via Web portal. The main functionality of the SDGE application solution is to provide a quality control tool for the purposes of creation and controlling of digital geodetic elaborate. With its range of functionality as well as the web services integrated with other external systems, SDGE is a revolutionary central digital solution in the daily work of the geodetic community in Croatia.

The SDGE is connected to the external systems by web services that provide data, official documents, and processes in the creation of DGE.

The SDGE has implemented automated controls that ensure the integrity and validity of the graphical part of DGE (spatial datasets). The controls ensure the geometric, topological and attribute validity of the graphical part of DGE, as well as the current and proposed new state of the geodetic elaborate, and the consistency between the current and proposed new situation in cadastre. In case of determined inconsistencies, the SDGE generates a quality control report containing the list of inconsistencies and their exact georeferenced position. Based on these reports' users can make their geodetic elaborate consistent with the valid legislative through iterations. The following section will briefly explain all SDGE system modules and their functionalities.

## 2.1 Modules of SDGE service

### 2.1.1 Business module

The Business module was developed to support the business process of keeping records of professional geodetic work in accordance with the Ordinance on the content of data of professional geodetic work records (NN 90/2018), which became official on 1<sup>st</sup> of January 2019. The module enables keeping of a record of the performance of professional geodetic works by individual and legal persons who have the consent of the State Geodetic Administration in electronic form via the SDGE application. The content of the Business module is in full compliance with the Ordinance.

### 2.1.2 Subject registry module

The Subject registry module is designed as a map of all subject items of one SDGE user. Users who use the SDGE system for the purpose of making digital geodetic elaborates keep a list of jobs through the Subject registry module. All geodetic works from geodetic activities prescribed by the Law on Geodetic Activities (OG 25/2018) performed by authorized geodetic contractors, and which are entered through the Subject registry module are automatically replicated in the Business module in accordance with the Ordinance on the content of professional geodetic works records.

### 2.1.3 Web GIS viewer

The Web GIS viewer module displays and makes available the official SGA data required for the preparation of geodetic elaborates and which are service-accessible from appropriate sources (Geoportal, Register of Spatial Units (RPJ), One Stop Shop (OSS)), as well as up-to-date data of geodetic studies of full content from the SDGE database. Within the Web GIS viewer it is possible to make a search of all data accordingly to the Register of Spatial Units - counties, municipalities / cities, settlements, streets, cadastral municipalities and house numbers (including display of attribute data on house number) and the data of the Digital Cadastral Plan.

### 2.1.4 Conversion module GMS→CAD

Considering that GML is defined as an exchange format for digital geodetic elaborate, and the geodetic chartered engineers make the graphic part of the digital geodetic elaborate (measurement sketches / copies of the maintenance plan) in CAD format (in accordance with the *Technical Specifications for Digital Cadastral Plan and the graphic part of the Digital Geodetic Elaborate (in Croatian Digitalni Geodetski Elaborat - DGE)*), the Conversion module of GML to CAD format enables the process of conversion from GML format to CAD in accordance with the Technical Specifications.

### 2.1.5 Digital geodetic elaborate module

The module for geodetic elaborate as an integral part of the SDGE application solution supports the complete process of the digital geodetic elaborate from creating the subject and entering basic information about the subject and project, loading initial data of the elaborate's current state, creating the current and new state of registration forms for cadastre and land register, generating and collecting the constituent parts of the elaborate until the elaborate is sent for a review and confirmation to the corresponding cadastral office. To facilitate the process of digital geodetic elaborate procedure, this module navigates user through step-by-step elaborate line. In this way, users always know in what status the DGE is and at which step to restore elaborate and continue to work on.

### 2.1.6 Quality control module

Quality control is the procedure of determining the inconsistency of geometric, topological and attribute relations in the graphic part of geodetic elaborate that should be prepared in \*.dxf format in CAD tools in accordance with the Technical Specifications for the preparation of DKP and graphic part of DGE. Quality control is a special procedure that can be performed autonomously and independently at all stages during the development of the DGE and is also an integral part of the import process of the survey sketch in order to sustain consistency of the data in accordance with the mentioned Technical Specifications.

### 2.1.7 Digital archive module

The Digital Archive System (SDA) is a system for storing the archives of the State Geodetic Administration. It is a module for service retrieval and review of digital archive data (SDA), as an integral part of SDGE, which consists of an interface for entering digital archive search parameters and an interface for displaying results.

