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Automation in Land Cadastre Cadastre at Sector Level or at Whole City Level

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Abstract: The study
This study aims to present research and conclusions on the automation of certain processes and easier data manipulation related to information from the national system Eterra, the process of preparing documentation for sector or general cadaster. The data is divided into input data and out-put data. Input data can be processed / manipulated in Excel, QGIS, CAD environment. Results are processed through the PHP programming language using PostgreSQL databases, Word and Excel file generation scripts, jQuerry, JavaScript, Linux, XML. All the information is assembled in a simple (web-based) solution through which the user can generate the sector / general cadaster documentation in a fast and simple way. Also, the implementation of such a solution in addition to automation, speed in obtaining results was also thought because the national institutes that verify the cadaster documentation (at county level) have particularities.

Keywords: Land Cadaster, Sector, General Land Cadaster, automations, results.

Introduction

Automations, easy data manipulation and generating files (results) are very important in implementing land cadaster in Romania. From the report of monitoring ANCPI institution in 2021 published on Transparency.org.ro we can see that several problems are blocking the process of land cadaster. But what we can read in the report is only the tip of the iceberg, because there are multiple problems that interfere in elaborating the land cadaster documentation. We confronted multiple additional requests from national institutes that are verifying land cadaster documentation so we needed a solution for automating and fast delivery results. The contractual terms are short if we are reporting to the volume of work needed to achieve results. The office job requires to obtain information from Eterra system, drawing, land subdivision, update with deeds data, importing Eterra information and generating results. We noticed that data received from the Eterra system was wrong in mostly of cases (almost 40% of data) because the user from national institutes or land surveyors didn't record the data properly. Generating the results is also important because we need to respect a format of tables and data. Also, beside of the regulations from national institute of land cadaster, counties national institutes are requesting to input more data for specific cases (example: when a plot is reduced in surface, we need to add more text and observations). Also, another important fact is to eliminate a worker error input data. Along with the volume of work, regulations and other factors, the surveyors have delays in offering results on time.

Using Postgres, we can manipulate geometry and textual data by correlating.

Using scripts to generate Word and Excel files we can generate the documentations for land cadaster. Also using XML language, we can generate the most important element of the documentation. This XML files are uploaded to Eterra system.

Using additional automations, for example georeferencing PDF files, can reduce the time to obtain and deliver the final documentation for land cadaster. We had a land cadaster documentation in which we had to georeference almost 50 PDF files and in manual mode it took almost half a day with 3 users working. After creating this automation, we managed to

make it in 20 minutes just by executing command line.

Materials and Method

In order to achieve results a identifications of solutions was needed. Based on the first information that we had we've created an Excel file in which we input the information that already existed somewhere (plot number, deed number and date, persons, surface data, category of use etc.). We managed to create a Excel file which is also verifying the data that was inputted. We managed to eliminate some errors from this step and also, we managed to automate some redundant data. Next step is to import the data into the application.

The application was created using PHP and PostgreSQL (W. Jason Gilmore, 2006). PostgreSQL is a powerful database manager and it was used because of his capacity of respecting the input data set-up (varchar, integer, float etc.). Also, the capacity of Postgis Extension has helped to store geometry data in a SQL Table.

After centralizing national institutes requests from multiple counties, we managed to create algorithms to automate some requests. Adding a multiple edit or batch edit for the data it helps the user to eliminate errors or correct data more easily.

Results and Discussions

In order to obtain a web application for generating land cadaster results multiple processing steps and automated operations were made. For achieving results various programming languages were used (PHP, VBA, Postgresql) and different OS were used (Windows, Linux).

First step is to complete a Excel file with information (information that already exists) and to verify the data (Fig. 1). Because the sector land cadaster is easier than general land cadaster, 2 models were created. This was done because some data in sector land cadaster can be generated automatically by the application and for general cadaster in some cases the user needs to input specific data (for example: the address of a plot).

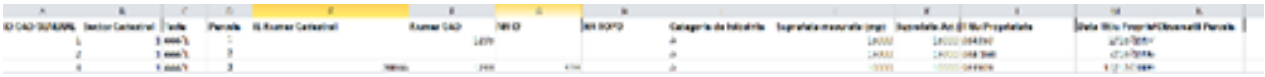

Fig. 1: Example of data to be added.

