

THE IMPACT OF SURVEYING WORKS ON THE DEVELOPMENT OF SMART CITY

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Abstract

The purpose of this article is to determine the impact of surveying works on the development of the Smart City on an example of City Rzeszow. The City of Rzeszow was chosen for detailed research, because Rzeszow ranks 55 in the European Smart Cities ranking. It is worth noting that on the 77 cities assessed from all over Europe, the list included 6 Polish cities, including the City of Rzeszow. In Rzeszow Smart City the research was carried out on 20 districts of cadastral registration. Geodetic works submitted to the Geodesy and Cartographic Documentation Center in Rzeszow in the years 2011-2015 were subject to analysis. The work focused on the group of works most frequently reported to the Center, constituting the following assortment of surveying works: division of real estate, delimitation of real estate, maps for design purposes, geodetic as-built inventory. The article is of research nature, hence a lot of attention was devoted to the analysis of particular assortments of surveying works performed in the Rzeszow Smart City and on the graphic presentation of results.

Keywords: Smart City, real estate management, real estate cadastre, spatial planning

Introduction

The current times are undoubtedly the period of urban development. The process of migration to urban centers is continuously increasing throughout the world. It is estimated that, in a few years, 75% of the population around the globe will have been living in cities (BIEDA et al., 2016).

European cities face the challenge of combining competitiveness and sustainable urban development in connection with economic and technological changes caused by globalization and the integration process. Very evidently, this challenge is likely to have an impact on issues of Urban Quality such as housing, economy, culture, social and environmental conditions (PAPADOPOULOU, GIAOUTZI, 2017). Therefore, you meet and create a smart city. The attempt to define the city of smart city, among other things, took place: GIFFINGER et al. (2007); CALAGLIU, DEL BO, NIJKAMP (2009); LOMBARDII (2011); BATTY et al. (2012); DAMERI (2013); MANVILLE et al. (2014); GLASMEIER, CHRISTOPHERSON (2015). A Smart City is a city well performing in 6 characteristics (Smart Economy, Smart People, Smart Governance, Smart Mobility, Smart Environment, Smart Living), built on the smart combination of endowments and activities of self-decisive, independent and aware citizens (STRATIGEA et al., 2015). This 6 parameters also contains multidisciplinary issues like quality of living space. Some examples of these aspects in Smart Environment and Smart Living context could be find in (BAJOREK-ZYDROŃ, WEŻYK, 2016). Among other things, Smart Living and precisely such features as: cultural facilities, health conditions, individual security, housing quality, education facilities, economic welfare are closely related to the development of real estate management and surveying work.

The surveyors are obliged to carry out these works in a reliable manner and in accordance with applicable regulations and technical standards. The geodetic land division is stage an indispensable of the investment process (NOGA et al., 2018). However, the delimitation of land consists in establishing the course of the boundaries of real estate, in a situation when they have become disputable and the legal state cannot be established. In turn, if we want to start building a house or other building object, it is necessary for the surveyor to create a situational map for design purposes. However, in accordance with the Construction Law (ACT, 1994), construction works requiring a building permit. After completion of construction, should be measured carry out field surveying inventory. Therefore, inventory is the last geodetic activity performed in the investment process. It can be stated that geodetic works are an inherent element of real estate management and the investment process in the city. Among other things, this topic was considered, among others, by: KWARTNIK-PRUC, HANUS (2014); BALAJEJDER et al. (2015); BUŚKO, PRZEWIĘŻLIKOWSKA (2016); KUKULSKA et. al. (2017); BALAJEJDER, WÓJCIAK (2017); WOLNY et al. (2017) and others, but no research was conducted in the context of Smart City. Therefore, the purpose of the article is to determine the impact of surveying works on the development of the Smart City on the example of the City of Rzeszow.

Characteristics of the research object

The city of Rzeszow was selected for detailed research, as Rzeszow occupies 55th place in the ranking of European Smart Cities (PLEEC project studies). It is worth noting that on the 77 cities assessed from all over Europe, the list included 6 Polish cities, including the City of Rzeszow (Fig 1).



Fig. 1. The European Smart Cities v. 3.0 project from 2014.
Source: PLEEC.

The city of Rzeszow is located in the south-eastern part of Poland, on the Wisłok River. Rzeszow is the capital of the Podkarpackie Voivodeship. It is the central academic, economic and cultural center of this region.

The city of Rzeszow is divided into 20 cadastral districts: Śródmieście, Nowe Miasto, Zalesie, Biała, Zwiężczyca, Staroniwa, Baranówka, Staroniwa II, Przybyszówka, Staromieście, Pobitno, Wilkowyja Pn, Wilkowyja Pd, Rzeszow – Załęże, Rzeszow – Słocina, Przybyszówka II, Rzeszow – Zwiężcz, Biała II, Budziwój, Miłocin, Bzianka. The layout of cadastral districts in the city is shown in Figure 2. Rzeszow covers an area of 120.4 km². This is 9.9% of the entire county's area. It has more than 188,000 inhabitants. The average population density is 1562 people/km².

The advantage of Rzeszow is its attractive location, well-developed road network, public transport and natural values. The city undertakes various efforts to continuously improve the natural environment. Rzeszow plays an important point on the map of Europe. It has an international airport. There are also intersecting international routes of road and railway communication (NOGA et al., 2017). Rzeszow focuses on educated youth. In the city there are two large state universities, such as: the University of Rzeszow and the Rzeszow University of Technology as well as several private ones.

Many enterprises and production plants prosper in the city, with around 100,000 employees. Constant development of Rzeszow and receiving the title of Smart City, forced somewhat city authorities to expand the borders of their territory by acquiring new areas. Beginning from 2006 to the present, Rzeszow joined a new cadastral district every year, thanks to which it increased its area. Over the past few years, they have been attached:

- 2006 – Słocina and Załęże;
- 2007 – part of Przybyszówka;
- 2008 – part of Przybyszówka and Zwiężczyca;

2009 – Biała;
 2010 – part of Miłocin and Budziwój;
 2017 – Bzianka.



Fig. 2.The division of the city of Rzeszow into cadastral districts.
 Source: Own study.

The acquired areas and the possibility of their utilities can be evidence of further investments, and thus the creation of new jobs, as well as the development of residential construction. Among other things, residential housing has an impact on Smart Living in the city of Rzeszow, as detailed in Figure 3.

