Trends in the application of the concept of smart cities in the Western Balkan countries

Trendovi u primeni koncepta pametnih gradova u zemljama Zapadnog Balkana

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Abstract: The concept of creating smart infrastructure, as well as the use of available resources and potentials leads to the idea of creating smart cities. The development of this concept implies the implementation of development trends related to life in the cities of the Western Balkans, but also the development of unique solutions that will assimilate development trends and enable their availability and use by citizens living in the city, which is the basic hypothesis of this research. The subject of this paper includes data collection through a survey of employees in various city administrations in Belgrade, Nis, Kragujevac, Trebinje, Podgorica, Herceg Novi, Skopje, analysis of collected data, and making unique conclusions and solutions to the survey. The aim of this paper is to point out the importance and significance of the concept of smart cities on the basis of relevant literature and available indicators obtained by the research, and to determine the extent to which it is implemented in urban administrations in the Western Balkans. The results of the research indicate that despite the cities in which significant progress is noticeable in the implementation of strategic solutions of smart cities, there are still noticeable problems in their implementation in the Western Balkans.

Keywords: smart cities, Western Balkans, infrastructure.

Sažetak: Koncept stvaranja pametne infrastrukture, kao i korišćenje raspoloživih resursa i potencijala dovodi do ideje stvaranja pametnih gradova. Razvoj ovakvog koncepta podrazumeva implementiranje razvojnih trendova koji se tiču života u gradovima zemalja Zapadnog Balkana, ali i razvoja jedinstvenih rešenja kojim će se asimilirati razvojni trendovi, te omogućiti njihova dostupnost i upotreba od strane građana koji žive u gradu, a koji je i osnovna hipoteza ovog istraživanja. Predmet istraživanja ovog rada obuhvata prikupljanje podataka putem ankete zaposlenih u različitim gradskim upravama u Beogradu, Nišu, Kragujevcu, Trebinju, Podgorici, Herceg Novom, Gradu Skoplje, zatim analizu prikupljenih podataka, te donošenje jedinstvenih zaključaka i rešenja sprovedenog istraživanja. Cilj istraživanja ovog rada je da se na osnovu relevantne literature i dostupnih pokazatelja dobijenih istraživanjem ukaže na važnost i značaj koncepta pametnih gradova, zatim utvrđivanje u kojoj je meri isti implementiran u gradskim upravama zemalja Zapadnog Balkana. Rezultati istraživanja ukazuju da i pored gradova u kojim je primetan značajan napredak primene strategijskih rešenja pametnih gradova, i dalje postoje uočljivi problemi u njihovoj realizaciji u zemljama Zapadnog Balkana.

Ključne reči: pametni gradovi, Zapadni Balkan, infrastruktura.

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INTRODUCTION

If we look at the last period of time, we can see that the concept of city management called "smart cities" is increasingly prevalent. This topic is covered in different journals on a daily basis (Fernandez & Danuta, 2016).

The research subject of this paper includes data collection through a survey of employees in various city administrations in Belgrade, Niš, Kragujevac, Trebinje, Podgorica, Herceg Novi, Skopje, then analysis of the collected data, and the adoption of unique conclusions and solutions of the conducted research.

The aim of the research of this paper is to point out the importance and significance of the concept of smart cities, based on the relevant literature and available indicators obtained through the research, then determine the extent to which it has been implemented in city administrations in the countries of the Western Balkans.

1. DEFINING THE CONCEPT OF SMART CITIES AND ITS CHARACTERISTICS

Regardless of the enormous challenges and disadvantages associated with urban agglomerations, the world's population is constantly concentrated in cities. What is the source of urban growth and sustainable urban development? This question has received constant attention from researchers and policy makers for many decades. Cities around the world show complex dynamics of progress (Caragliu et al., 2009).

If we want to define a "smart city", there is no specific, universal definition, but there are certain parameters that cannot be bypassed, and they concern a better quality of life, a development path that is sustainable, but also the level of ensuring efficiency. Apart from the fact that "smart city" implies the improved application of public services, it also implies the integration of citizens in decision-making (UCLG, 2020). The "Smart City" represents a turning point in the evolution of the urban reform movement around the world (Masik et. al, 2021). The first examples of the implementation of this concept are the cities of Amsterdam, Barcelona, Helsinki and Vienna (Mora et al., 2019).

