

# The Verification of the Modernization of the Real Estate Cadastre in the Context of the Quality of Cadastral Data – Case Study

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**Abstract.** The aim of the modernization is to improve the quality of the collected data. That is necessary especially in those areas where cadastral maps are used in the scale of 1:2880. The most satisfactory results in the process of modernization are obtained on the basis of geodetic field measurements. The aim of the paper is to verify the work related to real estate cadastre modernization in the context of the quality of the cadastral data collected in 1999–2001. This paper presents the results of surveying, which aim was to check whether the data contained in the register of land are a reflection of the facts boundaries and surface parcels. In the analyzes the materials of selected areas from state resources were used. The verification of graphic materials (maps) and descriptive (areas of plots) obtained from the District Office carried out in this paper showed a satisfactory level of data compliance. Factual status on the ground, in most cases, corresponds to the existing in extracts from the land registry, created on the basis of the land and buildings registry modernization in 1999–2001. These data correspond to the areas calculated from the results of the 2016 direct measurements.

**Keywords:** modernization of the cadastre, cadastral data quality, measurement of the plots area, the borders of plots.

**Conference topic:** Technologies of geodesy and cadastre.

## Introduction

The modern cadastre (Steudler, Williamson 2005), (Bennett *et al.* 2007), (Ying *et al.* 2012), (Bydłosz 2015) should be an information system, operating in a continuous manner, in accordance with rules and methods adopted throughout the country. It has official character, operates under the provisions of the law and is run by the public authorities. The cadastre is a system available to all interested, who can use cadastral data according to their needs. The cadastre should contain complete and reliable data on: cadastral objects (property) and cadastral subjects (people), i.e. legal entities (legal and natural persons). In addition, the cadastre should contain information on the legal and factual relationships between the cadastral subjects and objects.

In Poland, cadastral data include information on:

- lands – their location, borders, areas, types of land use and their quality classes of soil, records in land registers or collections of documents
- buildings – their location, purpose, utility functions and general technical data,
- premises – their location, utility functions and usable area.

In Poland these data are maintained in a computer system. The research has shown (Bieda 2013), (Mika, Leń 2016) that in many regions of the country they are also used in analog form, some of them even have a form of historical data (Austrian map at scale 1:2880). In addition, in the Polish cadastre, not only a variety of personal information such as the owner’s place of residence or a location of business are shown, but also information on the entry in the property register of monuments. In the future it is also planned to introduce to the cadastre an attribute in the form of real estate value. In relation to the state and local government land, in the cadastre the data of natural or legal persons are recorded, who possess (not only own) the land, buildings or parts thereof. It could be said that the changes in law in Poland are going in the direction of the multipurpose cadastre. Such cadastre, having the full version of the cadastral information about the property, can constitute the backbone of the real estates management and serve to conduct multidisciplinary spatial analyses of land development, to simulation of the effects of proposed changes, evaluation of alternative solutions at the local level (Mika, Salata 2015). Cadastral data should therefore be easily accessible to every user and appropriate to the needs in terms of information content, sufficiently accurate, current and complete in terms of area and scope of the content of this system. Global trends in cadastre endeavour to transform it into a multi-dimensional system, containing complete geo-spatial relationships between objects, which are the subject of complex laws in 3D (Mika *et al.* 2016). Unfortunately, the fact that in Poland the cadastre is run in distributed databases, prevents the rapid realization of this aim. The land and buildings registry (EGiB), that serves in Poland as the cadastre system was modernized several times and therefore it is imperfect. Currently the work is underway on the construction of the Integrated Information System properties (ZSIN) integrating multiple databases on a single platform. This is not an easy task because in the integrated databases, there is a lot of conflicting information about the property, first requiring arrangements. It should be pointed out first to such databases as EGiB

and land and mortgage registers (KW), which form the basis of the cadastre and have a lot of conflicting information about the cadastral objects and subjects (Przewięźlikowska, Buško 2014).