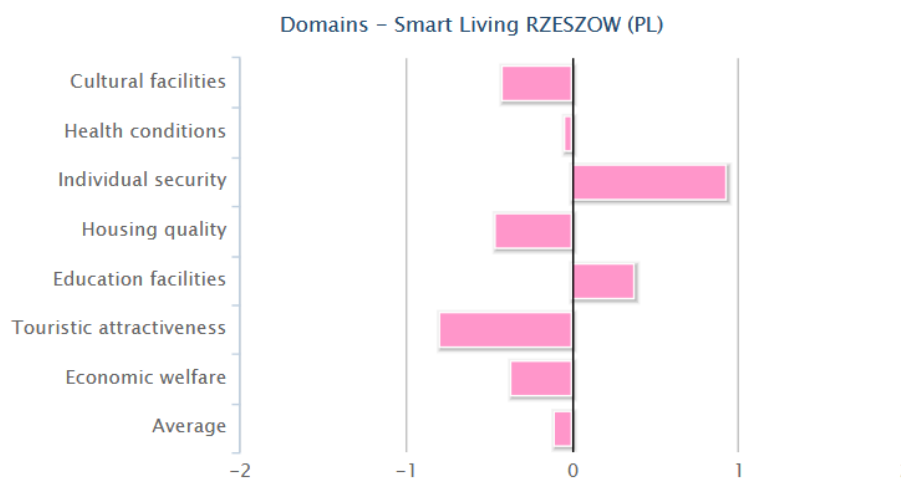


Fig. 3.Domains Smart Living in the city of Rzeszow.
 Source: PLLEC.

Overall, the city of Rzeszow has the 55th place in the ranking of European Cities. In the Smart Living category, on the other hand, it was 50th. As we note in Figure 3, Smart Living is influenced by: cultural facilities, health conditions, individual security, housing quality, education facilities, touristic attractiveness and economic welfare. In addition to the smart living feature, the overall ranking in

European cities is also influenced by 5 features: Smart Economy, Smart People, Smart Governance, Smart Mobility and Smart Environment that correlate with each other.

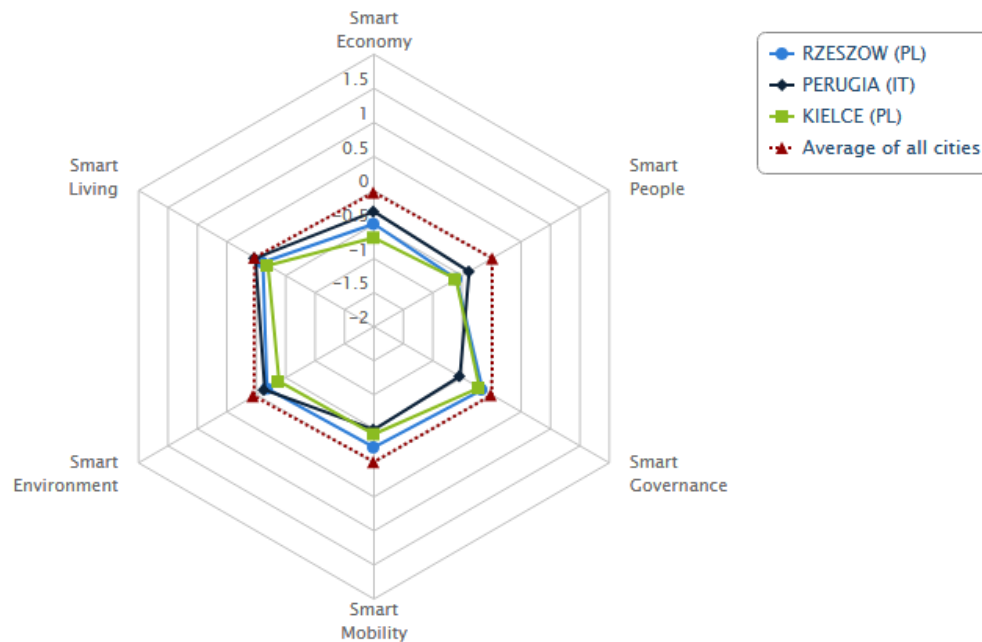


Fig. 4. Smart City profiles: Rzeszow, Perugia and Kielce.
Source: PLLEC.

The mutual correlation of features is presented in Figure 4. We see how Smart City Rzeszow ranks as compared to another Polish Smart City Kielce or Smart City Perugia in Italy. We observe that it differs little from the average of 77 cities in Europe. Therefore, geodetic works may influence the better result of the city of Rzeszow in the next study of European Cities.

Spatial planning and surveying works

Spatial planning is an extremely powerful tool with which the development of even the largest space can be shaped (BIEDA, PARZYCH, 2013). There is a very large link between spatial planning and surveying work. Both of them relate to information about the site. The geodetic works are based on real information about the area (BALAWEJDER, WÓJCIAK, 2017). In turn, spatial planning determines the state of the designed site. Existing planning materials can influence the initiation of real estate processes (BIEDA et al., 2015). This is especially noticeable when the land dividing. Namely, the land division can be made when it is in accordance with the arrangements of the local plan.

The local spatial development plan is an act regulating issues related to the destination, development conditions and land development as well as matters related to the deployment of a public purpose investment. Pursuant to the Act on Spatial Planning and Development (ACT, 2003), each commune should have its own spatial plan. Such a plan consists of two basic parts: the text part (resolution) and the graphic part (attachment to the resolution). A local plan is a document constituting the basis for spatial planning in each municipality. It is also the basis for issuing an administrative decision (no such study exists). In the case of a change in the use of agricultural and forest land for non-agricultural and non-forestry purposes, such changes are made in the local plan. The plan is drawn up within the administrative boundaries of municipalities and cannot go beyond it. There may be more than one plan in the municipality, but they cannot overlap.

The current coverage of the city of Rzeszow, applicable and being under development with local spatial development plans, is shown in Figure 5 from the Public Information Bulletin.

A local plan is an important document in the process of investment preparation. The area on which the investment project is planned, consisting in the construction of the building, must be designated for development in the local plan. In addition, the local plan contains information on: the minimum size that a plot must have, so that you can build a house, distance from the road, dimensions of the building, and even the color of the roof. Otherwise, we will not get a building permit. One of the basic materials for the needs of spatial planning are basic maps and topographic maps. Basic maps are used in the

development of local plans, and topographic maps in the study of conditions. The information contained in the basic maps, in particular construction objects with the indication of their use, property boundaries, land development elements, land use designation, underground and aboveground technical infrastructure allow for a thorough analysis of the existing development status (BALAWEJDER et al., 2016).

