

# ANALYSIS OF THE INFLUENCE OF THE QUALITY OF CADASTRAL DATA ON THE PROCESS OF SURVEYING WORKS IN POLAND

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## **Abstract**

*Under current regulations the role of cadastre of real estate in Poland plays Land and Buildings Registry (EGiB). This cadastre however has several flaws, and as a cadastral system of European standards, should constitute the backbone of a functioning real estate management and be the basis for legal, fiscal and planning actions of the state. In each of these aspects of the real estate economy important role play the configuration of borders, optimization of the shape and surface of the land and regulated legal status of the land. In the opinion of the author land consolidation procedures, can be an effective tool for corrections of the parcel geometry and regulations of the legal status of land. Faulty spatial structure of land in Poland was developing over many years. It is the result of complex historical, socio-economic and demographic processes. It causes a lot of inaccuracies and errors of the cadastre in Poland. These defects are particularly evident in the structure of possession of land, land use and lack of access roads to the cropland. Land and Buildings Registry (EGiB), as a public register, is subjected to the current and periodic modernization. The aim of the modernization is to improve the quality of the collected data. The article shows that making changes is necessary not only to increase the comfort of the surveyor's work, but above all in the context of ensuring the proper quality of cadastral data in accordance with European requirements. The aim of the article is to present the need of changing the borders configuration. The discrepancy of the registry map and the cadastral map shows that the cadastral maps should not be used by recovery of borders. They should be treated as ancillary materials in the borders course determining procedure. The paper is of a cognitive and research nature.*

**Key words:** *cadastre, spatial structure of land, modernization of land and building registry, cadastre, spatial data quality*

## **Introduction**

The problem of quality of cadastral data in Poland was already taken up in many scientific papers of Polish and international range, both in the context of urban and rural areas cadastre (BYDŁOSZ, PARZYCH, 2007), (BIEDA, PARZYCH, 2013) and (MIKA, LEŃ, 2016). According to these studies, the cadastre in Poland has its weaknesses. A major problem in the use and rational management of agricultural land is the widespread phenomenon of land fragmentation, which also creates a bad state of real estates cadastral databases. Among others (JANUS at all, 2016) and (LEŃ at all, 2016) write about it. Similar problems can be noted in other countries (VITIKAINEN, 2004). The role of cadastral data in real estate management processes is emphasized in studies of (SIEJKA, 2016) and (MIKA at all, 2016). The use of poor quality geodesic materials contained in the databases of real estates cadastre, for the purposes of performing surveying tasks in real estate management, generates further errors in the resource. This situation is not improved neither by the use of modern measurement techniques in geodesy (SIEJKA, 2016) nor by repeatedly emphasized defects in the legal framework related to the borders setting on the ground (HANUS at all, 2014). The increasing problem of deteriorating quality of cadastral data may lead to a complete loss of credibility of the cadastral system in Poland. Despite continuous changes in the legal provisions governing the transformation of the Land and Building Register (EGiB) into a full-fledged real estate cadastre there are no clear regulations to guarantee the better quality of system data. Regulations on the modernization of EGiB (acting as the cadastre of real estate in Poland) such as the Regulation of the Minister of Regional Development and Housing of 29 March 2001 on the land and buildings registry and

Geodetic and cartographic law provide certain accuracy criteria which, in surveying practice, are often impossible to obtain in the field because of the poor quality of the base material. Because, the analog registry maps are processed by vectorization into digital form. The lack of coverage in the field with the maps made on the basis of direct measurements and the aforementioned form of map transformation into digital form, is merely a duplication of errors existing on them. There are many concepts of combining several databases for the purpose of multi-purpose cadastre functioning, with elements of data multidimensionality (MIKA at all, 2016), but because of the inconsistency of the content of data stored in these databases - this situation does not seem possible to apply in practice in the coming years in Poland. On the basis of a study of world literature it can be seen that some countries have managed to overcome similar problems and raise standards of the cadastral system functioning (DEMIR, KORUHLU, 2008), (DEMIR, KORUHLU, 2009) and (DEMETRIOU, 2014). It is therefore important to periodically monitor the state of the data stored in the cartographic resource, including cadastral data, to determine their current relevance and suitability for further use..

