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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**

1. Introduction

Under this study the research was conducted with regards to time of information flow between institutions responsible for the Inventory of Land and Buildings (ILB), referred to also as the real estate cadastre (REC) and the courts keeping land and mortgage registers (LMR). Updating rights with reference to the same real estate has to be carried out in both registers. Because the character of data collected in both systems is different by law, each of them focuses on different types of information. All changes in terms of legal information, passing from LMR to REC refer to the cadastre subjects, while the real property marking, occurring in REC, is a collection of data which determine the range of real estate right.

The research was carried out independently in 2002 and 2012. In 2002 research was conducted in two Poviats Centres for Geodesic and Cartographic Documentation (PODGiK): Krakow and Ostrowiec Świętokrzyski [3]. Research results of 2002 are presented in Figure 1. The chart illustrates large diversification of time of updating information in the analysed centres. This result prompted the authors to carrying out another analysis after 10 years, of wider range.

In 2012 the research was carried out in larger number of poviats, located in the southern Poland: Kracow (municipalities: Michałowice, Zabierzów, Kocmyrzów-Luborzyca, Wielka Wieś), Gorlice (Moszczenica municipality), Chrzanów, Jasło, Częstochowa, Krakow-city. The selection of research centres was statistically random, related to logistic possibilities of conducting research, which makes it possible to accept the results obtained as representative ones. Among the centres analysed in 2012, Krakow powiat was selected for re-analysis, in order to obtain comparative results for both analysed years.

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This study aims at carrying out analyses in the following aspects:

- updating REC database after changes introduced in LMR system,
- updating LMR system after changes introduced in REC database,
- statistical analysis of the existing changes in the analysed decade.

2. Legal Issues

There are two separate systems in Poland that deal with registering information on the land in geographic and legal aspect. The first of them is the system of the real estate cadastre (REC), the aims of which are among others: spatial planning, marking real estate in land and mortgage registers, real estate management, fiscal and statistical purposes. REC system is carried out by public administration bodies. The second one is the land and mortgage register (LMR), used for legal purposes, and kept by land and mortgage divisions of District Courts [8]. Under acts of law and other executive provisions there is an organisational and institutional separability between both registers; they are, however, closely related to each other. Functions carried out by both systems overlap in the part connected with registration of rights in relation to real estate and its marking [5]. Objective aspect of the real estate is determined by actual state of affairs, shown in REC, and the subjective aspect – by the rights registration in LMR. Without information on the spatial data and actual state of affairs, revealed in REC, LMR system would not be able to exist. Therefore, both systems are dependent on each other, and this dependence entails the need for information flow between them in terms of the actual state of affairs and legal status. It is then obvious that the collection of data, contained in both registers and referring to the same objects, should be identical, including technical and legal procedures in both registers connected with the entry. If for any reason this is not the case, problems might occur in different procedures connected with real estate management.

Legal basis regulating information flow between REC and LMR systems are included in the following legal acts, listed in Table 1.

Table 1. Legal basis regulating information flow between REC and LMR systems

Legal act	Information flow from REC to LMR	Information flow from LMR to REC
The Act of 17 May 1989 – The Geodetic and Cartographic Law [9]	Art. 21.1 and 2 Art. 24b.1.3) and 5) Art. 37.2	Art. 2.8) and 15) and 16) Art. 4.1d Art. 7.1.2) a) Art. 20.1.1) Art. 21.2 Art. 23 Art. 24b.1.3) and 5) Art. 37.2

Table 1 cont.

The Act of 6 July 1982 on Land and Mortgage Registers and on Mortgage [8]	Art. 26.1 and 2 Art. 27 Art. 36.1 and 3 Art. 364.1	-
Ordinance of the Minister of Justice of 17 September 2001 on keeping land and mortgage registers and collections of documents [5]	§ 23.1 § 25.2 § 28 § 58	-
Ordinance of the Minister of Regional Development and Construction of 29 March 2001 on the Inventory of Land and Buildings [4]	§ 1.2) § 49.1.2)	§ 12.1.1) § 35.4) § 44.2) § 46.1. and 2.1) and 4) § 48.1. and 2 § 84

3. Analysis of Time of Information Flow on Selected Examples

According to §48 of the regulation on ILB [4], updating of register data is carried out on the basis of documents coming from the district head, with dates distinguished, referring to the stages of documents flow. Table 2 presents what time intervals were analysed with regards to information flow between LMR and REC systems.