The cases in which the city becomes smart refers to the access to the abundance of energy, resources and health, based on a process in which there is strategic decision-making, independence, innovation and awareness of citizens (Kubina et al., 2021). A large part of this concept is the notion of sustainability, which primarily refers to the preservation of natural resources that are increasingly depleted by the increase in the urban population. This means ecological, economic and social dimensions (Toli & Murtagh, 2020).

There is also the possibility of considering the definition of a "smart city" from the point of view of using information and communication technologies for the purpose of improving cities and improving the opportunities to live in them: "a smart sustainable city is an innovative city that uses information and communication technologies (ICT) and other means to improve quality of life, efficiency of urban operations and services and competitiveness, while ensuring that it meets the needs of current and future generations while respecting economic, social and environmental aspects' (Mohanti & Choppali, 2016).

Under "smart city" in the United Nations Development Program (UNDP) is defined the use of technologies that are new in order to ensure inclusive, sustainable urban development, taking into account people, the economy and the environment. Achieving a sustainable, inclusive and efficient mobility system for goods and people is the overall challenge to be addressed in the smart mobility action area. The implementation of a multimodal public transport system, fostering alternatives to car-based mobility and making public transport accessible to all citizens are the three main axes that will enable the reduction of congestion and pollution in cities and the improvement of connectivity (Glasmeier & Christopherson, 2015). Finally, the development of a "smart" city refers to the need for the public sector to partner with the private sector, as well as with non-profit entities.

These are partnerships that can encourage innovation and make risk management more flexible (Nasution et al., 2019). Observing economically developed countries, we can see that private and public partnerships often appear together in the course of history (Vujić et al., 2021).

A casual web search reveals thousands of references related to the said term. Many analysts and practitioners, however, are more modest in their definitions, limiting "smart city" to a few approaches that use publicly available data to solve discrete problems, such as waste management and traffic control. The authors have different perspectives, but they define a smart city by two essential attributes. First is the use of technologies to facilitate the coordination of fragmented urban subsystems (e.g. energy, water, mobility, built environment). Becoming "smart" by improving subsystems is assumed to be associated with new employment opportunities, wealth creation and economic growth. While

the second, more futuristic definition, defines smart cities as urban places where there is an experience that enables the removal of negative aspects and the formation of a new reality. Most smart cities deal with getting things right by adding off-the-shelf technology to existing functions such as transportation planning to make existing systems more efficient, predictable, and, in rare cases, redeployable with reprogramming (Monzon, 2015).

The need and concept for the development of smart cities is based on the fact that the number of inhabitants living and working in cities in a large number of developed countries is increasing, which results in pressure on the politics of a local character and on the development of its infrastructure (Paliaga & Oliva, 2018). The result of applying the concept of smart cities enables cities to be extremely competitive and to attract tourist visitors and improve the lives of their residents through the improvement of their infrastructure (Dejanović et al., 2018). In the middle of the 2000s, cities were populated, which led to the need for improvement and technological development. Living in cities causes citizens to be supplied with resources in the form of clean water, an abundance of healthy food and energy.

The limits of agreement around the concept arise in part because, as in previous moments when the rate of economic growth has faltered, economic actors are looking for new markets to apply existing technology. They create a synthesis of activities that will start a continuous cycle of job creation and capital investment.

If we look at the definitions of the smart city concept, the most important features are:

- smart economy;
- smart mobility;
- smart environment;
- smart people;
- smart life, and
- smart management (Moura et al., 2019).

A smart economy implies a merger of the private and public sectors, a flexible market, adaptation to changes and international cooperation. Challenges in the field of smart economy are related to the productive structure of the city. After the economic crisis, urban regions realized the convenience of not focusing their production model on only one economic sector. Improving the creation of a multi-sector economy would make cities more resistant to economic downturns, exploiting the unique conditions of each urban agglomeration within a certain region and interconnecting their production networks can improve this resistance.