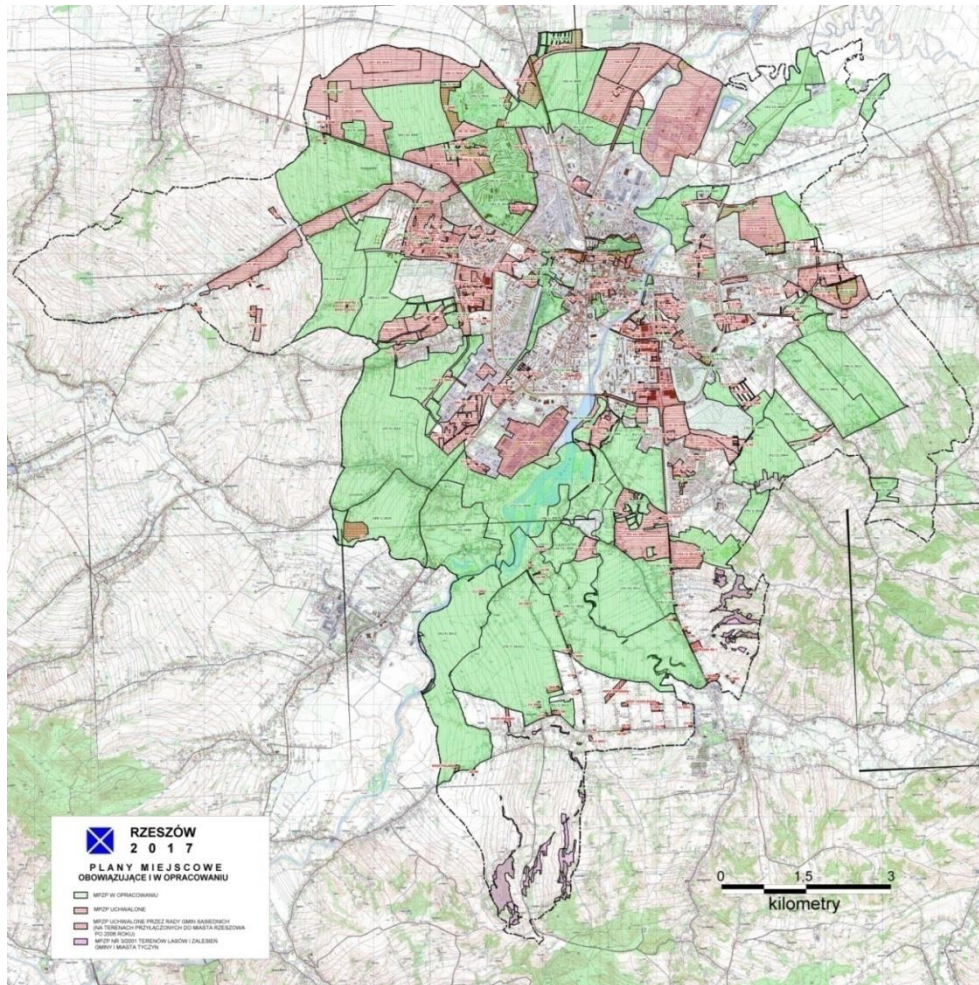


Fig. 5. Areas of the city of Rzeszów covered and being in the development of the local land development plan.
 Source: bip.erzeshow.pl/ (access 12.05.2018).

The table 1 below presents the number of local plans adopted from 2011 to the present and the number of plans developed.

Table1. The number of approved and planned local land development plans for the city of Rzeszów.

Year	Local spatial development plans in preparation		Approved local spatial development plans	
	quantity	%	quantity	%
2011	10	30.3	9	17.6
2012	8	24.2	7	13.7
2013	9	27.3	6	11.8
2014	1	3.0	3	5.9
2015	3	9.1	13	25.5
2016	2	6.1	11	21.6
2017	0	0.0	2	3.9
Total	33	100.0	51	100.0

Source: Own study.

Based on Table 1 and Figure 6, we see that in the years from 2011 to 2017, as many as 51 local spatial development plans were approved at the site. However, in the examined facility still 33 local

spatial development plans are under development. Therefore, in a situation where in the area where the investment is planned there is no valid development plan or the permit has not been adopted there, we will obtain a building permit by way of a decision on land development and development conditions. The investment will then be implemented based on this decision. Pursuant to the Act on spatial planning and development (ACT, 2003), we distinguish two types of decisions on building and land development conditions. One of them is the decision to locate a public goal. The second of them is the decision on building conditions for other investments. These decisions are issued by the municipality's executive body.

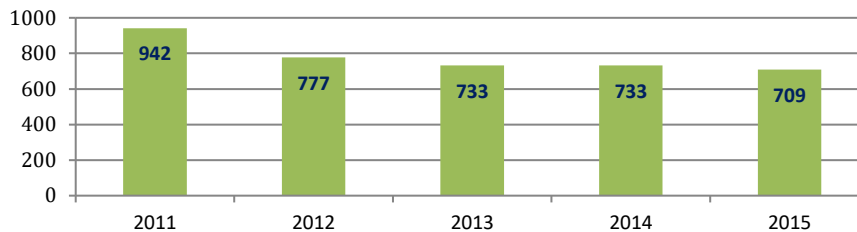


Fig. 6.Number of decisions on development conditions issued in 2011-2015.
Source: Own study.

On the basis of information obtained from the Faculty of Architecture of the city of Rzeszow, the number of issued decisions on land development and development conditions in the years 2011 -2015 is in total 3894. Figure 6 shows the number of decisions on building conditions in particular years. It is easy to see that they have a downward trend. Most decisions on building conditions were issued in 2011 for the areas of Budziwój and Przybyszówka II. They are the largest in terms of surface area. It can be concluded that the reason for this is probably the dynamic development of these areas. These areas have the largest number of areas previously undeveloped, which draws the attention of Smart City investors.