After completing the Excel file we must verify that the data is correct recorded and generate CSV file for importing in web application (Fig. 2).

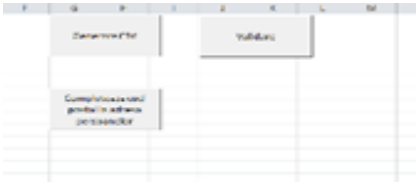

Fig. 2: Example of verifying and generate CSV data.

Importing the data (textual and geometry data, Fig. 3).

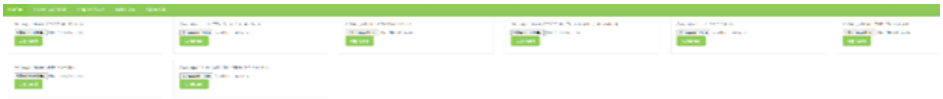

Fig. 3: Importing the data.

The data which can be imported:

A. Textual:
   a. CSV files for land, person, deeds, construction
   b. CSV files for DDAPT database which contains all the property titles – this is a verification for the user to see if he took in consideration all the plots from a property title

B. Geometry data:
   a. SHP geometry for land (plot)
   b. SHP geometry for constructions
   c. SHP geometry for georeferencing

After the data was imported, we have page like "Panel control" with buttons for generating data, administrate the data and download data (Fig. 4).

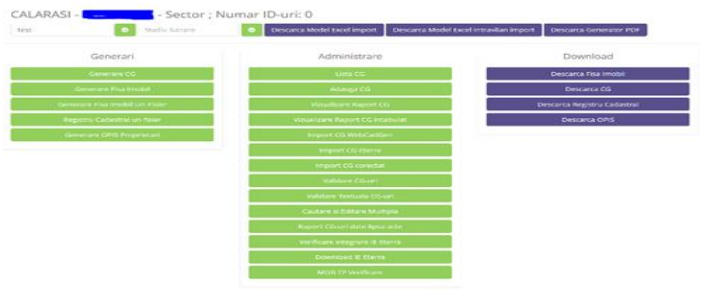

Fig. 4: Panel control.

Editing the data is easy as we managed to create a workflow and to identify redundant data. We have a autocomplete function with which we can populate fields if the data is already in the database, we can copy a person on multiple deeds, we can copy a registration to another ID etc.

Imported data from Eterra system is mostly wrong. For correcting this data, we implemented a solution for editing in batch (multiple fields and multiple data at once) by updating a field or more fields (Fig. 5).

Fig. 5: Editing multiple data at once.

This operation can reduce the time of work by not updating every field in every land identifier.

One particular automation that can help in the process for achieving the final results is to verify the data in the database with the Eterra system. Some id's need to be updated before delivering the cadaster documentation. On manual mode a user would check if new data is on a sector and update it in the application. This would mean a enormous time waste because the Eterra system is not that user-friendly or it was not built for specific operations that would help. For this we've created a automation. The geometries from the database are dissolved (Fig. 6)

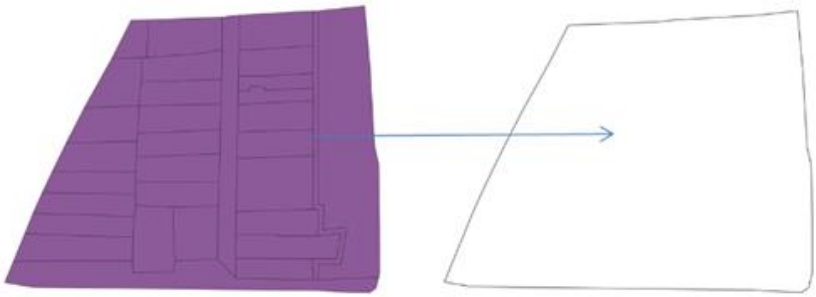

Fig. 6: Process automation.

After dissolving the geometries, the resulted polygon is transformed to JSON data and loaded to Eterra system in which the algorithm it's able to retrieve the data needed (Fig. 7).

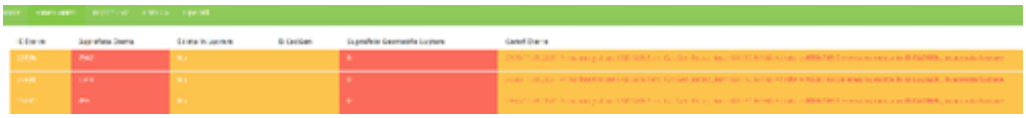

Fig. 7: Data visualtion.