Recently, in Poland another modernization of EGİB has been carried out. In accordance with the regulations (The Act 1989), modernization of the cadastre is a set of technical, organizational and administrative activities, whose aim is improving the quality of collected data, as well as their updating and computerization. The works related to update and modernization of the records are necessary, since the current state of real estate cadastre in Poland derives from the thirteenth-century tradition of land management and is a consequence of changes arising as a result of historical events in Central Europe over the centuries.

On account of many historical obstacles over the years the measures were taken to establish a uniform cadastral system.

The aim of the paper is the verification of compliance of data on real estate, concerning actual status on the ground with geodetic data coming from State Geodetic and Cartographic Resource on the tested area. On this basis, an attempt was made to assess the quality of impact of the modernization carried out there in 2001.

In recent years, in Poland several legal acts has been modified to suit the requirements of the INSPIRE Directive (Directive 2007/2/EC). These include, among others: The Act of 4 March 2010 on the infrastructure for spatial information, The Act on Real Estate Management of August 21, 1997, The Act of 17 May 1989 Surveying and Cartographic Law. To these legal acts, among other things, the following implementing acts were created: The Regulation on the database of topographic objects and basic map, The Regulation on the national register of borders and units of territorial division of the country, The Regulation on the registry of land and buildings. Did the changes of the law regulation have a positive effect on the quality of cadastral data in the process of next modernisation?

## **Materials and research methods**

The research part of this work was based on the measurement of the area of a complex of 15 plots, located in mountainous and steep terrain (Fig. 1). Area measurement was performed in two days, due to the large area of the measured plots complex (about 3.1440 hectares). The test area is selected in the open terrain dominated by meadows. The highest measured point had the height of 552.33 m above sea level, while the lowest point was situated at a height of 509.18 m above sea level. So the height difference in terrain was 43 m. The borders of measured plots were taken in accordance with local tradition – on the lower part of the balk. In order to accomplish the task GNSS receiver was used. The measurement was performed using the technique RTK (RTN) commonly used in Poland (Siejka 2016). The methodology of research was based on a comparison of the results of the course of borders and surfaces of registry plots, with data coming from the EGİB resource for the two time periods. The first one included data from the years 1969–1999, which concerned the period before modernization. The second period included data from 2001, after completion of modernization in the test district. Information about the area and configuration of the borders of plots was obtained from the District Office in the area of research (Southern Poland, małopolskie voivodship). Necessary calculation of the plots areas on the basis of measurement was made using WinKalk software.



Fig. 1. The scope of the study area

(Source: <http://mapy.geoportal.gov.pl> downloaded on-line 08.12.2016)

## Results

In the first stage of field work, control measurement was carried out. It was based on two points of class III geodetic control network with known catalog coordinates (in the national coordinate system). Then it was checked whether the results meet certain accuracy standards (Table 1). The result was positive, since the horizontal deviations in terms of the obtained coordinates were at the level of 0.12 m, while the height deviations did not exceed 0.9 m. The results of the calculations are presented in Table 2.

Table 1. Comparison of control points coordinates (Source: own elaboration – reports of ASG-EUPOS)

No. of point	Control points coordinates [m]			Measurement result [m]			Calculated differences[m]		
	X	Y	H	X	Y	H	dx	dy	dh
124 500	5 495 938.870	7 422 705.374	493.149	5 495 938.810	7 422 705.390	493.180	0.060	-0.016	-0.031
124 600	5 495 834.200	7 422 603.121	498.265	5 495 834.120	7 422 603.140	498.310	0.080	-0.019	-0.045

Table 2. Summary of the areas of the plots from the period before and after the modernization and the measurement

No.	Measurements before modernization (1969–1999)		Measurements as a result of modernization (2001)		The authors direct measurement (2016)	
	No. of the plot before modernization	Area [hectares]	No. of the plot after modernization	Area [hectares]	No. of the plot	Area [hectares]
1	727	0.2885	637	0.2924	637	0.2916
2	726	0.1946	638	0.2116	638	0.2122
3	719	0.2899	639	0.2957	639	0.2996
4	718	0.1948	640	0.3027	640	0.2991
5	717/2	0.1572	641	0.1262	641	0.1251
6	717/1	0.1208	642	0.1580	642	0.1522
7	716	0.2507	643	0.2641	643	0.2637
8	712	0.2622	644	0.2696	644	0.2736
9	785/7	0.3437	616	0.3106	616	0.3158
10	785/12	0.1285	618	0.1254	618	0.1265
11	795	0.1608	617	0.0627	617	0.2006
12	796	0.0573	619	0.1515	619	0.1526
13	785/3	0.2265	620	0.1690	620	0.1697
14	785/4	0.0436	621	0.0501	621	0.0472
15	797/1	0.1724	623	0.0135	623	0.2125