Analysis and the influence of geodetic works on the development of the city

Surveyor plays a very important role in building processes. He draws up the geodetic documentation necessary for the development of the construction project. The first geodetic stage in the construction process is the development of a map for design purposes, and the last inventory measurement. The determination of the impact of surveying works on the development of the city of Rzeszow was made on the basis of data provided by the Center for Geodetic and Cartographic Documentation in Rzeszow.

In Rzeszow, a large number of works related to the preparation of maps for design purposes and as-built inventory are performed. The analysis covered geodetic works from 2011 to 2015. During this period 5 373 maps for design purposes and 11 087 inventory field surveying were implemented. It can therefore be concluded that interest in this kind of work is high. The Figure 7 below presents the overall number of maps made for design purposes and inventory field surveying for each year.

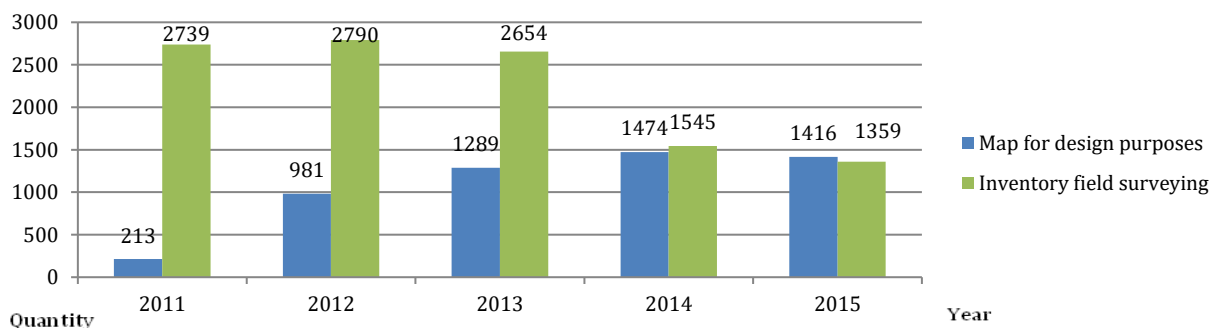


Fig. 7.Number of maps for design purposes and inventory field surveying made in 2011-2015.
Source: Own study.

The most maps for project purposes as many as 1474 were made in 2014, which gives 27.4% of all works carried out in 2011-2015. A little less 1416 fell in 2015, which gives 26.4% of all works.

However, they were the least in 2011 because only 4% (213) in relation to the whole. It can be noticed that year by year the number of developed maps for project purposes is increasing. This is probably due to the continuous development of Rzeszow Smart City. In addition, by conducting detailed research, Figure 8 was presented showing the intensity of maps for design purposes, broken down into Rzeszow Smart City.

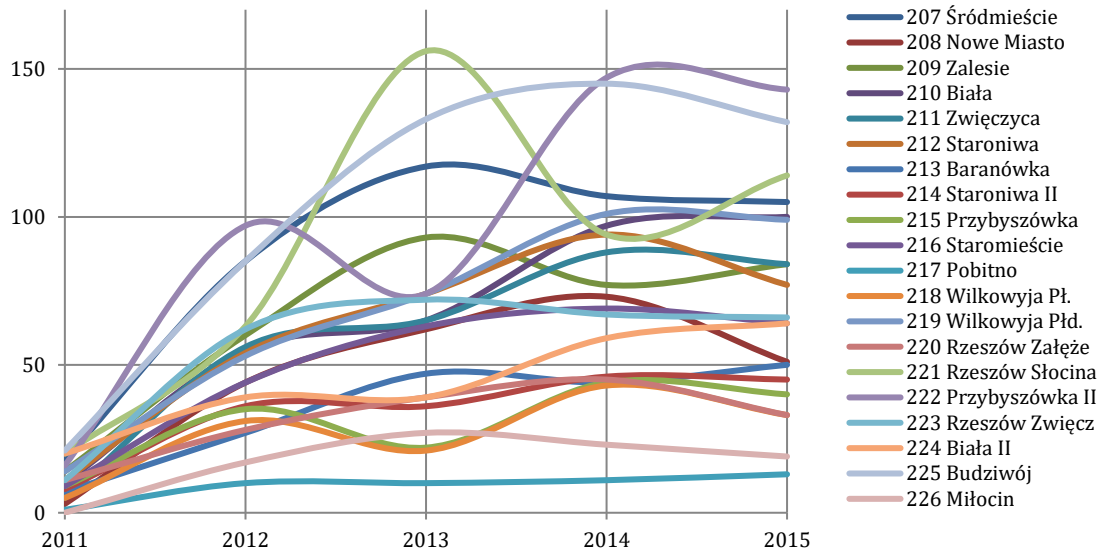


Fig. 8. Number of maps for design purposes carried out in individual districts of Rzeszow in 2011-2015.
Source: Own study.

As shown in Figure 8, maps for design purposes have been made in all cadastral districts. The most maps were made in the outer areas of Rzeszow Smart City. The most maps were made in 2014. In order to better illustrate, a cartogram was prepared (Figure 9) showing the intensity of maps for design purposes with the cadastral district in 2014.