Table 2. Time intervals of the analysed information flow

Information flow from LMR to REC	
analysed dates of notice	analysed time intervals [number of days]
date of entry into LMR	time passed from the date of entry into LMR to the date of issuing notice on changes from LMR
date of issuing notice from LMR	
date of submitting the documents on changes from LMR to REC	time of information flow – usually the time of passing information by post
date of recording the change in REC	time that passed between the date of submitting notice to REC and date of recording the change in REC
	total duration of the outdated information in REC – the sum of the above
Information flow from REC to LMR	
date of entry into REC	time passed from the date of entry into REC to the date of issuing notice on changes from REC
date of issuing notice from REC	
date of submitting the documents informing about changes from REC to LMR	time of information flow – usually the time of passing information by post
date of recording the change in LMR	time that passed between the date of submitting notice to LMR and date of recording the change in LMR
	total duration of the outdated information in LMR – the sum of the above

Table 3. LMR to REC – Zabierzów municipality, 2012 – time of information flow

No. of case	Date of entry into LMR	Date of issuing notice from LMR	Number of days passed from the date of entry into LMR to the date of issuing notice from LMR [days]	Date of submitting the document on the change from LMR to REC	Time of information flow from LMR to REC [days]	Number of days passed from the date of entry into LMR to the date when information is entered into REC (D+F) [days]	Date of recording the change into REC	Number of days between the date of submitting notice to REC and date of recording the change in REC [days]	Total duration of the outdated information in REC (G+H) [days]	Total duration of the outdated information in REC (column J sorted) [days]
A	B	C	D	E	F	G	H	I	J	K
1	21.08.2012	24.08.2012	3	27.08.2012	3	6	17.09.2012	21	27	23
2	09.08.2012	16.08.2012	7	20.08.2012	4	11	17.09.2012	28	39	27
3	09.08.2012	16.08.2012	7	20.08.2012	4	11	17.09.2012	28	39	28
4	09.08.2012	16.08.2012	7	20.08.2012	4	11	17.09.2012	28	39	31
5	11.07.2012	13.07.2012	2	16.07.2012	3	5	17.09.2012	32	37	31
6	12.06.2012	22.06.2012	10	25.06.2012	3	13	17.09.2012	84	97	35
7	12.06.2012	19.06.2012	7	21.06.2012	2	9	12.07.2012	19	28	37
8	30.05.2012	04.06.2012	5	06.06.2012	2	7	12.07.2012	36	43	39
9	17.05.2012	23.05.2012	6	06.06.2012	14	20	12.07.2012	36	56	39
10	21.08.2012	24.08.2012	3	27.08.2012	3	6	13.09.2012	17	23	39
11	31.07.2012	07.08.2012	7	09.08.2012	2	9	28.09.2012	50	59	43
12	02.08.2012	07.08.2012	5	09.08.2012	2	7	28.09.2012	50	57	43
13	23.02.2012	07.03.2012	13	09.03.2012	2	15	28.09.2012	203	218	56
14	24.05.2012	01.06.2012	8	05.06.2012	4	12	17.09.2012	104	116	57
15	20.04.2012	15.05.2012	25	17.05.2012	2	27	25.05.2012	8	35	59
16	12.04.2012	26.04.2012	14	30.04.2012	4	18	25.05.2012	25	43	64
17	22.03.2012	05.04.2012	14	10.04.2012	5	19	25.05.2012	45	64	70
18	16.03.2012	22.03.2012	6	26.03.2012	4	10	25.05.2012	60	70	97
19	31.10.2011	09.11.2011	9	14.11.2011	5	14	31.11.2011	17	31	116
20	31.10.2011	10.11.2011	10	14.11.2011	4	14	31.01.2011	17	31	218
AVERAGE							12.2	-	45.4	57.6

Source: [7]

In 2002, in order to analyse the flow of legal information from LMR to REC, the analysis of 65 notices was carried out [3]. The results of these analyses are presented in the summary report in the Table 4. Figure 1 presents the duration of the outdated information from the moment of entry in LMR, to the moment of registration in REC, on the basis of results obtained from Krakow and Ostrowiec Świętokrzyski in 2002.

