Concept of smart cities development strategy in the Western Balkans

Koncept strategije razvoja pametnih gradova u državama Zapadnog Balkana

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Abstract: If we keep in mind that we live in an age marked by digitalization, industry 5.0, as well as the accelerated population growth in urban regions, it is easy to conclude that the concept of smart cities is a very relevant topic for research. The aim of this paper is to examine whether and to what extent the concept of smart cities has been implemented in the city administration in the countries of the Western Balkans. For that purpose, a research was conducted, which includes surveying employed in various administrations in the following cities: Belgrade, Nis, Kragujevac, Trebinje, Podgorica, Herceg Novi, City of Skopje. The data indicate the fact that the respondents from Belgrade, Trebinje and Herceg Novi have the most knowledge and the most transparent insight into the data concerning smart city projects, while the respondents from Podgorica are the least knowledgeable about the entire issue. The general conclusion is that, although there are examples of cities with very positive progress in the field of implementation of smart city development strategies, there are still numerous problems in the implementation of projects in the countries of the Western Balkans.

Keywords: smart cities, strategy, development, West Balkan.

Sažetak: Ako imamo u vidu da živimo u dobu obeleženom digitalizacijom, industrijom 5.0, kao i ubrzanim rastom stanovništva u urbanim regionima, lako je zaključiti da je koncept pametnih gradova veoma relevantna tema za istraživanje. Cilj ovog rada je da se ispita da li je i u kojoj meri koncept pametnih gradova implementiran u gradskoj upravi u zemljama Zapadnog Balkana. U tu svrhu sprovedeno je istraživanje koje obuhvata anketiranje zaposlenih u različitim upravama u gradovima: Beograd, Niš, Kragujevac, Trebinje, Podgorica, Herceg Novi, Grad Skoplje. Podaci ukazuju na činjenicu da ispitanici iz Beograda, Trebinja i Herceg Novog imaju najviše znanja i najtransparentniji uvid u podatke koji se tiču projekata pametnih gradova, dok su ispitanici iz Podgorice najmanje upućeni u celokupnu problematiku. Opšti zaključak je da, iako postoje primeri gradova sa veoma pozitivnim pomacima u oblasti implementacije strategija razvoja pametnih gradova, i dalje postoje brojni problemi u realizaciji projekata u zemljama Zapadnog Balkana.

Ključne reči: pametni gradovi, strategija, razvoj, Zapadni Balkan.

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INTRODUCTION

Urbanization, which flourished especially after the industrial revolution, and continued in post-industrial society, intensified competition between cities. As a result, cities become competitive with each other and strive to improve infrastructure in order to attract tourist visitors, but also to improve the lives of the population (Dejanović et al., 2018). Since the mid-2000s, interest in the smart city concept has evidently grown as a result of technological advancement, but also an increasing number of people living in urban areas. The growing challenge is to supply the population with basic resources such as clean water, enough healthy food and enough energy. Namely, in 2020, 56.15% of the world's population lived in urban areas (World Bank, 2018). This should be accompanied at the same time by ensuring overall economic, social and environmental sustainability (Stübinger & Schneider, 2020). In that sense, strategies related to the construction of smart cities are being developed. Naturally, smart cities use new technologies with the aim to improve the quality of life of citizens, as well as to enable better use of the resources.

The goal of building smart cities is to improve the quality of life by using information and urban technologies to improve the efficiency of services and meet the needs of citizens. The development of information and communication technologies enables monitoring of the development of the city and enabling a higher quality of life. Real-time information collected through various devices and the knowledge gained on that occasion are the key to achieving efficiency (Nasution et al., 2019). Urban areas are, therefore, evolving from a technological point of view, and innovative technologies create new opportunities for more adequate and efficient mobility management (Zawieska & Pieriegud, 2018).

1. DEFINING THE CONCEPT OF THE SMART CITIES AND ITS CHARACTERISTICS

In its numerous interpretations and definitions in previous years, "Smart City" represents a major 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).

Smart cities do not have a universal definition, but there are certain key items that any attempt at definition cannot avoid, and they relate to the search for a better quality of life, efficiency, and sustainable development (UCLG, 2020). The adjective in the phrase "smart city" is related to whether the city is able to create a better life for its citizens, not only

through the innovation of public services, but also through the involvement of citizens in decision-making (UCLG, 2020).