The studies have shown high compliance of the areas of measured plots, comparing the registry data after the modernization in 2001, with the author's measurements carried out in 2016. The compliance of the plots area of 0–15 m<sup>2</sup> occurs at the level of 47%, which implies that the area of 7 plots of the study area slightly differs from their area measured in 2001, and 5 parcels of the analysis have compliance of 16–40 m<sup>2</sup>. Taking into consideration that the plots taken for analysis are quite large (the average area of the plot is 0.2095 ha), this result can be considered satisfactory. For example, the length of the plot No. 644 is approx. 100 m, so the difference of the area 40 m<sup>2</sup> in this case is relatively small. Only 3 of the plots showed an area difference greater than 40 m<sup>2</sup>. So the results showed that the current state on the ground is similar to that measured using the direct method in the years 1999–2001. In turn, the result of the comparison of data before the modernization of EGİB and those received as a result of modernization in 2001, showed inconsistency of the plots areas on the level of 86%. On the other hand, comparison of the area of plots before modernization to the results of the author's measurement in 2016, showed an inconsistency at 80%.



Fig. 2. The resulting map (scale 1: 2000) of the measured complex of plots showing the differences in the course of borders

Figure 2 shows the resulting map (scale 1: 2000) of the measured complex of plots, showing some differences in the course of borders. In purple the borders put on the map according to the results of the author's measuring were marked, black color shows the borders according to the EGİB data after modernization.

## Conclusions

Verification of graphic materials (maps) and descriptive materials (areas of plots) obtained from the District Office carried out in this study showed a satisfactory level of data compliance. The factual situation on the ground in most cases corresponds to the state described in extracts from the land register. The technique GPS RTK (RTN) used in the study, is suitable for measurements of a registry nature and gives a satisfactory accuracy of measurement results (even in mountainous terrain). Modernization of EGİB in research area put in order, regulated and unified registry system in the area. If it had not been carried out, the area of 80% of the plots from the EGİB database would be different in relation to the actual status on the ground. The cause of the detected differences in areas of plots entered to EGİB as a result of modernization in 2001, in relation to the area of plots from the measurement in 2016, may be the fact that this is the terrain used for agriculture. In this area, the borders are determined by balks, which are quite broad, often constitute a slope, so it is difficult to identify the border line. Certainly important is the fact that the studied terrain is constituted by arable lands and meadows, which are not a wasteland, so during these 15 years balks may be slightly shifted as a result of the agricultural works. If the opposite job had been done that is setting off border points, coordinates of which were determined in EGİB modernization documentation in 2001 year using GNSS receiver, then surely the borders of plots would correspond in a large extent with the current land use.

Therefore, it can be said that the changes in the law regulations after 2001 in direction of EGİB modernization had a positive influence on the quality of cadastral data for the study area. But it should be noted, that this terrain, although with the large area, is an area used for agricultural purposes where the borders of cultivated fields have been unchanged for 15 years. Similar studies conducted for areas with a different form of management, may give less satisfactory results. So in the future it is planned to perform the next case studies to verify present thesis.