Simple and fast availability of archival data of cadastral offices to authorized geodetic contractors significantly speeds up and simplifies the process of making digital geodetic elaborates, especially in construction areas where the frequency of preparation and implementation of geodetic elaborates is significant.

### 2.1.8 Administrative module

The administrative module allows administrators of offices of certified geodetic engineers, joint offices or legal entities that perform professional geodetic work to edit the roles and data of application users / employees from their own office / legal entity, and SDGE administrators.

### 2.1.9 Help Desk module

It enables the users of the application to report problems in the process of creating a digital geodetic elaborate in the SDGE and receive feedback from customer support (available to the user all in one place).

### 3. Overview of the SDGE usage

This section presents some of the most important statistics related to the first two years of SDGE service. The data shown refer to the period from the establishment of the system on September 1, 2018 to March 1, 2021.

- Number of active users of the application - In the SDGE application, more than 2745 active users have been created who have access to SDGE and the ability to work in modules according to the defined roles of each user account.
- Number of enrolled cases and studies - More than 108 033 cases were opened within the Subject register module, and more than 78 113 elaborates were created. Related to the purpose of the elaborate most elaborates are created for documenting, deleting or changing the data on buildings or other structures and for documenting the actual position of already registered cadastral parcels.
- Statistics of GML to CAD conversion jobs - Using the GML to CAD Conversion module, 428 461 conversions were initiated and more than 98% were successfully completed.
- Statistics of quality control activities by type of specification - Quality control enables control of initial DKP data according to the "old" Specification for vectorization v.2.9.5 and control of the graphic part of DGE according to the new Technical Specifications (TS DKP). According to the data from the system, most quality control activities were initiated for the purpose of checking the graphic part of the DGE for the purposes of digital geodetic elaborate, i.e. 92% of the total number of quality control activities.
- Statistics of submitted studies for review and confirmation - Of the total number of geodetic elaborates submitted for a review and confirmation in February, 2021, 79% of elaborates were submitted digitally through SDGE. The ratio of prepared digital geodetic elaborates in relation to analogue ones is continuously growing on a monthly basis (see Table 1). Data of the usage of the SDGE application show a constant monthly trend of growth in the number of geodetic elaborates prepared via SDGE and submitted for a review and confirmation by the service in OSS (see Table 1).

Table 1 Ratio of analogue and digital geodetic elaborates in period of 1.9.2018. – 1.3.2021.

month/year	analogue	digital	%
9/2018	907	3	0.22%
10/2018	1082	119	7.04%
11/2018	1406	344	16.41%
12/2018	1395	520	24.8%
1/2019	1419	815	34.85%
2/2019	1584	1096	40.65%
3/2019	1552	1356	45.31%
4/2019	1463	1436	48.83%
5/2019	1601	1717	51.23%
6/2019	1154	1433	54.48%
7/2019	1561	2103	57.38%
8/2019	1057	1615	59.95%
9/2019	1313	2166	62.01%
10/2019	1282	2430	65.13%
11/2019	1357	2509	64.64%
12/2019	1268	2364	65.16%
1/2020	1110	2478	68.39%
2/2020	1189	2816	70.16%
3/2020	1164	3107	72.37%
4/2020	986	2494	71.51%
5/2020	994	2813	73.36%
6/2020	1019	2780	72.95%
7/2020	1063	3483	75.99%
8/2020	706	2508	78.03%
9/2020	953	3558	78.68%
10/2020	980	3649	78.8%
11/2020	828	3357	80.17%
12/2020	992	3495	77.82%
1/2021	894	2931	76.48%
2/2021	932	3620	79.31%
3/2021	366	1694	80.85%
<b>TOTAL</b>	<b>35577</b>	<b>66809</b>	

Visualisation of the ratio between the digital and analogue geodetic elaborates is shown in Figure 2. Furthermore, the amount of digital elaborates submitted per county's cadastral offices, in period of 1.9.2018.-1.3.2021., based on county's cadaster office data, is shown in Figure 3. Most submissions of geodetic elaborates have been made in the cities and counties with the largest population, as expected.

