WEB-BASED GEOGRAPHIC INFORMATION SYSTEMS AS A PART OF SMART CITIES GOVERNANCE IN THE AGE OF GLOBALIZATION – A CASE STUDY

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Abstract. Globalization and good governance influence each other. Good governance can attract global activities. On the other hand, globalization can support an increase of the level of the governance. Good governance is a pre-condition for sustainable development at the regional, national, and global levels. Simultaneously, it is a component of the development of a society. Public administration authorities as governance bodies make many decisions. Most of the decisions are spatially oriented, i.e. they include a particular location. Thus, geographic information systems (GIS) are used as a tool for data processing. Web-based GIS systems are widely used as a tool offering an interactive presentation of spatial data to inhabitants. Some of the solutions can also allow citizens to take an active role, e. g. to submit some information like reporting faults in the city. These applications support several key attributes of good governance: participation, responsiveness, transparency, and accountability.

The case study provides an overview of how Web-based GIS are used by municipalities to inform or include inhabitants into public activities and affairs. Two former districts in the Pardubicky region, the Czech Republic, are chosen for the case study. These two districts consist in total of 227 municipalities. The number of inhabitants varies from 52 to 90 335 so both very small and large municipalities are included. The covered municipalities use five different commercial Web-based GIS solutions. The solutions are compared from the point of view of available functionality and a level of inhabitant involvement. Possible links to the size of cities are discussed. Some results are visualised by maps.

Keywords: smart cities, e-Participation, Web-based GIS, good governance

JEL Classification: R59, H83, D83

1. Introduction

Cities are very important for people. Globally, more people (55 % of the world's population) contemporary live in urban areas whereas only 30 % lived in urban areas in 1950 (World Urbanization Prospects, 2018). The contemporary aim of cities is to provide good living conditions for their inhabitants, meet their various needs (Kopackova, 2018), and further develop sustainably. Sustainable development is even perceived as an inclusive globalization (Gawor, 2008). Competitive Sustainable Globalization together with

Competitive Sustainable Manufacturing were proposed as a new approach to address both global and local aspects of contemporary challenges (Jovane et al., 2017). So, sustainable development is deeply connected to modern cities development planning as a specific issue (Williamsn 2010) and it can be used as a measure of the success of e-government (Kopáčková, 2017). Barbosa et al (2013) proposed a new model for evaluation of e-government performace with focus on social nature of it.

Nowadays, a concept of smart cities supports the sustainable development of modern cities. In general, innovative technologies, and new economic and social approaches represent key activities supporting smart cities development. Particular smart cities projects are very different, they focus on different aspects of the further development (Albino et al., 2015).

Many definitions of smart cities exist (Albino et al., 2015). They demonstrate complexity and scope of issues included in the smart cities concept. For example, Caragliu et al. (2011) defined a city to be smart when "*investments in human and social capital and traditional (transport) and modern (ICT) communication infrastructure fuel sustainable economic growth and a high quality of life, with a wise management of natural resources, through participatory governance*." Albino et al. (2015) concluded that the reason of the existence of so many definitions might be in describing two different kinds of domains. The first group represents hard domains, e.g. buildings, waste management, water management, energy grids, and transportation. Soft domains comprise the second group, e.g. social issues, governance, education, policy innovations. Information and communication technologies used in smart cities support information sharing and integration between government agencies and external stakeholders (e.g. citizens) which represents another important benefit (Pereira et al., 2017)

Batty et al. (2012) presented a typology of smart city functions, which represent various views, later on understood as components. The components include the smart economy, smart people, smart governance, smart mobility, smart environment, and smart living (Batty et al., 2012), (Albino et al., 2015).

All the components are spread in the city so space issues are very important. Smart cities need quality spatial data and geographic information systems to assure spatial intelligence (Roche, 2014), good services, good governance (OGC, 2015), and inclusion of citizens into public affairs (e-Participation). Vazquez-Burguete et al. (2016) suggested that citizens do not have enough knowledge about their role and smart cities concept itself. Zheng (2017) pointed out the importance of functionality of applications used to involve citizens in public affairs and increase citizens' e-Participation usage.

Smart cities can include citizens in data collection. Benouaret et al. (2013) proposed a crowdsourcing framework for a large-scale citizens participation. Panek and Benediktsson (2017) used emotional mapping to engage cyclists to express their emotional reactions to routes and places.

The main aim of the paper is to evaluate how Web-based geographic information systems (GIS) are used by municipalities to inform or include inhabitants in public activities and affairs. Two former districts in the Pardubicky region, the Czech Republic, are included in the case study. The solutions are compared from the point of view of available functionality. Possible links to the size of cities mentioned. Some results are visualised in a form of maps.