In order to investigate the scale of the divergence between the actual (current) state and the situations presented on the existing cadastral maps, a case study covering the maps of a fragment of Dobczyce in Małopolskie Voivodship was made.

### Materials and methods

The starting materials used for this research work were data from the District Geodetic and Cartographic Resources (PZGiK) in the form of cadastral maps in the scale of 1: 2880, parcel protocols as well as the current vector registry map with the necessary elements of the descriptive part of EGİB for the plots (parcels) concerned. The object of the research was a complex of 26 registry plots with a total cadastral area of about 5 hectares, located in the Dobczyce registration unit, Dobczyce precinct. The location of the research object is presented in Figure 1.



**Fig. 1.** Location of the research object. *Source: www.pl.wikipedia.org*

Single surfaces of selected parcels and sides dimensions measurements (linear measures representing the geometric representation of their borders) were analyzed. The obtained results were compared with the equivalents of those borders recorded on the current registry map. An additional element of the study was the verification of the spatial data with the descriptive part of EGİB.

The research work was divided into the following stages:

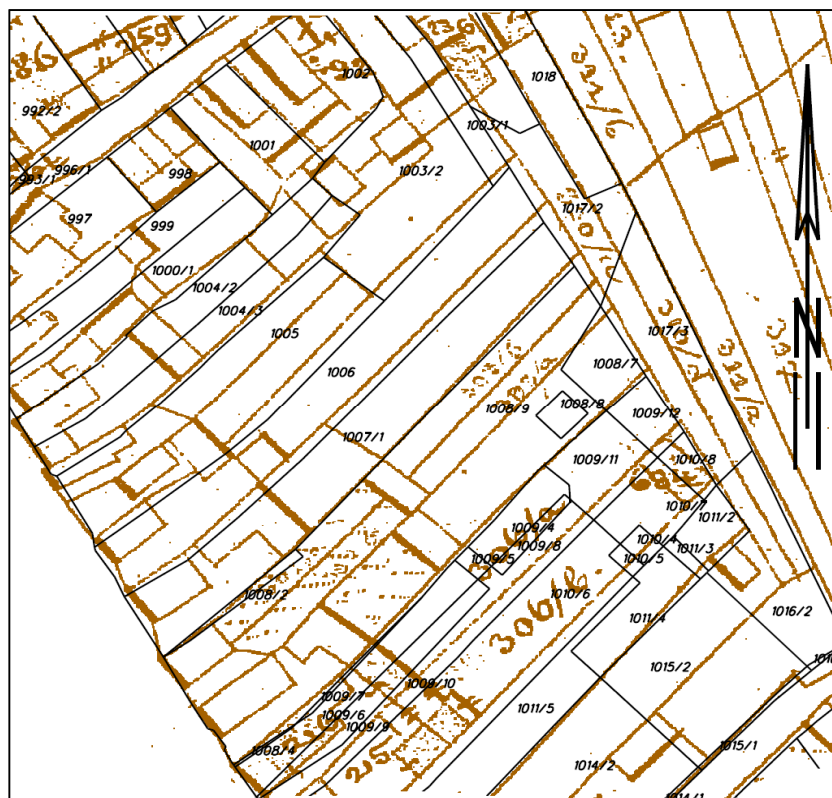
- Graphical comparison of the cadastral map with the registry map;
- Numerical comparison of the lengths of sides of the parcels and corresponding plots;
- Determining the relative errors of the sides lengths;
- Analysis of plots with a large relative error;
- Comparison of parcels and plots areas;
- Determination of the relative area error;

The first and most important element of the research work was the proper calibration of the cadastral map section and its transformation into the registry map coordinate system. This was done using the calculated coordinates of the grid section of the cadastral map section. Next, the points were transformed by the affine method into the coordinate system of the registry map, taking into account the scale factor. Such made fitting enabled to reliably carry out further research work.