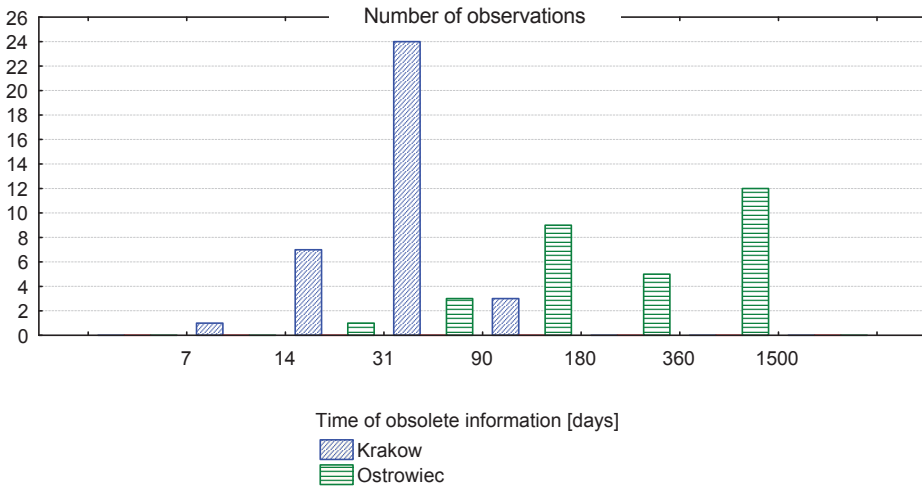


Fig. 1. The duration of the outdated information from the moment of entry in LMR to registration in REC in 2002

Source: [3]

Great diversification, visible in Figure 1, of the time of updating information between analysed centres led to conducting another analyses after 10 years. In 2012 nine centres were analysed, some of which are located in the area of Krakow poviat, where the analysis was carried out in both years. Table 3 presents sample results of the research on the time of information flow from LMR to REC in the area of Zabierzów municipality. Analogical compilation as those presented in Table 3 were performed for all analysed centres.

4. Evaluation of Results and Statistical Analysis

On the basis of the results of partial research carried out in all analysed centres, in the way presented in Table 3, summary reports have been prepared of data for further analysis, presented in Tables 4 and 5 (information flow from LMR to REC) as well as 8 and 9 (information flow from REC to LMR). In these tables the number of analysed documents has been distinguished in three time intervals and the cases of maximum duration of the outdated information were specified.

Table 4. LMR to REC – Poland, 2002 and 2012 – summary report of all analysed centres

Year	Town	General number of analysed cases	Duration of the outdated information in REC [number of cases]			No update within 30 days [%]	Maximum duration of the outdated information in REC – 3 cases [number of days]
			up to 30 days	30–60 days	over 60 days		
2002	Krakow powiat	35	8	17	10	77.1	91, 114, 158
	Ostrowiec Świętokrzyski	30	1	1	28	96.7	925, 1145, 1254
2012	Michałowice (Krakow powiat)	20	8	9	3	60.0	76, 78, 83
	Zabierzów Michałowice (Krakow powiat)	20	3	12	5	85.0	97, 116, 218
	Moszczenica	49	29	18	2	40.8	55, 62, 93
	Krakow-city	40	18	20	2	55.0	52, 65, 78
	Chrzanów	40	12	17	11	70.0	112, 121, 201
	Jasło	25	17	8	0	32.0	41, 43, 47
	Częstochowa	29	23	6	0	20.7	36, 37, 37

Table 5. LMR to REC – Poland, 2002 and 2012 – average time of detaining information on respective stages in all centres analysed

Year	Town	Average time from the entry into LMR to submitting information into REC [number of days]	Average time between the date of submitting notice to REC and recording the change in REC [number of days]	Average total duration of the outdated information in REC [number of days]
2002	Krakow powiat	24	28	52
	Ostrowiec Św.	395	19	414
2012	Michałowice (Krakow powiat)	4	34	38
	Zabierzów Michałowice (Krakow powiat)	12	45	57
	Moszczenica	19	12	31
	Krakow-city	5	29	34
	Chrzanów	18	33	51
	Jasło	15	12	27
	Częstochowa	7	11	18

In order to deepen the research, statistical analysis of the results obtained has been performed. Because of data specificity (equally accurate data) and its number (over 30 elements), interval estimation has been used for the average value, based on

normal distribution for the assumed confidence level $p = 0.95$. In order to determine confidence intervals the following values have been calculated:

- mean value for the equally accurate observations (arithmetic average):

$$\hat{x} = \frac{1}{n} \sum_{i=1}^n x_i \tag{1}$$

- standard deviation in test:

$$\hat{\sigma}_x = \sqrt{\frac{\sum_{i=1}^n (x_i - \hat{x})^2}{n - 1}} \tag{2}$$

- accuracy of the average:

$$\sigma(\hat{x}) = \frac{\hat{\sigma}_x}{\sqrt{n}} \tag{3}$$

- point estimation result:

$$\mu \cong \hat{x} \pm \sigma(\hat{x}) \tag{4}$$

- interval estimation result:

$$\mu \in (\hat{x} - kw \cdot \sigma(\hat{x}); \hat{x} + kw \cdot \sigma(\hat{x})) \tag{5}$$

where $kw = 1.9600$ – normal distribution quantile read out from statistical tables for the confidence level $p = 0.95$.

Statistical analyses of the collected data were carried out in a few comparative groups.

4.1. Information Flow from LMR to REC in Krakow Poviát in Years 2002 and 2012

Time of updating information from LMR to REC in Krakow poviát in years 2002 and 2012 was compared. On the basis of calculations performed, put together in Table 6, Figure 2 was drawn up, illustrating average total duration of the outdated information in REC, along with calculated confidence intervals.

Table 6. LMR to REC – Krakow poviát, years 2002 and 2012 – time of updating information

Year	Number of cases n	Average total duration of the outdated information in REC \hat{x} [number of days]	Standard deviation in test $\hat{\sigma}_x$	Accuracy of the average $\sigma(\hat{x})$	Quantile kw	$kw \cdot \sigma(\hat{x})$	Point estimation result μ [number of days]	Interval estimation result μ [number of days]
2002	35	53	28.7	4.8	1.96	9.5	53 ± 9.5	(44 ; 63)
2012	40	48	35.6	5.6	1.96	11.0	48 ± 11.0	(37 ; 59)



Fig. 2. LMR to REC – Krakow poviat, years 2002 and 2012 – time of updating information

- On the basis of the analysis of Figure 2 can be formulated the following conclusions:
- The average duration of the outdated information in REC of Krakow poviat decreased from 53 days in 2002 to 48 days in 2012, therefore it seems that the situation has improved in some way.
 - However, as the interval estimation indicated that the timeframes of confidence intervals overlap significantly, it can be assumed that the existing improvement is not very significant.
 - The above conclusion can be confirmed by means of statistical test, in which zero hypothesis is assumed (formula (7)) as a fact that in Krakow poviat in 2012 no significant decrease took place in terms of time needed for information updating when compared to year 2002.

The statistical test carried out for the comparison of two mean values, was based on model III (formula (6)), because of the number of samples n and m over 30 elements [1, 2]:

$$Z = \frac{\hat{x}_1 - \hat{x}_2}{\sqrt{\frac{\hat{\sigma}_1^2}{n} + \frac{\hat{\sigma}_2^2}{m}}} \tag{6}$$

$$H_0 : K_{2002} = K_{2012} \tag{7}$$

$$H_1 : K_{2002} > K_{2012} \tag{8}$$

$$Z = 0.6166 \tag{9}$$

From statistical tables of normal distribution the value of quantile $Z(0.95) = 1.6448$ has been read out, being the border of critical region, presented in Figure 3.



Fig. 3. LMR to REC – Krakow poviat, years 2002 and 2012 – normal distribution with 5% critical region

Because value $Z = 0.62$ does not belong to critical region, presented in Figure 3, it can be concluded that there is no reason to reject the null hypothesis. Final conclusion can be then formulated that in Krakow powiat in years 2002–2012 there has been no significant improvement in quickness of information updating in the real estate cadastre (REC) after the change was made in land and mortgage register system (LMR).

4.2. Information Flow from LMR to REC in Selected Offices in Poland in Years 2002 and 2012

In the next stage, information flow from LMR to REC in all offices in Poland is compared, in which it was possible to collect information in years 2002 and 2012. The results of statistical calculations are presented in Table 7 and Figure 4.

