Original article

THE ROLE OF PROGRAM MANAGEMENT IN THE SMART CITIES DEVELOPMENT PROCESS

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Abstract: The aim of this paper is to present the basic charachteristics of smart cities and the way in which program management application can contribut to the process of smart cities development. Through theorethical background of smart cities concept the main factors that are nessesary for success of smart cities are being highlighted. On the other hand, through the presentation of program management it is stated in which way this managerial concept can contribute to smart cities development. The main conclusions of the paper are based on the analysis of projects and programs of the most developed smart cities in Europe. The research results of this paper presents the basics for further analysis, accompanying the evolutionary progress of this concept and the application of program management as a managerial concept relevant wich can contribute to smart cities development.

Keywords: Program management, projects, smart cities.

1. INTRODUCTION

Since the industrialization, there has been a sharp increase in the number of cities in the world, which is confirmed by United Nations data from 2016, even 54.5% of the world's population lives in urban areas with a tendency to increase up to 60% by 2030 (United Nations, 2016). Based on International Project Management Association (IPMA) research, it is projected that the world population until 2050 is expected to be around 10 bilions, and almost 80% will live in cities. Already at this moment, 60% of energy is consumed and 70% of waste is produced in cities, which in total represents a significante risk for cities and their development IPMA, 2018).

Recently, many cities are increasingly using technology to improve the quality of life of their citizens and develop the smart city. There is an increasing number of global conferences on this topic are organized: Smart City Exbo World Congress i IEEE International Smart Cities Conference organized in the past six years.

In addition to conferences on this topic, many scientific studies have been conducted showing that: a) smart cities need to be on the functintional at first, b) solutions made by smart cities are an integrated solution that encompasses multiple segments, c) initiatives in one segment of society should not create problems in the second segment, d) urban development should be initiated by the state and that e) citizens have a significant role in urban development (Anttiroiko, et al., 2014; Batty, 2013; Priano, & Guerra, 2016; Yeh, 2017).

What characterize smart cities are a series of changes in different segments of society: social, legal, economic, technological aspects, public administration, organizational,

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infrastructure segment, transport and mobility, environment (natural resources and energy) (Ramaprasad, et al., 2017). Given the fact that changes in these segments cannot be implemented by a single project but by a series of projects, and that all projects involve a number of participants who must cooperate with each other, there is a need to use an appropriate management approach.

Program management includes managing projects aimed to one joint goal. Implementing multiple projects is actually inevitable when it comes to urban development, where each project makes one type of contribution, but is an integral part of a broader puzzle that cannot be completed without a connection to other segments.

2. SMART CITIES

The development of a city is increasingly observed through the level of digitalization and modernization (Jucevičius, 2014). Digitalization is the process of using technologies to improve the usage of information as a main asset and digital business (Ringenson, et al., 2018), while modernization represents the transition from traditional to modern society and forms a link between the current and future state of development (Jong, et al., 2015).

There are several definition of smart city, but all of then include *Internet of Things* (Perera, et al., 2014; Zanella, et al., 2014).

Smart cities can be defined as the effective integration of the physical, digital and human systems into the built environment with the aim of creating a sustainable and prosperous future (BSI, 2014). According to another definition, smart cities use information and communication technologies to increase operational efficiency, availability of information and quality of government services and people (Liotine, et al., 2016). The same authors believe that by applying technologies, things acquire characteristics similar to human behavior in order to properly meet the needs of people and improve the quality of life of citizens.

Certain authors, through their definitions of smart cities, emphasize sustainability and effectiveness, i.e. the ability of solutions to function after implementation and the extent to which solutions are focused on the needs of citizens. (Forcan, et al., 2016; Ibrahim, & Morsy, 2016; Mundula, & Auci, 2016). Smart cities aims to implement as many initiatives as possible based on the use of Internet and communication technologies and thus contribute to the development of cities (Dameri, 2017). The concept of a smart city has a multidisciplinary character, but the focus of all definitions are the needs of construction and application of technologies for these purposes. (Batty, et al., 2012; Nam, et al., 2011).

According to the above definitions, the characteristics of a city to be considered smart are: smart governance, smart economy, smart construction, smart mobility, smart citizen life, smart agriculture, smart health, internet and open data.

2.1. Smart cities: Examples

Research studies are focused on the analysis and classification of cities according to different criteria - technological achievements, attitudes and the degree of involvement of citizens in the entire system, the way of governance etc. In Europe, among the most developed smart cities are Amsterdam, Barcelona, London, Copenhagen, Stockholm. At the global level among the top ten of smart cities are Seoul, San Francisco, New York, etc. In the following text of the paper, we will present several cities in Europe that have the status of the most developed smart cities over the years.