Smart mobility is reflected in access to information and communication infrastructure, through the development of sustainable, innovative and safe transport.

Smart environment refers to the attractiveness and preservation of the natural environment, pollution levels, ecological activities, as well as methods of smart and sustainable resource management.

The concept of "smart people" implies an educated population with a tendency to lifelong learning, social and ethnic diversity and mutual acceptance of these differences, creativity, openness and active participation in public life. Avoiding urban sprawl and seeking denser cities and more livable cities will improve the mix of uses and population concentration, reducing car use. On the other hand, reducing energy consumption, pollution and CO_2 emissions is a growing environmental demand for achieving sustainable development.

Improving social cohesion and quality of life are the main challenges to be faced in the Smart People action area.

Smart life implies the existence and visiting of cultural institutions, it refers to living conditions (health, safety, housing), educational facilities, tourist attractions and social cohesion.

Smart management is expressed through the transparency of city management, population participation in decision-making, the level of public services and the implementation of development strategies (Schipper & Gilbert Silvius, 2018).

The strategies needed to develop smart cities should consider the use of sustainable technologies. In order for a technology to qualify as a "sustainable technology", these solutions must have the following characteristics, in addition to the existing requirements and constraints (e.g. economic viability):

- minimal use of non-renewable energy sources and natural resources;
- satisfying human needs while respecting natural and cultural heritage;
- minimal negative impact on the Earth's ecosystem (Joshi et al., 2016).

Smart cities rely on smart infrastructure. The key components of smart city infrastructure are: smart buildings, smart mobility, smart energy, smart water, smart health smart digital layers and smart waste management (Latinović, Jovanović, 2019). Abundant community life is the ultimate goal, and in order to achieve this it is necessary to take initiatives to address the high level of unemployment in cities, as well as to use demographic trends and the mix of the population in order to create opportunities for inn-

ovation, taking into account all citizens regardless of their age, gender, culture or social status. The main challenges in this area relate to housing, health conditions and the crime situation. These three aspects, together with the social cohesion of the population, are the main issues that make the difference that a city can talk about a good quality of life (Munitlak Ivanović, 2020).

Smart city projects must be multidimensional and must integrate different fields of action of the city, in interaction with human and social capital. Technological solutions must be understood as a tool to achieve the goals of a smart city and to face the challenges that cities have to face. The main goals of "smart city" projects must be to solve urban problems in an efficient way in order to improve the sustainability of the city and the quality of life of its inhabitants. From a governance point of view, projects must be framed in multi-stakeholder partnerships at the municipal level to ensure complex and effective solutions (Kitchin, 2015).

The main requirement for smart city projects must be to address the real challenges that cities will face in the future.

2. RESEARCH METHODOLOGY

The research methods used in this paper are analysis and synthesis methods, specialization methods and sample comparison methods.

The survey included 191 persons employed in the Belgrade Traffic Secretariat, the City Administration of Niš, the City Administration of Trebinje, the Administration of the Capital City of Podgorica, the City Administration of Kragujevac and Herceg Novi, as well as the City Administration of Skopje. Respondents from the Republic of Serbia have the largest share, at 35%, while respondents from Podgorica, Republic of Montenegro, have the smallest share, at 5.8%.

The basic instrument of the research refers to a survey questionnaire that includes closed-ended questions. The author, for the purposes of this work, created a questionnaire. After creating the questionnaire, a certain number of answers were formulated according to the Likert scale.

The research for the purposes of this paper was carried out in June 2021. The research included a survey of employees in city administrations: the Secretariat for Traffic in Belgrade, the City Administration of Sarajevo, the City Administration of Niš and Trebinje, the Administration of the Capital City of Podgorica and the City Administration. Kragujevac and Herceg Novi, as well as the City Adm-

inistration of Skopje. The completed questionnaires were forwarded to the respondents online. They were informed that there is a possibility of opting out of participation in it. Also, the respondents were informed that the obtained data will not be used for other purposes, except for research purposes for the purposes of this paper. When the data were collected, they were analyzed.