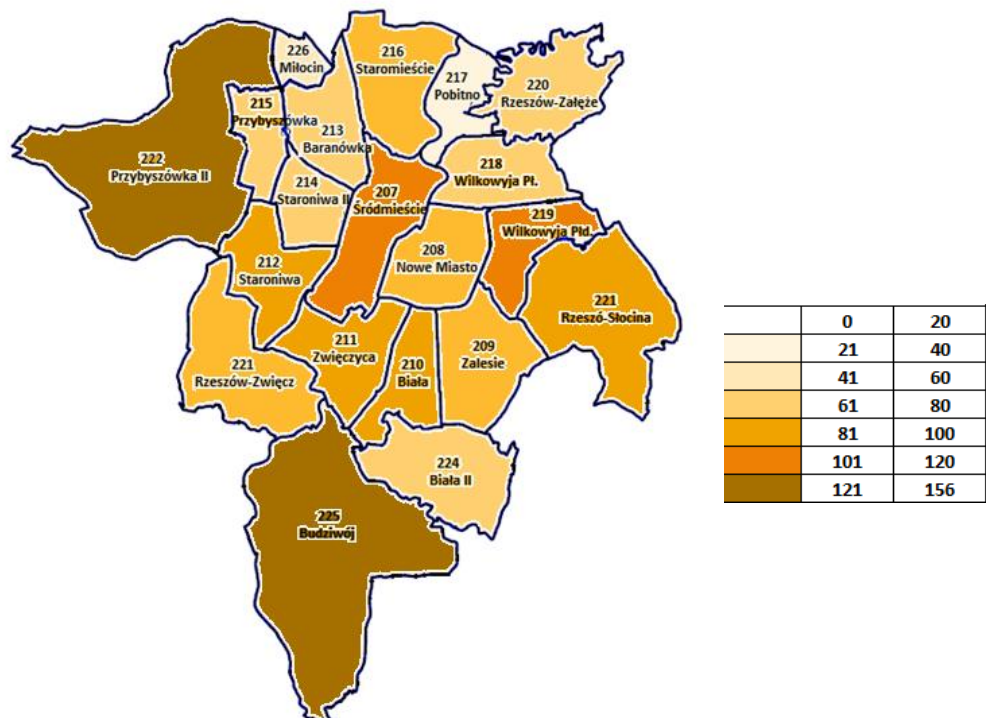


Fig. 9. Strength of maps for design purposes in 2014 in particular districts.
Source: Own study.

As can be seen from figure 9, the most maps for project purposes were performed in district 222 and 225. The least in 226 and 217. In 207-Śródmieście, a moderate number of maps for design purposes was performed, which indicates the development of the investment towards Smart City development.

In the case of inventory field surveying, a downward trend can be observed. As shown in Figure 7, in the first three years, the number of such works has remained almost at the same level. However, in 2014 and 2015 there was a decrease. Additionally, while conducting detailed research, Figure 10 was presented showing inventory field surveying intensity divided into a district in the city of Rzeszow Smart City.

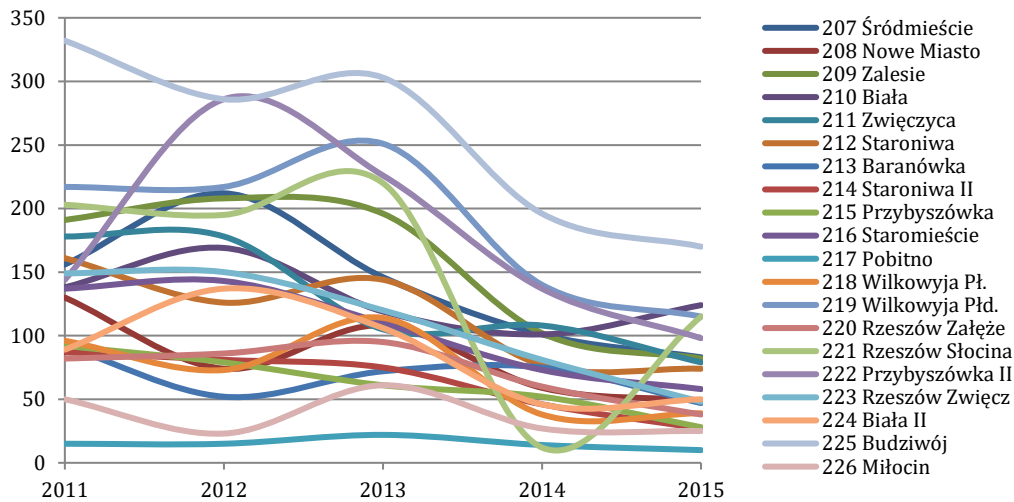


Fig. 10. Number of inventory field surveying carried out in individual districts of Rzeszow in 2011-2015.
Source: Own study.

As shown in Figure 10, inventory fielding was performed in all districts. The most inventory was made in external Rzeszow Smart City. The most inventory was made in 2012. For better illustration, Figure 11 was presented showing the cartogram of the inventory field surveying volume divided in districts in 2012.

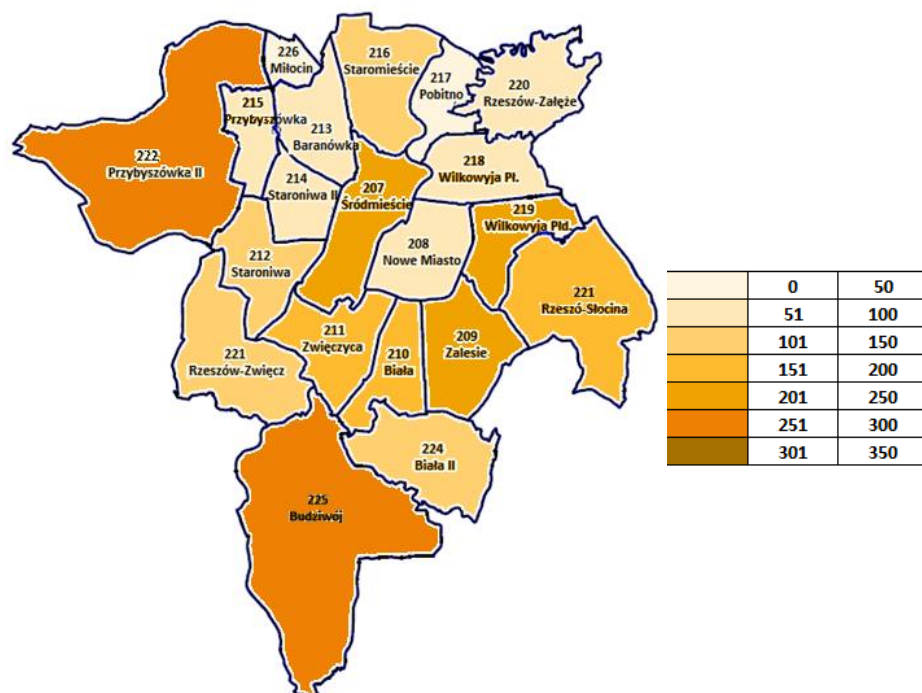


Fig. 11. Strength of inventory field surveying in 2012 in particular districts.
Source: Own study.

As shown in Figure 11, most inventory field surveying was also performed in districts 222 and 225. The least in the areas of 226 and 217. In 207-Śródmieście, a moderate inventory field surveying was performed, which indicates the development of investments towards Smart City.

As far as real estate management is concerned, it has a very large impact on shaping space in accordance with the arrangements contained in the local land development plan and in the decisions of WZZT (KWARTNIK-PRUC, HANUS, 2014). Among the tasks of the real estate management, the divisions of land can be mentioned as the most frequently executed ones. However, much less land delimitations are carried out.