2. Web-based Geographic Information Systems as an e-Participation tool

Spatial information and spatially-oriented decision making have become an inevitable part of peoples' lives. Many spatial data is already available online. So, the importance of Web-based GIS is today indisputable. Desktop GIS applications provide too complex user interface with many functions. Their utilization requires appropriate skills and knowledge. The necessity of installation in a PC represents another disadvantage. Correctly designed Web-based GIS prevents a user to make mistakes because of his/her insufficient knowledge (Komarkova et al., 2007). Utilization of tablets and mobile phones as a client's device represents a contemporary trend, which corresponds to the smart cities concept. Another advantage of Web-based applications is that data are maintained by the publisher.

In many cases, the online presentations are interactive, in other cases, they still provide limited functionality. Importance of an adequate functionality was emphasized by Zheng (2017). A number of specific functions required by end-users of Web-based GIS applications is limited (Komarkova et al., 2011). They need to be able to zoom and pan (to move around their area of interest). Users usually need to control data visualization (to set, which data layers will be visible). Spatial and attribute database queries (i.e. searching according to location and/or attributes) and features identification represent the first group of analyses. Network analyses, like path optimization, belong today to the highly required functions but they are suitable just in adequate applications. Results saving, printing, and sharing is another group of required operations (Komarkova et al., 2011). Bugs et al. (2010) showed that Web-based GIS may support participatory urban planning. Importance of a careful choice of a suitable participation tool is pointed out by Afzalan et al, (2017).

3. Case Study

The case study covers two former districts in the Pardubicky region, the Czech Republic, namely Pardubice District and District Usti nad Orlici. These two districts consist in total of 227 municipalities. The city of Pardubice is the regional capital. It had 90 335 citizens by January 1, 2018. On the other hand, the smallest municipality was Holotin with 52 citizens. In total, there were 186 municipalities with less than 1 000 citizens, 31 municipalities with 1001 – 5 000 citizens, 9 municipalities with 5001 – 20 000 citizens by January 1, 2018. There were no municipalities with 20 0001 – 90 334 citizens (CSO, 2018). Terrain of the Pardubice District is mostly flat and there is a high concentration of industry. On the opposite, the Usti nad Orlici District covers mountainous areas and provides less urbanizes environment (BussinessInfo.cz, 2017).

In total, 95 of the covered municipalities used 5 different commercial Web-based GIS solutions as geoportals or map portals by March 20, 2018: Cleerio (https://www.cleerio.com/map-application/), Gepro (http://www.gepro.cz/produkty/geoportal-gepro-2/), GObec (https://www.gobec.cz/mapovy-server/), Marushka (https://marushka. geostore.cz/), and T-mapy (https://www.tmapy.cz/hlaseni-zavad). All the solutions provide zooming and panning. T-mapy solution is implemented only once and it is implemented in a specific form of fault reporting application so it is not fully comparable to the other solutions. Table 1 describes the basic functionality of evaluated Web-based GIS solutions. Evaluation is based on the visiting all Web sites of included municipalities, in detail on the following Web sites: https://maps.cleerio.cz/borek-pardubice, http://geoportal.gepro.cz/obce/574821#/,