Detailed research results are presented and discussed further in the article.

## Results

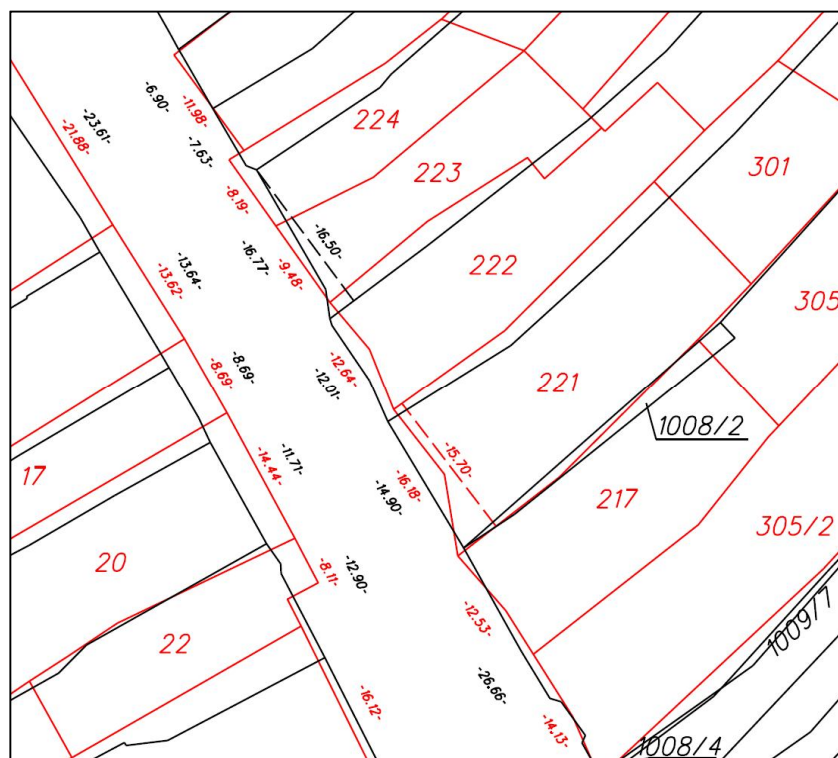
The next step was to examine the compliance of the calibrated cadastral map with the current registry map. This map, in accordance with current regulations, is updated on the basis of the results of surveying work adopted at PZGiK. The comparison was made using the graphical method. Its result is shown in Fig. 2.



**Fig. 2.** Graphical presentation of differences in the course of borders of plots on the cadastral map (brown color) and the registry map (black). *Source: own elaboration*

Figure 2 shows considerable divergences in the course of the examined borders. This size can be estimated at 70% of divergences. The cause of the situation is the cumulation of errors during the processing of the map from analog to vector form. The most important are: cadastral map shrink, scanning and then vectorization errors.

The next stage of the research was the comparison of linear measures of selected parcel borders and the corresponding borders of the registry plots. This action was performed in Microstation software (Figure 3).



**Fig. 3.** Fragment of a sketch of sides lengths of the cadastral parcels (red color) and registry plots (black). *Source: own elaboration*

The values of the corresponding linear measures are listed in Table 1. Basing on them, their lengths differences and relative lengths errors were calculated. The relative error was determined according to the formula (1):

$$m_d = \frac{\Delta D}{D_1} \quad (1)$$

where:

$m_d$  – side length error (relative),

$\Delta D$  – the difference between the side length on the registry map and on the cadastral map,