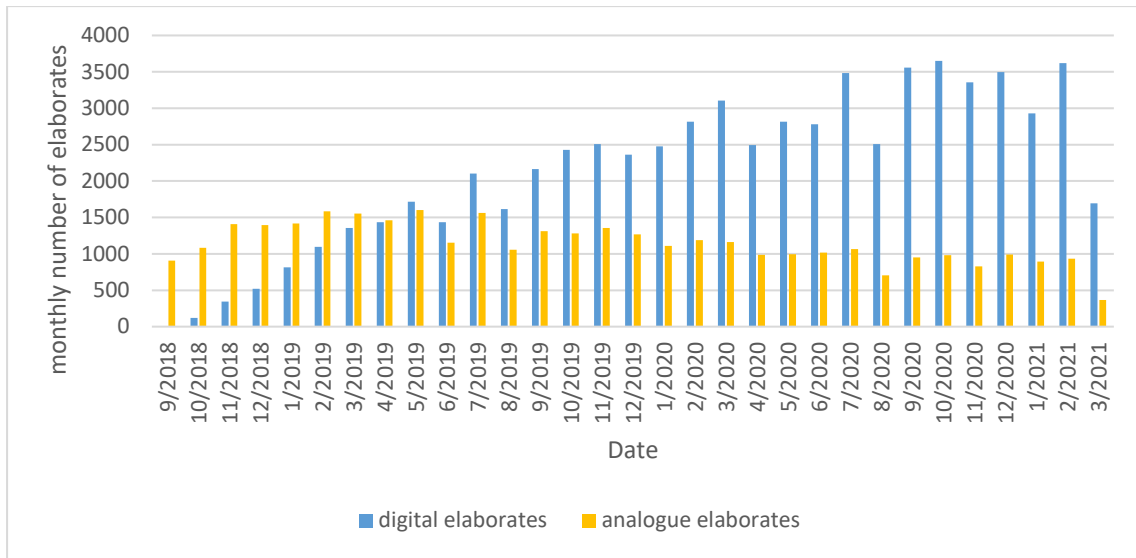


Figure 2 Ratio between analogue and digital elaborates submitted in period of 1.9.2018.-1.3.2021.

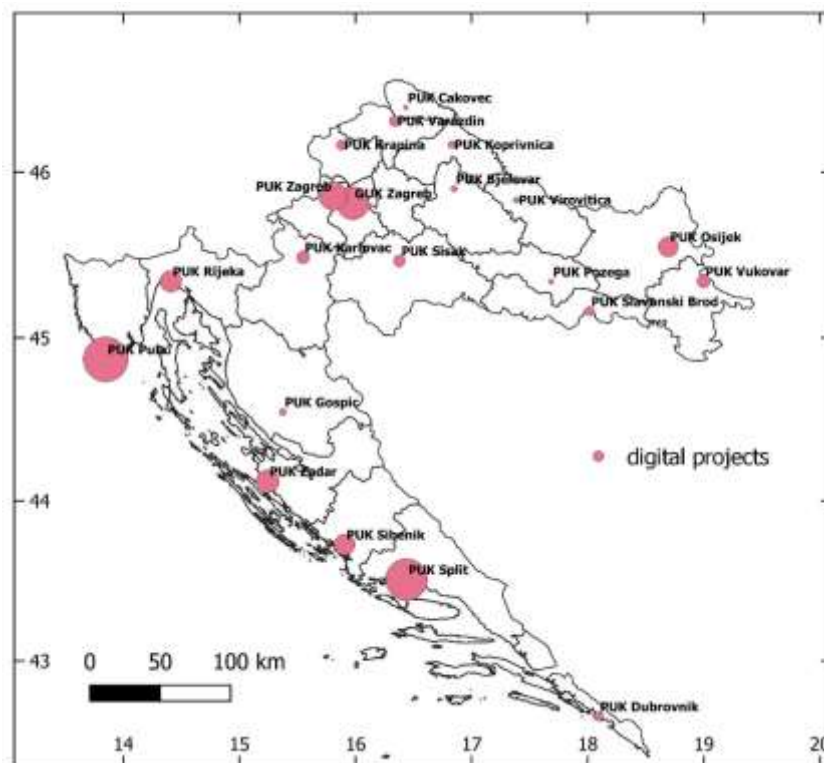


Figure 3 Amount of digital elaborates per each county, in period of 1.9.2018.-1.3.2021., based on county's cadaster office data

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- **SDGE Helpdesk module statistics** – Since the introduction of the Help Desk module for problem reporting, a total of 15387 user reports have been received, 99% of which is resolved. The statistics by category of inquiry is given in Table 2.