In the analyzed period, a total of 2,662 divisions and only 142 delimitations of land were recorded. Below is a figure 12, which presents the total number of land divisions made and land delimitation for each year. Due to the very small number of delimitations made, they were not subjected to detailed analysis, while the numerous divisions of land were elaborated in detail.

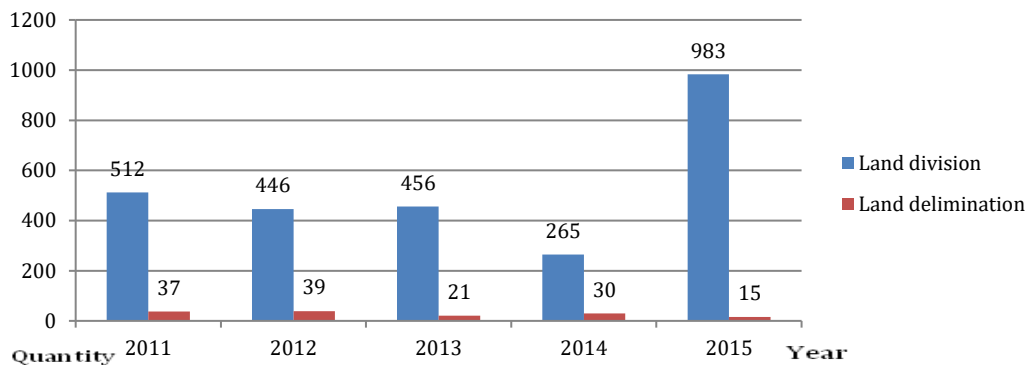


Fig. 12. Number of divisions and delimitation of land completed in 2011-2015.
Source: Own study.

As shown in Figure 12, the most divisions up to 983 were made in 2015, which gives 36.9% of the total work done in 2011-2015. A lot less only 512 fell in 2011, 456 in turn in 2013, and 446 in 2012. However, the least was in 2014, because only 265 divisions of land in relation to the whole. It can be noticed that year by year the number of developed divisions of design real estate decreased, and in 2015 it increased three times. This is probably due to the arrival of the city of Rzeszow on the Smart City list. It may be caused by the investment development of the city, the planning of numerous smart construction projects, as well as the development of road infrastructure. Additionally, while conducting detailed research, Figure 13 was presented showing the intensity of property divisions divided into cadastral districts in Rzeszow Smart City.

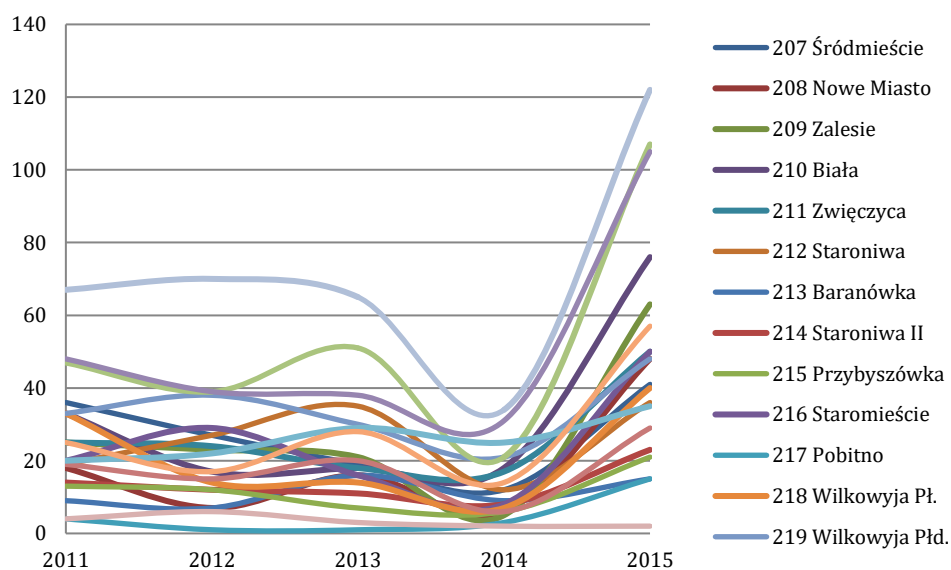


Fig. 13. Number of property divisions carried out in individual cadastral districts of the city of Rzeszow in 2011-2015.
Source: Own study.

As shown in Figure 13, property divisions have been made in all districts. The most divisions of land were made in external Rzeszow Smart City. The most divisions of land were made in 2015. For the purpose of better illustration, an additional illustration was prepared, showing the intensity of property divisions divided into districts in 2015.

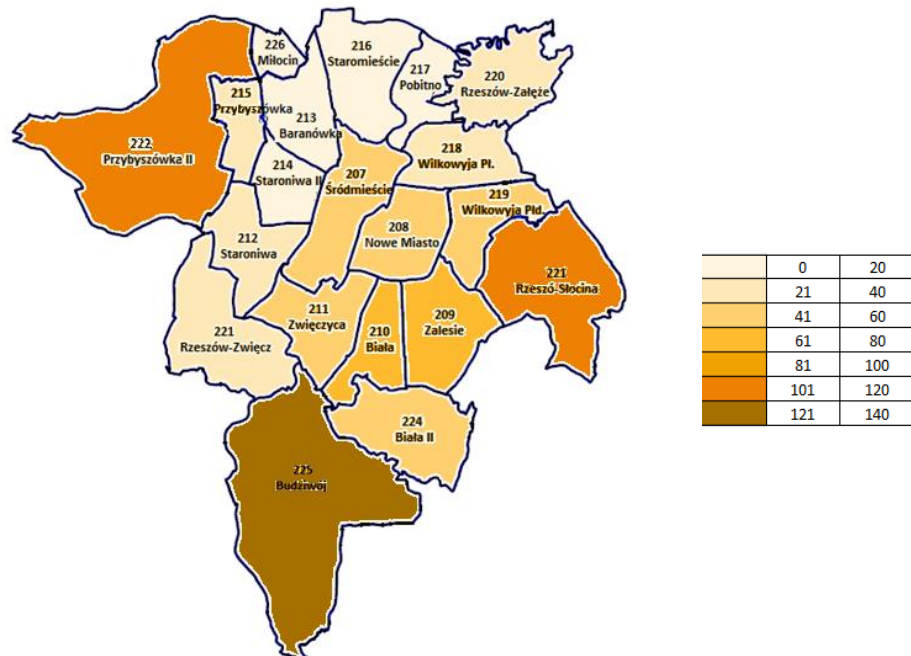


Fig. 14. Strength of land division in 2012 in particular districts.
Source: Own study.