Fort particular requests from national institutes and for changes in regulations and data structure for upload we implemented specific function for updating data. For example, the structure of XML data was changed in some point and an attributed needed to be inserted. So, we developed a function to update that attribute for all the data. Some errors when importing to Eterra system were generated because of the data imported from the same system so a function to automatically detect and remove errors was needed. These functions even though a user can't see to work behind for updating the data are very helpful because is reducing the time of work to correct/update the data. Even though the application does an update in 30 seconds for more than 500 IDs, imagine if a user would do this manually.

Another useful tool is a algorithm which is checking the data on each ID based on our experience. For reducing the errors identified by nations institutes after delivering a land cadaster documentation we have implemented a algorithm which checks data recorded in the database. Types of data checking:

- missing data in fields which are mandatory based on some other attributes
- wrong data put in fields based in other attributes (especially for deed type)
- missing observations on fields based on other attributes
- if the textual number of constructions is matching the number of constructions from geometries
- validation of data recorded etc.

These functions have the important role to reduce the errors before delivering of results. This fact is important because the rework is taking more time. In this step we can identify even more important or critical errors which will take more time to repair or if they are identified later, it will be more problematic to repair because of the regulations (Fig 8).

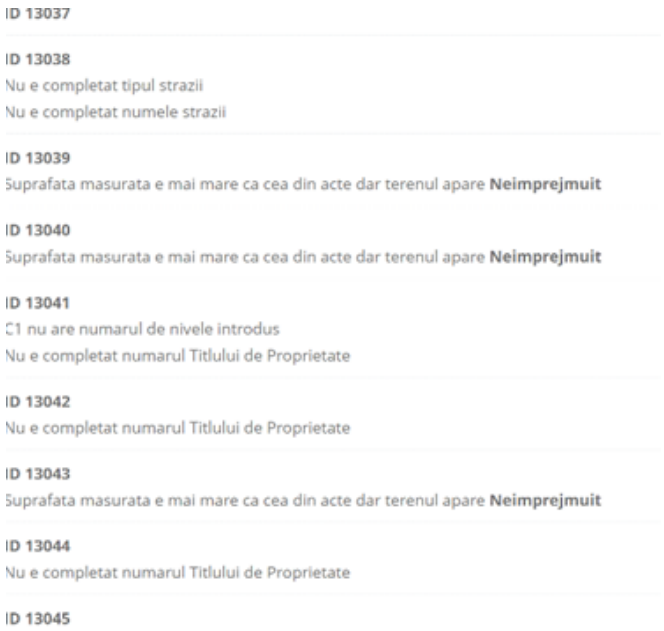

Fig. 8: Types of error identified.

For general land cadaster we've developed a workflow for merging all the data from each sector to one big documentation. Based on this operation we can identify and eliminate errors like if there is the same ID on multiple documentation which will generate an error. Beside this overview we can generate a piece of documentation for the whole administrative territory which also is reducing time for this (manually merging data from each sector will be more time consuming). Working with PostgreSQL database is very helpful because another piece of documentation is to generate a CSV file with the address of the land and the coordinates of the postal number which needs to be in the geocenter of the polygon. Using Postgresql fuctions this step will be done in very little time.

Another function that Eterra system doesn't have and is improving a step in validating the land cadaster documentation is a search function. One stop in validating land cadaster documentation is for the owner to check their textual data operated by the land surveyor. He has to check from the geometry part and textual part (deeds). Identifying a owner or land is more easier with a search function which we introduced and we made the process more easier and more effective because number of owner processed per day or per hour is larger. Searching by hand in papers it's not effective and that operation will pass the deadline for this step which is a period of 60 days.

Conclusions

1. Developing and implementing all these solutions into one module or one application for sector or general land cadaster is better for a user or land surveyor because it's a plus, it's helping him to reduce the work time and concentrate on more important parts from this operation.
2. By implementing this kind of technology or software they can reduce the work time an respect the deadlines from contract, the changes in regulations or in XML structure doesn't need to be so harmful because of automations and different functions to achieve the results.

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