Table 2 View Help Desk inquiry by category in period of 1.9.2018. – 1.3.2021.

Help Desk inquiry category	Total	Resolved	Resolved ratio
Initial data: quality control / Conversion GML in DXF	1407	1393	99.0%
Questions related to applicable legislation in digital geodetic elaborate process	860	815	94.8%
SDGE: problem report during the process of digital geodetic elaborate development	10691	10596	99.1%
Measurement layout / Copy of cadastral plan: quality control / CAD questions	2429	2413	99.3%
<b>TOTAL:</b>	<b>15387</b>	<b>15217</b>	<b>98.9%</b>

#### 4. Upcoming upgrades

The SDGE service is continuously upgrading in order to enable as automated and intuitive process as possible, retaining the data consistency and legal acts frameworks. The upgrades are made regularly, based on the noticed need, possibility for upgrade the automated connections with other used services, user requirements and feedback. Some of a upcoming upgrades are:

- *Integration of underground sites* – this integration would enable all underground sites, such as garage, underground shelter or underground business space to be surveyed and recorded officially
- *Automatically generating the call for neighbors consent* – upon the creation of the digital geodetic elaborate with all interested parties included, the SDGE service would automatically create the form for each party
- *Post office integration* – the user could automatically send notification and invitations to neighbours and other participating party through the SDGE system, without the need for going personally to the post office
- *Road infrastructure in GIS viewer* – in order to upgrade the Web GIS viewer of SDGE service, it is planned to integrate the vector data within the GIS viewer to enable users precise inquiries considering the highways and other road infrastructure.

- *All-in-one calendar* – calendar would be established for a legal person, comprehending all deadlines for geodetic elaborates feedback from the Cadastral office, relevant notifications about the SDGE system, and all deadlines generated from automatic procedures based on submission through the SDGE. Also, the user could make individual calendar entries and comment them.
- *Partially annulate the process for digital geodetic elaborate data* – this upgrade would enable the user to erase generated data of digital geodetic elaborate only partially, leaving created data up to the step of the process chosen by user.
- *Digital geodetic elaborates without field measurements*– additional feature in the SDGE that will allow creation and upload of only partially made digital geodetic elaborate, without graphical part
- *Digital geodetic elaborates from the office* – this upgrade will allow civil servants from the cadastral offices to create and submit digital geodetic elaborate through SDGE system, which was up to now limited to chartered geodetic engineers only
- *Geodetic groundwork foundation* – type of geodetic field work different to digital geodetic elaborate that will be enabled to be submitted through the SDGE. It is a necessary geodetic elaborates' predecessor in obtaining the locations' information in a bigger infrastructure elaborates
- *Type of legality act of buildings* – aside from other legal acts concerning the buildings, another act is planned to be
- *Digital signing in cloud* – at the moment the parts of digital geodetic elaborates can be digitally signed at the local computer and uploaded again into the system. This upgrade would enable digital signing of all documents from the SDGE system in the cloud, saving time and fastening the process

## 5. Conclusion

SDGE is a web application developed and launched on September 1, 2018 for the purpose of digital support of the complete business process of geodetic elaborate development. In just one year from its establishment, the system had over 2 400 registered users, and more than 10 000 geodetic elaborates submitted for review and confirmation to the corresponding cadastral offices through the system. Until today, two and a half years after the establishment of the SDGE service, there have been 66 809 geodetic elaborates made and submitted through the SDGE service. Given the economic potential of a regulated real estate market, SDGE is becoming one of the indispensable links in the chain of access to geodetic data and the implementation of changes in spatial data. System availability and stability, ease of use, intuitive user experience and upgrades based on user feedback are factors that contribute to the rapid growth of system usage. System is continuously upgrading based on user feedback and professional surrounding requirements. Hence, in the forthcoming period, further system upgrades are expected, which would facilitate and speed up the process of digital geodetic elaborates even more and enable the preparation of the complete scope of geodetic elaborates, which would create the first prerequisite for gradual and controlled decommissioning of analog studies.

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