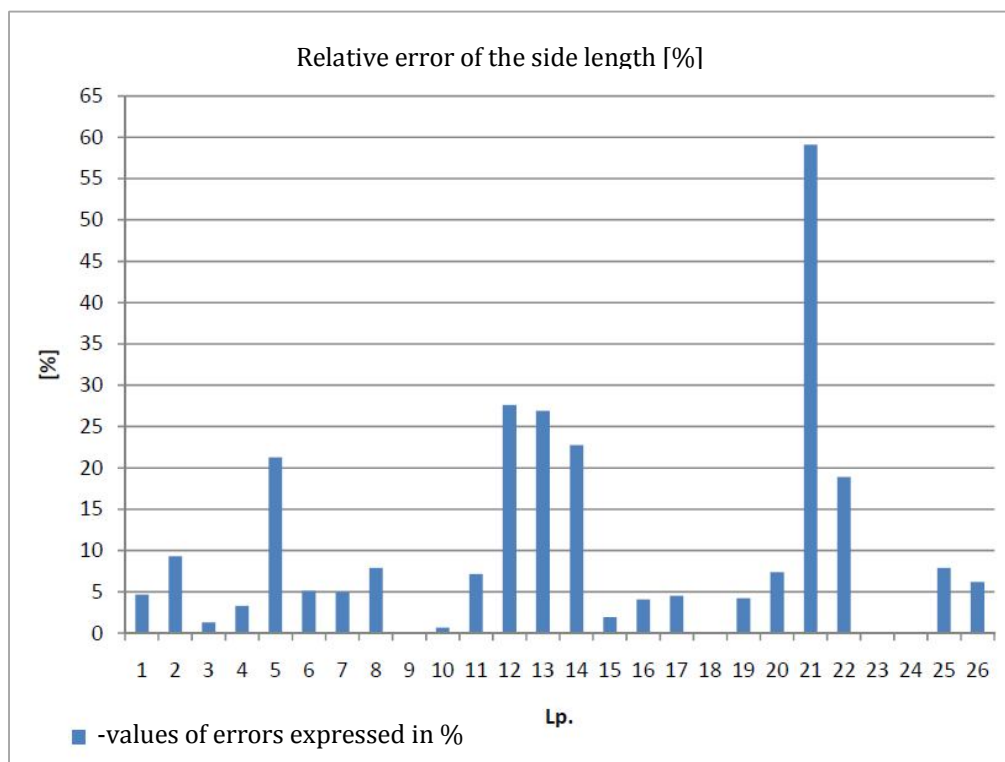
$D_1$  – the side length from the registry map.

**Table 1.** Comparison of linear measurements of borders on the cadastral map and on the registry map

Number of plot	998	1001	1002	1003/1 1003/2
The length of the border on the registry map [m]	16,17	14,36	21,91	4,75 7,70 Σ 12,45
Numbers of parcels	229 230	231 291	232 292	233 235 293 298/1 298/2
The length of the border on the cadastral map [m]	10,24 5,21 Σ 15,45	5,50 10,33 Σ 15,83	11,66 10,54 22,20	12,05
Difference $\Delta D$ [m]	-0,72	-0,72	0,29	-0,40
Relative error $m_d$ [m]	-0,05	-0,05	0,01	-0,03
Relative error [%]	4,66	4,66	1,31	3,32

*Source: own elaboration*

Figure 4 shows a graph of the relative errors values of the border line measures.



**Fig. 4.** The graph of relative error values of measurement results. *Source: own elaboration*

It follows from the data presented in the graph (Figure 5), that the relative error of the difference in border length from cadastre and from land registry of selected plots fall into the interval from 0% to 59%. Basing on the analysis of the large discrepancies it was found that the biggest errors affect plots which, during registration, have been regulated for the purpose of roads widening. This fact was confirmed by the field investigation and examination of the unit documentation for the concerned plots. However, most of the differences are due to errors in the cadastral map processing from analog form to vector one.

The next stage of works was the study of descriptive documentation. An analysis was conducted comparing the surfaces of the cadastral parcels disclosed in the parcel protocols and the registry plots area of the descriptive part of EGIB. On the basis of such analysis, the surface differences, followed by their relative error mp were determined. The error was calculated in the same way as the deviation differences error in formula (1). For the purpose of carrying out the tests it was checked in appropriate documentation from which parcel was the given plot created. The results are shown in Table 2.