The basic hypothesis from which this work is based: The application of the concept of smart cities is proportional in the analyzed cities of the Western Balkans.

The ch² test was used to analyze the collected data and to verify the accuracy of the hypothesis. The ch² test belongs to the group of non-parametric statistical techniques, which are ideal in cases where we have data measured on nominal (categorical) or ordinal scales (whose amounts can be ranked). These techniques are also useful when the sample is small or when the data do not meet the strict requirements of parametric techniques. The ch² test is used to investigate the relationship between two categorical variables. Each of them can have two or more categories. The test compares the frequency or proportion of cases observed in each of the categories with the values that would be expected if there was no relationship between the two variables. It is based on a cross table, that is, a table in which the categories of one variable are crossed with the categories of another.

Since, due to the large number of categories of variables that were the subject of the analysis, the assumption of the minimum number of respondents in each cell was violated, the attitude scale was summarized so that respondents who answered "do not agree at all" and "partially disagree", "agree se" are classified as "disagree", while respondents who answered "mostly agree" and "strongly agree" are classified as "agree". For variables for which it was not possible to perform the ch² test due to disturbed assumptions (not related to the attitude scale), cross-tabulation was applied.

3. RESULTS AND DISCUSSIONS

In the continuation of this work, the obtained research indicators are presented in a graphical and tabular manner. To the greatest extent, the method of description was used to analyze the structure of the sample of respondents.

Graph 1 shows the gender structure of the respondents, so we can conclude that (62.30%) men participated in the survey, while women participated (37.69%).
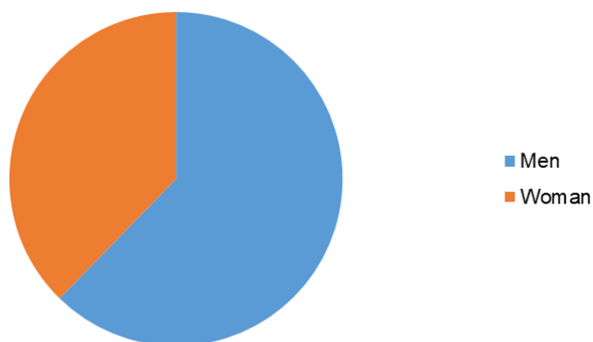
Graph 1 - Gender structure of respondents
Source: Authors

When it comes to project financing and respondents' familiarity with it, out of the total number of affirmative answers, the most respondents are from Herceg Novi (29.73%) and Trebinje (27.03%), while the smallest percentage is from Podgorica. Unfortunately, there is a significantly larger number of respondents who are not familiar with the method of financing smart city projects in their city, so we have the situation that this answer was mostly given by respondents from Belgrade (20.0%), followed by respondents from Herceg Novi (17.50%), as well as from Skopje (16.25%) (Table 1).

In Table 2, a cross-tabulation of respondents' answers from all observed cities is shown in relation to whether the general public in their city has a transparent insight into who finances smart city projects. From the above, it can be concluded that the respondents from Herceg Novi (39.29%) and Belgrade (28.57%) have positive attitudes about the examined issues, while the respondents from other cities opted for such an attitude to a lesser extent. Respondents who stated that they were not familiar with the above were mostly from Belgrade (17.65%), followed by Herceg Novi (16.47%), as well as from Trebinje and Skopje (15.29%).

With the next question, we wanted to get information on whether the surveyed persons are familiar with the advantages provided by the application of the concept of smart cities. Respondents were offered answers related to the improvement of services for citizens and the economy, cost reduction, indirect benefits and new revenues. The largest percentage of respondents (47.1%) sees the benefits of implementing projects related to smart cities in the reduction of costs (saving resources), then in the improvement of services for citizens and the economy (37.3%), as well as in indirect benefits related to inclusion of citizens, quality of life, health of citizens, etc. (11.8%). The smallest percentage of respondents believes that these projects can contribute to economic growth (3.9%) (Table 3).

Table 1 - Cross table of the cities with the question "Are you familiar with how projects are financed?"