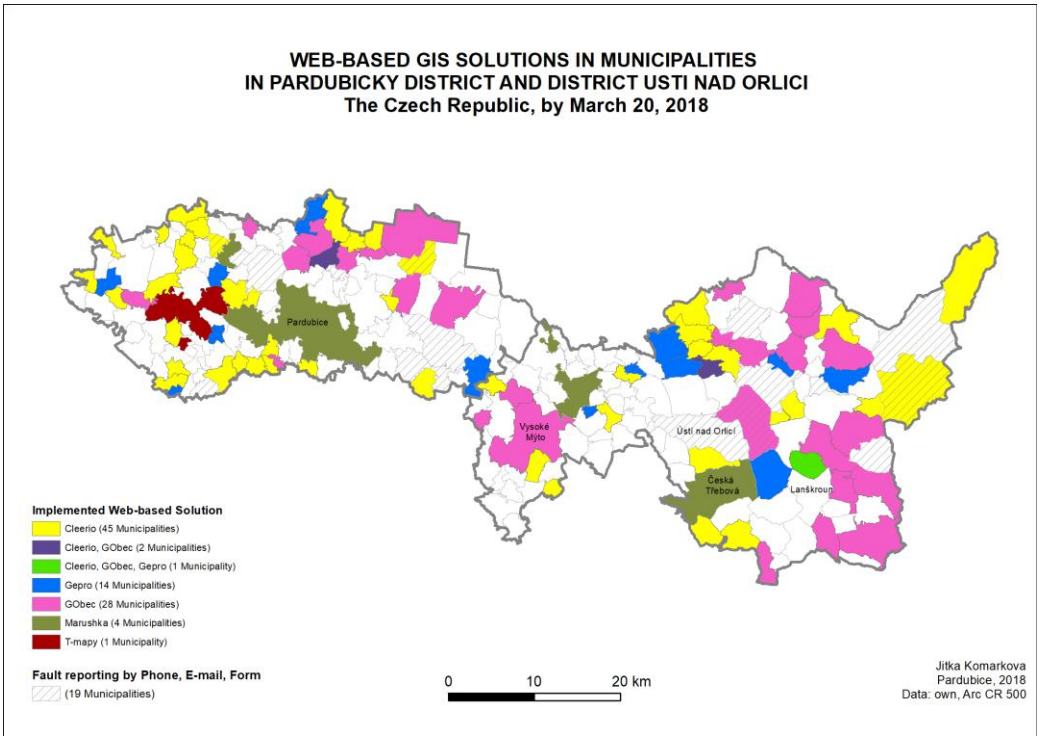
https://www.gobec.cz/dritec/, http://mapy.ceska-trebova.cz/marushkapublic/, https://hlaseni.tmapy.cz/#575500. As it can be seen from URLs, almost all Web-based GIS sites are run at the side of provider, not by municipalities themselves. Maruska is the only exception.

Table 1: Overview of Basic Functionality of Implemented Solutions

Solution	Turning Layers On/Off	Distance/area measurement	Coordinate information	Printing
Cleerio	Click on the layer name	Y	N	Y, choice of size, orientation, additional information available
Gepro	Checkbox	Y	Y	Y, choice of size, orientation, additional information available
GObec	Checkbox	Y	Y	N
Marushka	Checkbox	Y	Y	Y, choice of size, orientation, additional information available
T-mapy	Click on the layer name	N	N	N

N – not available, Y – available
Source: authors

Figure 1: Spatial Distribution of Utilization of Web-Based GIS Applications and Utilization of Phone, E-mail or Electronic Form to Report a Fault



Source: authors, based on data Arc CR 500 and own data

One of the functions, which may be very interesting for citizens, is fault reporting, e.g. public lighting failure, litter, or a hole in the pavement. Only three of the municipalities with Web-based GIS have implemented this functionality. Two municipalities offer a specialized mobile application. Out of these, the cities of Pardubice and Ceska Trebova offer both a specialized mobile application and electronic form. Fig.1 shows implemented solutions and it

points out municipalities, which still provided only phone, e-mail or electronic form for fault reporting by March 20, 2018.

4. Results and Discussion

Web-based GIS applications can provide an environment able to involve citizens in public affairs, i.e. to support e-Participation. Zheng (2017) pointed out that rich functionality supports citizens' involvement in public affairs.

The paper focuses on fault reporting functionality. The following ways of fault reporting are taken into account:

- Phone, E-mail, electronic form (PEF)
- Web-based GIS application, which allows location of the fault in the map (WebGIS)
- Mobile application (MA)

The evaluation is conducted at two levels. At first, all municipalities over 1 000 citizens in the Czech Republic are included. Next, all municipalities of the former Pardubice District and Usti nad Orlici District (highlighted by violet colour in Fig. 2) are included. Some of the municipalities have implemented more than one way so a sum of municipalities with different ways of fault reporting may be higher than the total number of municipalities.

Table 2: Ways of Fault Reporting in the Czech Republic in Municipalities over 1 000 Citizens