## References

- Bennett, R.; Wallace, J.; Williamson, I. P. 2007. Organising land information for sustainable land administration, *Journal of Land Use Policy* 25: 126–138. <https://doi.org/10.1016/j.landusepol.2007.03.006>
- Bieda, A. 2013. Using historical maps in researches over changeability of river network. SGEM 2013, in *13<sup>th</sup> International Multidisciplinary Scientific Geoconference*, 16–22 June 2013, Albena, Bulgaria. Conference proceedings, vol. 2: Geodesy and mine surveying, Photogrammetry and remote sensing. Sofia, 517–524. ISSN 1314-2704, ISBN: 978-619 7105-01-8.
- Bydłosz, J. 2015. The application of the Land Administration Domain Model in building a country profile for the Polish cadaster, *Land Use Policy* 49: 598–605. ISSN 0264-8377.
- Directive 2007/2/EC of the European Parliament and of the Council of 14 March 2007 establishing an Infrastructure for Spatial Information in the European Community (INSPIRE) [online], [cited 15 April 2016]. Available from Internet: <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2007:108:0001:0014:en:PDF>.

- Mika, M.; Leń, P. 2016 analysis of the faulty spatial structure of land in the context of assessing the quality of cadastral data in Poland, in *16<sup>th</sup> International Multidisciplinary Scientific GeoConference SGEM 2016*, www.sgem.org, SGEM2016 Conference Proceedings, 28 June – 6 July 2016, Book2, 2: 91–100. ISBN 978-619-7105-59-9 / ISSN 1314-2704
- Mika, M.; Salata, T. 2015. The use of local databases of spatial information for the preservation of spatial order on example of selected units of local government in Poland, in *15<sup>th</sup> International Multidisciplinary Scientific GeoConference SGEM 2015*, www.sgem.org, SGEM2015 Conference Proceedings, 18–24 June 2015, Book2, 2: 1163–1174. ISBN 978-619-7105-35-3 / ISSN 1314-2704.
- Mika, M.; Siejka, M.; Leń, P.; Król, Ż. 2016. The concept of using the water cadastre databases components for the construction of multidimensional cadastre in Poland, *Survey Review*, 1–11. <https://doi.org/10.1080/00396265.2016.1263180>
- Przewięźlikowska, A.; Buško, M. 2014. The analysis of the updating time of subject and object data due to the information flow between the systems of the real estate cadastre and the land and mortgage register, in *14<sup>th</sup> International Multidisciplinary Scientific Geoconference (SGEM)*, 17–26 Jun 2014, Albena, Bulgaria. Geoconference on informatics, geoinformatics and remote sensing, vol III, Book Series: International Multidisciplinary Scientific GeoConference-SGEM, 933–940. ISSN 1314-2704. ISBN: 978-619-7105-12-4.
- Siejka, Z. 2016. Assessment of accuracy of rtk measurements using various combinations of GNSS, in *International Multidisciplinary Scientific GeoConference SGEM 2016*, www.sgem.org, SGEM2016 Conference Proceedings, 28 June – 6 July 2016. Book2, 2: 117–124. ISBN 978-619-7105-59-9 / ISSN 1314-2704.
- Stuedler, D.; Williamson, I. P. 2005. Evaluation of national land administration system in Switzerland. Case study based on a management model, *Survey Review* 38(298): 317–330. <https://doi.org/10.1179/sre.2005.38.298.317>
- The Act of 17 May 1989 Surveying and Cartographic Law, *Journal of Laws of 2015*, pos. 520, 831, 1137, 2281 and of 2016, pos. 65, 352, 585, 903.
- The Act of 4 March 2010 on the infrastructure for spatial information, *Journal of Laws of 2010*. No. 76, pos. 489.
- The Act on Real Estate Management of August 21, 1997, *Journal of Laws of 2015*, item. 1774.
- The Regulation of the Ministry of Administration and Digitization of 2 November 2015 on the database of topographic objects and basic map, *Journal of Laws of 2015*, pos. 2028.
- The Regulation of the Council of Ministers of 21 February 2012 on the national register of borders and units of territorial division of the country, *Journal of Laws of 2012*, No. 193, pos. 1287.
- The Regulation of the Ministry of Regional Development and Building of March 29, 2001 on the registry of land and buildings, *Journal of Laws of 2001*, No. 38, pos. 454 as amended.
- Ying, S.; Guo, R.; Li, L.; He, B. 2012. Application of 3D GIS to 3D Cadastre in Urban Environment, in *3<sup>rd</sup> International Workshop on 3D Cadastres: Developments and Practices*, 25–26 October 2012, Shenzhen, China.