**Table 2.** Comparison of parcels area with appropriate areas of registry plots

Number of plot	998	1001	1003/1 1003/2	1004/2 1004/2
The plot area [ha]	0,0242	0,0443	0,0260 0,1106 Σ 0,1364	0,0552 0,0553 Σ 0,1105
Parcel number	229 230	231 291	233 235 293 298/1 298/2	225 295
Parcel area [ha]	0,0080 0,0137 Σ 0,0217	0,0266 0,0162 Σ 0,0428	0,0201 0,0478 0,0191 0,0291 0,0291 Σ 0,1452	0,0514 0,0457 Σ 0,0971
Difference ΔP [m <sup>2</sup> ]	-25	-15	88	-134
Relative error m <sub>P</sub>	-0,12	-0,04	0,06	-0,14
Relative error [%]	11,52	3,5	6,06	13,80

*Source: own elaboration*

Figure 5 shows a graph illustrating the area relative error size.

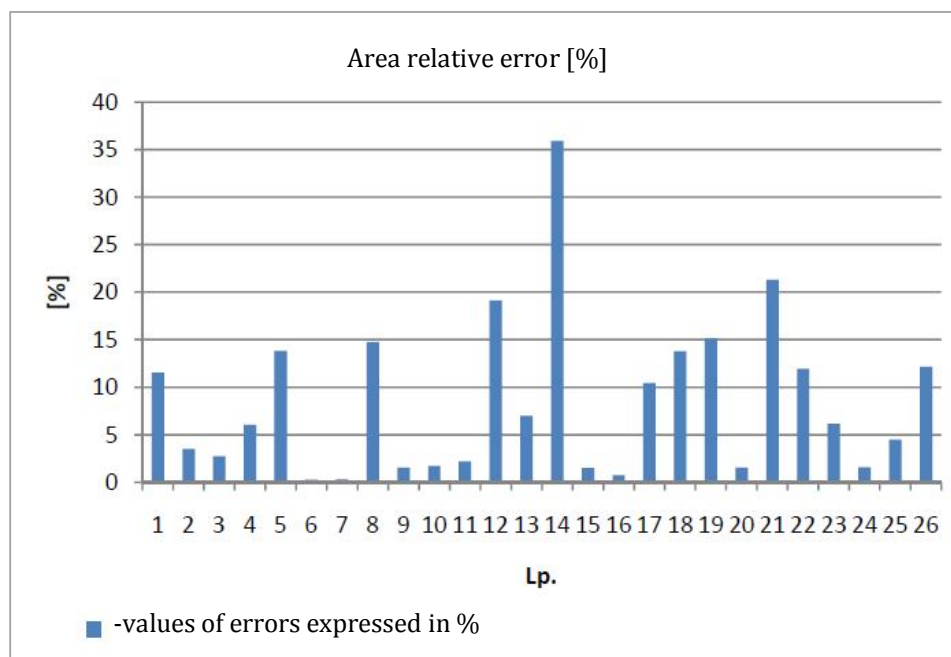


Fig. 5. Graph of the values of relative area errors. *Source: own elaboration*

It follows from the data presented in the graph (Figure 5), that The relative error of the cadastral parcel area and the registry plot area difference falls in the range of 0.25% to 36%. The maximum errors (as in the case of side length errors) occur on parcels, parts of which have been carved out to widen the roads.

### Discussion and conclusion

Basing on the studies conducted, a negative scale of the phenomenon of duplication of geodetic survey errors in the geodetic resource, by using the poor quality geodetic materials accumulated in it was shown. The discrepancy of the registry map and the cadastral map shows that the cadastral maps should not be used by recovery of borders. They should be treated as ancillary materials in the borders course determining procedure.

This situation should be prevented immediately by streamlining procedures for determining borders on the ground and ensuring appropriate procedures for enforcing liability for such nonconformities. The credibility of the cadastral system should also be improved through the updating (descriptive and graphical part) of the EGİB, especially in the field of buildings and land use.

The introduction of changes is necessary not only to increase the comfort of the surveyor's work, but above all in the context of ensuring the proper quality of cadastral data in accordance with European requirements.

### Acknowledgments

This research was supported by funds from DS - 3356/KG/17.

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