As can be seen from figure 14, the most divisions of land were also made in districts 222 and 225. The smallest in districts 213, 214, 216 and 217. The 207-Śródmieście, a moderate number of property divisions was performed, which indicates the development of investments towards Smart City development.

In the last stage of the analysis, as a summary, a tabular summary (tab.2) was prepared, in which the number of discussed types of works for each year was placed. A figure 15 was also drawn up showing the distribution of the number of individual works in the examined period.

Table 2. A summary of the total number of surveying works carried out in individual years.

	Year 2011		Year 2012		Year 2013		Year 2014		Year 2015		Total	
	Quantity	%	Quantity	%	Quantity	%	Quantity	%	Quantity	%	Quantity	%
1.Land division	512	11,5	446	1,9	456	2,0	265	1,1	983	4,2	2662	11,5
2.Land delimitation	37	0,2	39	0,2	21	0,1	30	0,1	15	0,1	142	0,6
3.Map for design purposes	213	0,9	981	4,2	1289	5,6	1474	6,4	1416	6,1	5373	23,2
4.Inventory field surveying	2739	11,8	2790	12,0	2654	11,5	1545	6,7	1359	5,9	11087	47,9
5.Decisions of the WZZT	942	4,1	777	3,4	733	3,2	733	3,2	709	3,1	3894	16,8
Total	4443	19,2	5033	21,7	5153	22,3	4047	17,5	4482	19,4	23158	100,0

Source: Own study.

Among the analyzed works, the most inventory field surveying were carried out, as much as 47.9% of all works carried out in the analyzed period. The rare occurrence of the works are the delimitation of only 0.6% of the total geodetic tasks performed. As regards the decisions of the WZZT, their number since 2012 has remained more or less at the same level (16.8%). It is also easy to notice that the number of inventories has dropped significantly. This is due to the fact that probably the number of planned investments was completed in 2015. The European Smart Cities v. 3.0 project from 2014 showed that Rzeszow was placed on the list of Smart Cities. This caused a sudden interest in land in Rzeszow Smart City. Investors started the investment process due to the number of property divisions in 2015

increased. In summary, the development of real estate management and surveying work have a significant impact on the development of Smart Cities, including Smart Living.

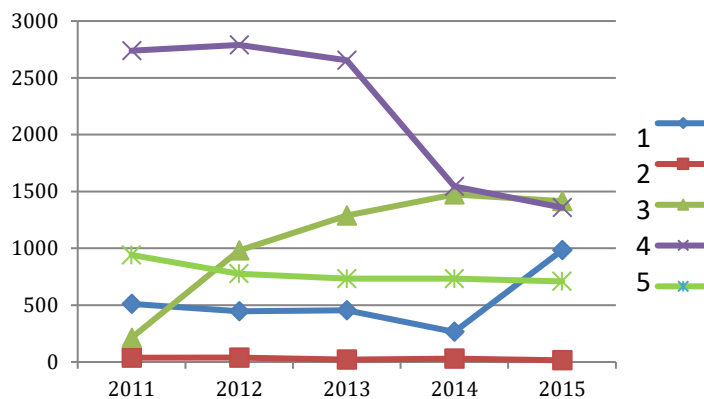


Fig. 15. The total number of surveying works carried out in individual years.
Source: Own study.

Conclusions

This article specifies the impact of geodetic works on the development of the Smart City on the example of Rzeszow. Rzeszow ranks 55th in the ranking of European Smart Cities (PLEEC project studies). The ranking includes 6 Polish cities, including the city of Rzeszow.

1. Detailed research was conducted on 20 city districts of the City of Rzeszow. Such a large area covered by the analysis allowed for a precise interpretation of the phenomenon. The data was obtained from the Center for Geodetic and Cartographic Documentation in Rzeszow. The article focuses primarily on surveying works related to real estate management and construction processes that have an impact on the development of Smart City. The analysis covered geodetic works in the field of: land divisions, land delimitations, maps for design purposes and inventory field surveying. This kind of work is very often carried out while executing most investments.
2. Overall, the City of Rzeszow has the 55th place in the ranking of European Cities. In the Smart Living category, on the other hand, it was 50th. The following factors influence Smart Living: cultural facilities, health conditions, individual security, housing quality, education facilities, touristic attractiveness, and economic welfare. In addition to the smart living feature, the overall ranking in European Cities is also influenced by 5 features: Smart Economy, Smart People, Smart Governance, Smart Mobility and Smart Environment that correlate with each other. The article shows the mutual correlation of features against the background of another Polish Smart City Kielce or Smart City Perugia in Italy. We observe that it differs little from the average of 77 cities in Europe. Therefore, geodetic works may influence the better result of the City of Rzeszow in the next study of European Cities.
3. Among the analyzed works, the most inventory measurements were carried out, as much as 47.9% of all works carried out in the analyzed period. As regards the decisions of the WZZT, their number since 2012 has remained more or less at the same level (16.8%). It is also easy to notice that the number of inventories has dropped significantly. This is due to the fact that probably the number of planned investments was completed in 2015. The European Smart Cities v. 3.0 project from 2014 showed that Rzeszow was placed on the list of Smart Cities. This caused a sudden interest in land in Rzeszow Smart City. Investors started the investment process due to the number of property divisions in 2015 increased. In summary, the development of real estate management and surveying work have a significant impact on the development of Smart Cities, including Smart Living.

Summing up, based on the data provided, it was found that the most works were carried out related to building processes. This only proves that Rzeszow Smart City is constantly growing. It is constantly attracting new investors, and thus new investments are being made all the time, which has an impact on the development of the Smart City.