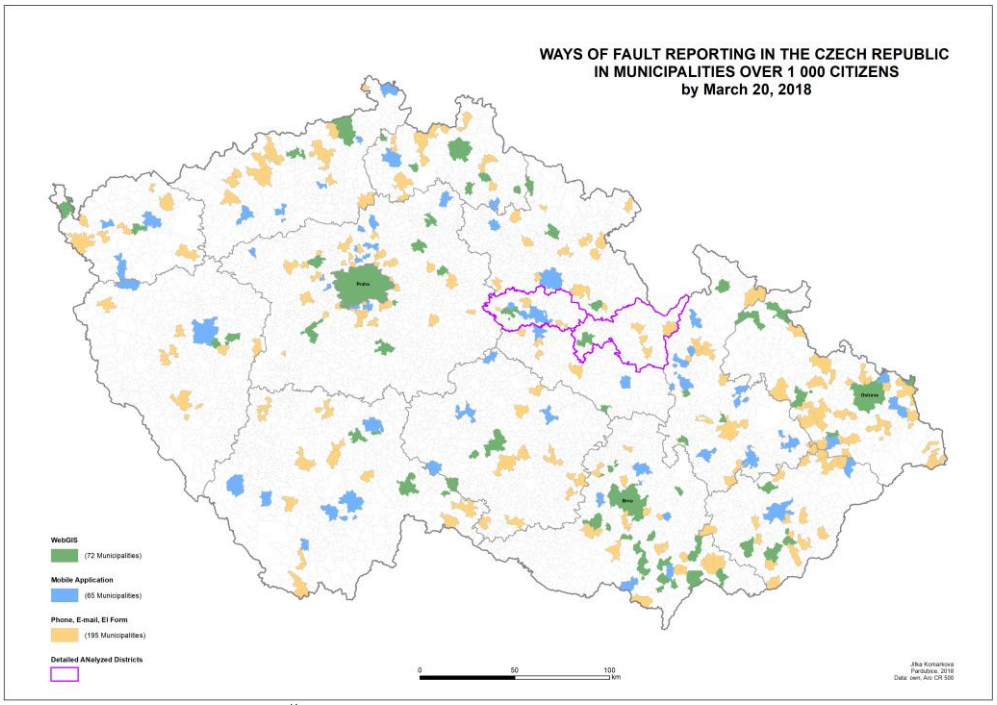
Number of citizens	1 000 – 5 000		5 001 – 20 000		20 001 – 50 000		Over 50 001	
No of municipalities	1170		212		44		18	
Fault Report	No	Share [%]	No	Share [%]	No	Share [%]	No	Share [%]
Nothing	998	85	101	48	16	36	0	0
PEF	126	11	65	31	19	43	16	89
WebGIS	31	3	29	14	6	14	6	33
MA	21	2	25	12	11	25	8	44

Source: authors

Table 2 reveals that larger cities are more interested in providing more tools for citizens to allow them participation in public deals. Mobile applications have become popular. Some cities have their own application (e.g. Brno), more of them use "general" applications like "Dej tip" or "V OBRAZE".

Table 3 describes results for the two districts. The only city over 20 000 citizens is the city of Pardubice (90 335 citizens). It offered both phone and a mobile application reporting. The last line of the table shows number of Web-based GIS used as a general-purpose geoportal.

Figure 2: Ways of Fault Reporting in the Czech Republic in Municipalities over 1 000 Citizens



Source: authors, based on data Arc ČR 500 and own data

Table 3: Ways of Fault Reporting in the Pardubice District and District Usti nad Orlici in All Municipalities

Number of citizens	0 – 100		101 – 500		501 – 1000		1001 – 5000		5001 – 10000		10001 – 20000		Over 20 000	
Number of municipalities	12		120		52		31		5		3		1	
Fault Report	No	[%]	No	[%]	No	[%]	No	[%]	No	[%]	No	[%]	No	[%]
Nothing	12	100	116	97	48	92	24	77	1	20	1	33	0	0
PEF	0	0	3	3	3	6	7	23	3	60	2	67	1	100
WebGIS	0	0	1	1	1	2	0	0	1	20	0	0	0	0
MA	0	0	0	0	0	0	0	0	0	0	1	33	1	100
WebGIS – general app	3	25	50	42	26	50	10	32	3	60	2	67	1	100

Source: authors

Implementation of this kind of services has started and number of available Web-based solutions and mobile applications is increasing. It is now important to focus on the quality of applications as pointed out by Simonova and Novak (2016).

5. Conclusion

Globalization can promote good governance as showed Asongu (2017). Good governance can improve the conditions of life of people in cities. Globally growing population requires a high quality of life. Web-based GIS applications can provide an interactive online tool to

publish spatial data and provide information to citizens and tourists. These applications can be used as an interactive tool to involve citizens into public affairs and local governance.

The paper describes the utilization of Web-based GIS as a tool for fault reporting. It provides two levels of view. At first, municipalities of the Czech Republic with more than 1 000 citizens are included. Next, all municipalities of the Pardubice District and District Usti nad Orlici are included. Utilization of Web-based GIS is increasing. It has become a part of Web sites of many cities and even small municipalities as far as ready-made solutions are provided and hosted by service providers, which take care of base data as well. Municipalities do not need to employ a skilled administrator and own a necessary hardware and software. Additionally, popularity of mobile applications increases along with availability of suitable applications as it can be seen from the data.

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