Table 7. LMR to REC – Poland, years 2002 and 2012 – time of updating information

Year	Number of cases n	Average total duration of the outdated information in REC \hat{x} [number of days]	Standard deviation in test $\hat{\sigma}_x$	Accuracy of the average $\sigma(\hat{x})$	Quantile kw	$kw \cdot \sigma(\hat{x})$	Point estimation result μ [number of days]	Interval estimation result μ [number of days]
2002	77	189	293.8	33.4	1.96	65.6	189 ± 65.6	(123; 255)
2012	222	36	26.2	1.8	1.96	3.4	36 ± 3.4	(33 ; 40)

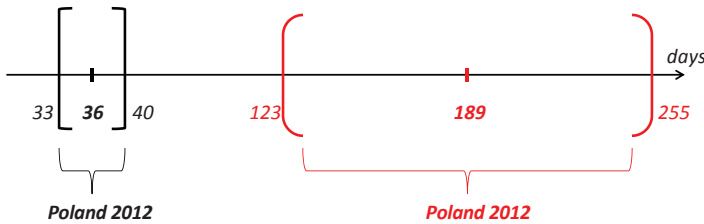


Fig. 4. LMR to REC – Poland, years 2002 and 2012 – time of updating information

- On the basis of the analysis of Figure 4 the following conclusions can be drawn:
- As the average number of days of outdated information duration in REC after recording change in LMR is much lower in 2012 when compared to 2002, and what is more, timeframes of confidence intervals are separate, it can be concluded that a significant improvement took place with regards to time of updating information in Poland, in flow from LMR to REC, in recent decade.
 - On the basis of research conducted in 2002, many inaccuracies could be noticed in relation to data updating in REC, no logging of notices sent from LMR, no logging of date when the change was recorded and general anonymity of the updating activities performed. Computer systems currently used record all stages of data input, which introduces much better ordering in information analysis.

4.3. Information Flow from REC to LMR in Selected Offices in 2012

Along with the attempt to conduct a research on time of updating information in LMR, after recording changes in REC, two different attitudes of land and mortgage register courts were observed in relation to introducing such changes. Research of information flow from REC to LMR was possible to carry out only in two of all analysed towns. The reason for that was lack of consent for the access to the required materials in land and mortgage register courts or no information recording in LMR on the basis of the notices coming from REC. That results from the fact that some courts believe that the document about the occurring change, received from REC, is not a basis for this change being recorded in LMR in relation to geographic data. In those courts, all changes are recorded in LMR exclusively by the request of a party. Data obtained from the analysed centres are put together in Tables 8 and 9.

Table 8. REC to LMR – Krakow powiat, 2012 – summary report from the analysed centres

Year	Town	General number of analysed cases	Duration of the outdated information in LMR [number of cases]			No update within 30 days [%]	Maximum duration of the outdated information in LMR – 3 cases [number of days]
			up to 30 days	30–60 days	over 60 days		
2012	Kocmyrzów-Luborzycza Michałowice (Krakow powiat)	20	10	5	5	50.0	69, 77, 78
	Wielka Wieś (Krakow powiat)	17	12	3	2	29.4	37, 68, 95

Table 9. REC to LMR – Krakow powiat, 2012 – average time of detaining information on respective stages in the analysed centres

Year	Town	Average time from the entry in REC to submitting information into LMR [number of days]	Average time between the date of submitting notice to LMR and recording change in LMR [number of days]	Average total duration of the outdated information in LMR [number of days]
2012	Kocmyrzów-Luborzycza (Krakow powiat)	10	28	38
	Wielka Wieś Michałowice (Krakow powiat)	9	20	30

On the basis of the research carried out it can be concluded that legal regulations should be introduced to standardise the attitude of land and mortgage register courts towards recording geographic changes in relation to real property, which occurred in REC, for the whole territory of Poland.

4.4. Comparison of Information Flow from LMR to REC and from REC to LMR in Krakow poviát in 2012

As the last, the comparative analysis was performed of time of information flow in Krakow poviát, in both directions: from LMR to REC and from REC to LMR in 2012. The results of statistical calculations are presented in Table 10 and Figure 5.