2.1.1. London

London is the technology center of Europe with over 46,000 companies from the IT industry and the IT world and the main headquarters of many innovative programs in the field of digitalization of public administration, health, finance, transport. The Smart London plan was launched in 2013 at the initiative of the Greater London Authority (GLA). The plan was established with the aim of implementing technology in the everyday life of citizens, improving urban development and the economy (GLA, 2013).

London has been considered as the one of the most developed smart cities in the world, with a series of innovative projects based on modern technologies. An example of such a project is the construction of a Datastore platform that contains various data about the city and has open access for all citizens. The platform, since its establishment, has been used by more than 50 thousand different users for various analyzes, establishment of policies and rules, as well as numerous other activities. The project was awarded by the International Open Data Institute for a leader in local and regional open data in 2015.

In addition, there is a number of projects related to environmental protection. One of the most serious projects is the Heatrow pods project, which focused on the transport and involves deployement of small cars without drivers. One of the projects is Innovative18, which involves upgrading new metro stations using new technologies to enable a new way of using metro stations enabling the transport of 1.5 million people in just 45 minutes.

2.1.2. Barcelona

Barcelona was among the first in the world to introduce a new evolutionary system of smart cities 3.0. This system is a combination of the systems, 1.0. and 2.0. The system 1.0. it is mostly used in South Korea and is a technology-driven system. Smart City 2.0. is focused on the needs of citizens and the state and is becoming more and more represented lately.

The smart city development plan is led by the state and refers to the digital infrastructure, to solve the key problems of the citizens. The plan seeks to establish a digital infrastructure base to improve the functioning of the city in the areas of health, energy, transport, realestate etc. (Ruiz, 2017). Typical projects with the most effects are Wi-fi routers for free internet, air quality sensors, smart street poles, bicycle rental system, smart parking system, smart garbage cans, smart sensors in water parks, etc. The most significant effects or improvements were achieved in the field of energy consumption, water, waste management, environmental protection and citizens' life standards.

2.1.3. Copenhagen

Copenhagen is one of the most important cultural and political centers in Europe, which has been on the list of cities with the best quality of life and is the leader of the green city, due to the initiatives to reduce the presence of carbon monoxide. The main goals of this city are focused on the social and environmental aspect through projects in a clean and healthy city, increasing green areas, encouraging the use of bicycles as a means of transporting, organic food and a healthy lifestyle. The most important projects are related to the application for renting bicycles for transportation, construction of bicycle paths, construction of a special model of bicycle (in cooperation with the MIT Institute), construction of parks, etc.

The city implements many projects in cooperation with companies, research centers and universities. The Copenhagen Solution Lab (CSL) incubator has been established to enable new technology development for the purpose of innovative solutions. Similar to London, the Copenhagen Connecting platform for digital infrastructure has been established, presenting a real-time database as the basis for development.

What is common for all three presented cities is the great involvement of the state administration in the process of creating a smart city. Copenhagen has received many awards in the past few years. CNN declared it the healthiest city in the world in 2014 and received the status of European green capital the same year by the European Commission.

3. PROGRAM MANAGEMENT

International standard ISO 21503 defines a program as a temporary structure of several components (projects) that are jointly managed in order to achieve a joint effect and contribute to the achievement of strategic goals and other benefits. (ISO, 2017). The program management enables management, administration, synchronization and realization of several projects that are interconnected and have the same goal. Projects serve to get a particular job done, while the role of the program is to achieve a common goal and achieve benefits. According

to the definition of the Project Management Institute (PMI), a program is a group of projects that have a common goal (PMI, 2017) The program is also seen as a separate organization with its own structure, resources, processes and goals and which as such functions independently to achieve its goals (Kwak, & Anbari, 2009).

The paper specifically deals with the topic of application of program management in the process of smart city development. Program management includes the phase of preparation and definition of the program, program goals, defining the time frame of required resources and costs and analysis of the expected effects of the program, to make a decision on the justification of the program (Schipper, & Silvius, 2018). Planning of time and resources for each project, summarizing plans in a central place, consolidation of plans into a program plan, analysis of potential conflicts between projects (especially resource), decision making, revision of project plans, project implementation, monitoring and program control, are the following steps (Gareis, 2005).