References

- BAJOREK-ZYDRON, K., WEZYK, P., (red.) 2016. *Atlas pokrycia terenu i przewietrzania Krakowa (Atlas of land cover and ventilation in Krakow)*, Kraków, p. 56-57.
- BALAJEJDER, M., ADAMCZYK, T., CYGAN, M. 2016. *The problem of adjusting Polish Spatial Information Resource to the standards of the INSPIRE*. Geographic Information Systems Conference and Exhibition - GIS ODYSSEY 2016, Conference proceedings, Perugia, Italy, p. 14-24.
- BALAJEJDER, M., BUSKO, M., CELLMER, R., JUCHNIEWICZ-PIOTROWSKA, K., LEN, P., MIKA, M., SZCZEPANKOWSKA, K., WOJCIK, E., WOJCIK-LEN, J., ZROBEK, S. 2015. *Aktualne problemy gospodarki nieruchomościami w Polsce na tle przemian organizacyjno-prawnych (Current problems of real estate management in Poland against the background of changes of organizational and legal)*. WSI-E, Rzeszów, p. 144.
- BALAJEJDER, M., WOJCIK, E. 2017. *Application of GIS tools in analysing a road network providing access to cadastral parcels in the project concerning land consolidation and exchange*. Geographic Information Systems Conference and Exhibition "GIS ODYSSEY 2017", 4th to 8th of September 2017, Trento-Vattaro, Italy, Conference proceedings, p. 13-21.
- BATTY, M., AXHAUSEN, K., FOSCA, G., POZDNOUKJ, A., BAZZANI, A., WACHOWICZ, M., OUZOUNIS, G., PORTUGALI, Y. 2012. *Smart cities of the future* (Paper No. 188). London, United Kingdom: University College London (UCL), Centre for Advanced Spatial Analysis (CASA).
- BIEDA, A., ADAMCZYK, T., BIEDA, A. 2016. *The energy performance of buildings directive as one of the solutions for smart cities*. Geographic Information Systems Conference and Exhibition "GIS ODYSSEY 2016", Conference proceedings, Perugia, Italy, p. 44-49.
- BIEDA, A., GLANOWSKA, M., HANUS, P., PESKA, A. 2015. *Rozgraniczenie jako proces wspomagający procedury gospodarki nieruchomościami oraz planowania przestrzennego (Delimitation as a process supporting real estate management procedures and spatial planning)*. Infrastruktura i Ekologia Terenów Wiejskich, IV(1):1068-1080.
- BIEDA, A., PARZYCH, P. 2013. *Development of spatial politics of monumental towns based on Krakow example*. International Multidisciplinary Scientific GeoConference: SGEM: Surveying Geology & mining Ecology Management, 2, p. 143.
- BUSKO, M., PRZEWIEZLIKOWSKA, A. 2016. *The problem of demonstrating cadastral changes in surveying documentation. 5th-9th September 2016, Perugia, Italy : conference proceedings*. Zagreb: Croatian Information Technology Society, GIS Forum, p. 50-62.
- CARAGLIU, A., DEL BO, C., NIJKAMP, P. 2009. *Smart cities in Europe (Series Research Memoranda 0048)*. Amsterdam, Netherlands: VU University Amsterdam, Faculty of Economics, Business Administration and Econometrics.
- DAMERI, R. P. 2013. *Searching for smart city definition: A comprehensive proposal*. International Journal of Computers & Technology, 11(5): 2544-2552.
- GIFFINGER, R., FERTNER, C., KRAMAR, H., KALASEK, R., PICHLER-MILANOVIC, N., MEIJERS, E. 2007. *Smart cities – Ranking of European medium-sized cities(Final report): Vienna University of Technology, Vienna, Austria*.
- GLASMEIER, A., CHRISTOPHERSON, S. 2015. *Thinking about smart cities*. Cambridge Journal of Regions. Economy and Society, 8(1): 3-12.
- KUKULSKA, A., CEGIELSKA, K., SALATA, T., SZYLAR, M. 2017. *Wpływ ośrodka miejskiego na kształtowanie się obszarów inwestycyjnych (The influence of the urban center on the development of investment areas)*. Acta Sci. Pol. Administratio Locorum, 16(2): 97-110.
- KWARTNIK-PRUC A., HANUS P. 2014. *Geodezyjne aspekty rozgraniczeń i podziałów nieruchomości (Geodetic aspects of real estate demarcation and divisions)*. Wydawnictwa AGH, Kraków pp.137.
- LOMBARDI, P. 2011. *New challenges in the evaluation of smart cities*. Network Industries Quarterly, 13(3): 8-10.
- MANVILLE, C., COCHRANE, G., CAVE, J., MILLARD, J., PEDERSON, J. K., THAARUP, R. K., LIEBE, A., WISSNER, M., MASSINK, R., & KOTTERINK, B. 2014. *Mapping smart cities in the EU (Study – Document requested by the European Parliament's Committee on Industry, Research and Energy)*. Brussels, Belgium: Directorate General for Internal Policies, Policy Department A: Economic and Scientific Policy.
- NOGA, K., BALAJEJDER, M., NOSEK, G., 2018. *Ways of Acquiring Land Property for the Construction of Province Roads*. Real Estate Management and Valuation, 26(1): 108-121.
- NOGA, K., BALAJEJDER, M., MATKOWSKA, K. 2017. *Dimensions of the destruction of road network providing access to cadastral parcels resulting from the motorway construction*. Geomatics and Environmental Engineering, 11(4): 65-81.
- PAPADOPOULOU, CH.-A., GIAOUTZI, M. 2017. *Crowdsourcing and Living Labs in Support of Smart Cities' Development*. International Journal of E-Planning Research, 6(2): 22-38.

- PLLEC–*Ranking of European cities (Final report)*: Vienna University of Technology, Vienna, Austria.
www.smart-cities.eu.
- STRATIGEA, A., PAPADOPOULOU, CH.-A., & PANAGIOTOPOULOU, M. 2015. *Tools and Technologies for Planning the Development of Smart Cities*. *Journal of Urban Technology*.
- THE ACT of 7 July 1994 *Construction law* (Official Journal 2018 No. 1202- consolidated text, as amended).
- THE ACT of 23 March 2003 *on planning and spatial development* (Official Journal 2017 No. 1073- consolidated text, as amended).
- WOLNY, A., DAWIDOWICZ, A. ŻRÓBEK, R., 2017. *Identification of the spatial causes of urban sprawl with the use of land information systems and GIS tools*. In: Rogatka, K. and Szymańska, D. (eds.) *Bulletin of Geography. Socio-economic Series*, 35, Toruń, Nicolaus Copernicus University, p. 111–122.