Table 10. LMR to REC and REC to LMR – Krakow poviát, 2012 – comparison of time of updating information

Direction of information flow	Number of cases n	Average total duration of the outdated information \hat{x} [number of days]	Standard deviation in test $\hat{\sigma}_x$	Accuracy of the average $\sigma(\hat{x})$	Quantile kw	kw · $\sigma(\hat{x})$	Point estimation result μ [number of days]	Interval estimation result μ [number of days]
LMR to REC	40	48	35.6	5.6	1.96	11.0	48 ± 11.0	(37; 59)
REC to LMR	37	34	22.5	3.7	1.96	7.2	34 ± 7.3	(27; 42)

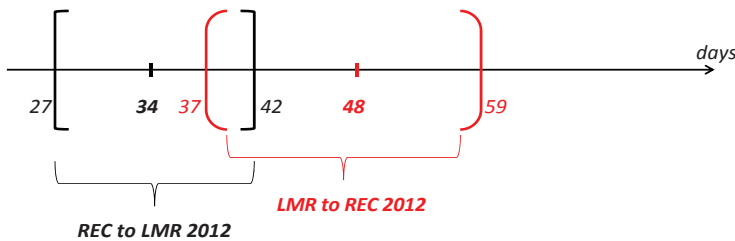


Fig. 5. LMR to REC and REC to LMR – Krakow poviát, 2012 – comparison of time of updating information

The analysis of Figure 5 shows that information flow from REC to LMR is a bit faster (average 34 days) than in the other direction (average 48 days). As the confidence intervals overlap in part, the significance of difference in time should be verified, for the information flow in both analysed directions of changes updating. Statistical test Z should be therefore performed, which for over 30 elements is based on model III [1, 2], and has been calculated according to formula (6).

In statistical test, the fact can be assumed as the null hypothesis (formula (10)) that in Krakow poviát in 2012 the time of updating information in both flow directions is the same.

$$H_0 : KW \rightarrow KN = KN \rightarrow KW \tag{10}$$

$$H_1 : KW \rightarrow KN > KN \rightarrow KW \tag{11}$$

$$Z = 2.0379 \tag{12}$$

From statistical tables of normal distribution the value of quantile $Z(0.95)=1.6448$ for the significance level of 0.05, being the border of critical region, presented in Figure 6.

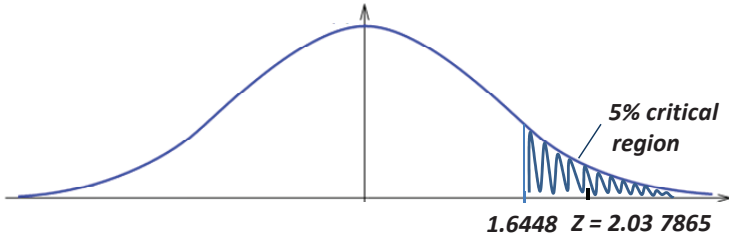


Fig. 6. LMR to REC and REC to LMR – Krakow powiat, 2012 – normal distribution with 5% critical region

The conducted test proved that calculated statistics (testing function) Z belongs to the critical region and therefore there is a ground to reject hypothesis H_0 in favour of alternative hypothesis H_1 . It means that time of information flow in the direction from REC to LMR is significantly shorter than in the other direction, which was already proven by values of average time of information flow, presented in Figure 5. This conclusion cannot be, however, generalised for the whole territory of Poland, as in other analysed towns the information on changes recorded in REC, sent in form of notices, were not recorded in land and mortgage registers.

5. Summary

On the basis of research carried out in 2002 it was shown that information flow between cadastre offices and land and mortgage register courts was to correct in terms of requirements presented in mentioned provisions of law. What is more, significant differences occurred then in information flow in different offices analysed in Poland (Fig. 1) [3].

In research carried out in 2012, when compared to 2002, an improvement in time of updating data in REC can be noticed, after changes recorded in LMR, both in analysed centres in Poland and in Krakow powiat. As the statistical analysis carried out has proved, within Poland the improvement is very radical; however, for Krakow powiat it is not very significant.

When comparing the slight improvement in time of updating information for Krakow poviat and significant improvement in time of updating information within Poland it should be noticed that already 10 years before in Krakow the duration of outdated information in REC after recording changes in LMR was relatively short.

Another conclusion can be made that there is a large diversity of attitude of land and mortgage register courts towards recording information that occurred in REC and sent to LMR. Legal regulation is then recommended which will standardise the attitudes of courts towards recording such changes.

To sum up, it can be stated that only fully automatic integration of both systems, implemented with the ordinance on Integrated Real Estate Information System (IREIS) [6] can minimize the duration of outdated information in the database.

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