4. THE APPLICATION OF PROGRAM MANAGEMENT IN SMART CITIES DEVELOPMENT

Program management generally involves the following phases, which can be applied in the smart city development process (Gareis, 2005; Milosevic, et al., 2010; Schipper, & Silvius, 2018;):

- Program preparation and planning - The first phase is related to program preparation and creation. At this stage, it is necessary to select projects that contribute to the program goal. The preparation phase includes the assessment of the feasibility of the program, (the preparation of a feasibility study), to provide the financial and national evaluation of the program, as a set of projects and an assessment of long-term effects of projects and the sustainability of the solutions. The next phase is the planning phase: specific objectives and project's results, the plan of activities, key responsibilities, resources, milestones, and budget for the execution of the program are defined, determined by the project managers, project teams and the program manager. Depending on who is the initiator and owner of the program, the organizational structure and the governance system should be defined.
- Implementation and monitoring - Project managers together with project teams work on the realization of their individual projects, make decisions related to their projects and monitor development processes. The role of the program manager at this stage is to coordinate all project managers and projects that make up the program in order to achieve the goal of the program. In this stage, the monitoring system should be established: key performance indicators for each result, targeted values, frequency of monitoring, responsible person, reporting etc.
- Integration and program closer - In the final phase, mutual integration is necessary in order to control the achieved results and enable the use of the final solution. In the case of smart cities and their projects, the program is often not fully completed since there are projects aimed to improve the existing solution are often launched. In any case, each of the projects must be integrated into the existing system.

Organizing the implementation a program is more complex than organizing a single project. The implementation of several projects in the same time period, with overlapping resources, and tracking the contribution of individual projects to the program's goal, makes the program management process more complex. The organizational structure of the program consists of the projects, the program ownership team, the program manager, the program team and the program bureau, depending on the program management approach. From the city perspective, each individual city development project has a project manager and project teams that work specifically on a given project. However, when it comes to higher hierarchy level in the

organizational structure, there are no specific structures that are the same in all smart cities and depend a lot on the size of the city, the city management system, the economic situation, technical support, etc. (Bjørner, 2018). If the state or city government has a leading role in the process of city development, the organization comes from the state, which can form its own organizational units for the preparation, planning, implementation and monitoring of programs (Carta, 2012; Chigona, et al., 2010).

There are two recognized challenges in smart city development process: financing and the involvment of a broader audience. Based on the examples of cities around the world, it can be concluded that the sources of funding are numerous (state, public-private partnerships, various funds, donors). The second challenge relates to the involvement of key stakeholders in the program implementation process to provide them with monitoring activities and results of control and evaluation of projects within the program.

Based on the examples of the most developed smart cities in Europe, a typical example of the program is the program in Copenhagen where there are projects that are largely related, such as the bicycle project as the main means of transport, the construction of a bike path and the design of a special bicycle model. In London, projects related to the metro station are also part of the program, as they involve several initiatives at the same time that contribute to one common goal. According to the Horizon 2020 survey published in IPMA (2018), the goals of smart city projects and programs in the most of the cases are: development of an open data platform for citizens; an open platform for services to citizens, empowering citizens to access data, creating an impact on the city.

5. SMART PROGRAM MANAGEMENT

Given the basic characteristic of smart cities, and that is the application of new technologies and digitalization, certain authors believe that for the development of a smart city we need „smart program management“ (Bohli, et al., 2015; Maritz, 2017; Obradović, Montenegro, & Bjelica, 2018). By introducing the concept of "smart" whether it refers to cities or the way of management, we are achieving agility and sustainability at the same time. In addition to effectiveness, according to Ibrahim and Morsy (2016), sustainability is a key element of a smart city, while the application of new technologies and its incorporation into existing segments requires significant agility. In today's world, these two concepts are becoming indispensable and complementary (Obradović, Todorović, & Bushuyev, 2018).

The smart version of project and program management relies on new technologies that should enable constant access to information and a holistic approach to goals. Constant access to information in the team is necessary for decision making and actions on the project within the program. Today's technology development allows the usage of data applications that users can have on their phones. The aim of using technology for these purposes is certainly to establish and maintain collaboration within the program and effective communication. The holistic approach to the program goal is extremely important, because the projects of smart cities should contribute to its development and as shown in the examples, they contribute to a program goal.

6. CONCLUSION

Based on the above, it can be concluded that the application of program management concept can contribute to better results of the smart city development process, in the segment of setting the program concept, harmonization with strategic city goals, state policy, defining program goals and determining projects to be implemented. Further contribution of this concept is in the processes of planning, implementation, control and evaluation of the program. On the other hand, the feature of smart cities is modernization, application of technologies and digitalization. This further creates the need to improve the way of management and create a “smart” management, or an improved version of the existing concept so that projects and programs of the smart city can be managed.

Innovation projects and a smart city development program involve many stakeholders, from cooperants to the citizens as beneficiaries, which makes them complex

and creates the need for a systematized way of management. Based on the abovementioned successful examples of London, Barcelona and Copenhagen, it can be concluded that they implement a large number of programs in their practice. The key challenges in managing a smart city development program are funding and citizen satisfaction as well as all other stakeholders.

The paper presents a theoretical presentation of the concepts of smart cities and program management and presents conclusions about the purpose and advantages of applying a systematized way of management, in accordance with the development trends of the urban environment. The results of this paper provide the basis for further analysis of smart cities, following the evolutionary progress of this concept and the application of program management as a concept that can contribute to the development process of smart cities from the management aspect.

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