Sity	Yes, totally	I am not familiar with the above	I'm not sure	In total
Sity of Belgrade	9	16	4	29
Niš	3	10	7	20
Kragujevac	8	8	2	18
Trebinje	10	9	2	21
Podgorica	1	3	7	11
Herceg Novi	11	14	3	28
Skopje	2	13	9	24
In total	37	80	36	153

Source: Authors

Table 2 - Cross table of the cities with the question "Does the general public have a transparent insight into who finances smart city projects?"

| Sity	Exists	I am not familiar with the above	No one	In total
City of Belgrade	8	15	6	29
Niš	3	13	4	20
Kragujevac	5	10	3	18
Trebinje	5	13	3	21
Podgorica	1	4	6	11
Herceg Novi	11	14	3	28
Skopje	2	13	9	24
In total	28	85	40	153

Source: Authors

Table 3 - Cross table of the cities with the question "Do you have any knowledge about the implementation of projects, as well as their final outcome?"

Sity	I have	I am not familiar with the above	I don`t have	In total
City of Belgrade	3	10	16	29
Niš	6	3	11	20
Kragujevac	6	8	4	18
Trebinje	9	4	8	21
Podgorica	1	3	7	11
Herceg Novi	10	9	9	28
Skopje	6	7	11	24
In total	56	60	75	153

Source: Authors

With the next question from the questionnaire, we wanted to get information on whether the respondents believe that the advantages realized by applying the concept of smart cities will speed up their wider application in the coming period. We can see the results in graph 2.
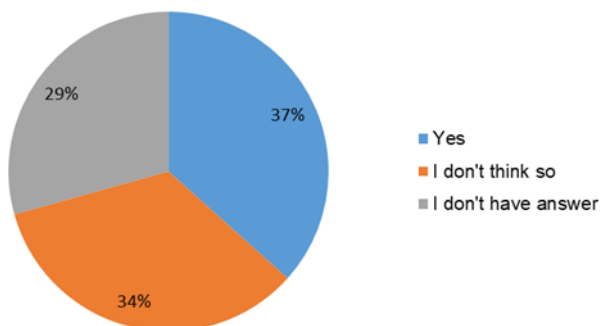
Graph number 2 - Do you think that the advantages provided by the concept of twin cities will speed up its application in the coming period?
Source: Authors

Respondents believe that the application of the concept of smart cities in the coming period will have an accelerated growth, namely (36.64%), persons who believe that the mentioned advantages will not accelerate its application are (34.03%), while (29.31%) have no answer to the said question.

CONCLUSION

The concept of developing the idea of smart cities implies the application of different approaches, that is, the use of technology that solves specific problems of an urban nature. Its application is conditioned by monitoring the existing disparities and their adequate resolution in accordance with the needs of the local population. Some cities are involved in the very process of introducing certain smart solutions, while others are already implementing them.

The results of the research indicate that citizens are not well informed when it comes to project financing, that is, there is a significantly larger number of citizens who are not familiar with the way of financing smart city project solutions in their city. Then, there is a significantly higher number of positive responses related to the question of whether the general public in their city has a transparent insight into who finances smart city projects, i.e. respondents from Herceg Novi (39.29%) and (28.57%) have positive attitude on the said issue. Respondents gave a significantly higher number of negative answers about being informed about the final outcome of the project's implementation, i.e. (39.3%). The obtained indicators show that respondents who live in Belgrade, Kragujevac, Trebinje and Herceg Novi have the most information related to smart city projects that are implemented in their city, while this is not the case in Podgorica, where citizens are the least familiar with the questions asked.

We can conclude that, although there are examples of cities with very positive progress in the implementation of smart city development strategies, there are still numerous problems in the implementation of projects in the Western Balkans. The problems are most often reflected in the lack of resources and expertise, familiarization of respondents with the method of financing and implementation of projects, which can be a big obstacle to the further development of these cities in terms of the concept of a smart city. Trust in institutions and transparency of data, which should always be available to the public, are directly related to each other. If there is a lack of trust in the work of public institutions, the progress of cities slows down. This can only be solved by the participation of citizens in the process of creating a more efficient and mobile, but also healthier urban environment.

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