One of the most applicable definitions that defines the concept of a smart city is that a city is made smart by a high level of resource, energy, mobility, or health management based on strategic decision-making processes, independence, innovation and citizen awareness (Kubina et al., 2021). A large part of this concept is the notion of sustainability, which primarily refers to the conservation of natural resources that are depleted by increasing urban population. This means the ecological, economic and social dimension (Toli & Murtagh, 2020).

Also, one of the definitions considers the concept of smart cities from the point of view of the use of information and communication technologies for the purpose of developing cities and improving life in them: "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 present and future generations while respecting economic, social and environmental aspects" (Mohanti & Choppali, 2016).

In the United Nations Development Program (UNDP), the term "smart cities" means the use of new technologies to contribute to ensuring inclusive, sustainable urban development, taking into account people, the economy and the environment.

Finally, the development of a "smart" city refers to the need of the public sector to partner with the private sector as well as non-profit entities. These are partnerships that can foster innovation and make sea risk management more flexible (Nasution et al., 2019).

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

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

A smart economy means joining the private and public sectors, a flexible market, adapting to change and international cooperation. 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, envir-

onmental 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. 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 governance is expressed through the transparency of city governance, the participation of the population in decisions, the level of public services and the implementation of development strategies (Schipper & Gilbert Silvius, 2018).

All these characteristics are also the basic postulates that make a city "smart". Innovative technologies play a major role in all of this, most of which:

- "Information and Communications Technology",
- "Internet of Things" and
- "Data" (use and work with data, data analysis, etc.), all with the aim of smart applications are created that make everyday life better (Winkowska et al., 2019).

Strategies needed for development of smart cities need to consider use of sustainable technologies. In order to qualify a technology as "sustainable technology", these solutions must have the following characteristics, in addition to existing requirements and limitations (eg economic sustainability):

- minimal use of non-renewable energy sources and natural resources,
- meeting human needs while respecting the natural and cultural heritage,
- minimal negative impact on the Earth's ecosystem (Zavargo, 2014).

Smart cities rely on smart infrastructure. The key components of smart city infrastructure are: smart buildings, smart mobility, smart energy, smart water, smart waste management, smart health and smart digital layers (Munitlak Ivanović, 2020).

2. SMART CITY DEVELOPMENT STRATEGY

With the aim of recognizing the most important factors of smart city development strategies, in this part of the paper, a review of recent conclusions in the professional literature is given.

For example, the approach given by the authors Komninos et al. (2019). On that occasion, they present a general roadmap for smart city planning, which consists of the following steps:

- defining challenges and assets,

- management,
- development and implementation of the strategy (Komninos et al., 2019).

However, this map is not entirely accurate and cannot help in finer steps in strategy development.

As a significant segment of the smart city development strategy, the authors Allam and Ibrahim emphasize the security of the smart city. In that sense, the mentioned authors give an overview of the cyber security strategy for the development of safe smart cities, which is based on three dimensions: human resources, technologies and institutions (Alam & Ibrahim, 2019). This approach seems very universal and possible to implement in the Western Balkans.

In designing smart cities and infrastructure, several key design principles need to be followed, namely inclusiveness, resilience, sustainability, interoperability, flexibility, risk mitigation and safety (UN, 2016).

Authors Picardal et al. (2020) presented the transformation of the city of Bellevue in the state of Washington into a smart city. This transformation will begin with the testing of the water module on the new city portal, starting with a control panel that will organize and optimize data for a better customer, utility and city experience. The authors present an approach to software module development based on the following features: Extract Transform-Load (ETL) scripts, long-term storage, short-term storage, application programming interfaces (APIs), and web interfaces (Picardal et al., 2020).

Noori et al. classify the paths for smart city development by comparing the application paths of four smart cities: Smart Dubai, Masdar City, Barcelona Smart City and Amsterdam Smart City (Noori et al., 2020). The comparison is made using the Input-through the Output model for smart city development. It is a model that characterizes the inputs (resources), flows, outputs (applications) and outcomes (externalities) of the smart city development process. Although the authors do not deal with strategic guidelines for the development of smart cities, they represent relevant elements of a smart city that contribute to the development of a smart city strategy:

- innovation, inclusion, visionary-ambitious leadership, technological optimism,
- competition, entrepreneurial innovation, citizen empowerment,
- smart mobility, smart energy, smart health, smart citizens, smart governance,
- human resources, entrepreneurship, ICT, data and financial resources,

- knowledge and innovation management, data management and financial management (Noori et al., 2020).

These segments include almost all the elements that make up a strategy for the development of smart cities, and although the authors did not deal with the strategy in their work, they made an outstanding contribution to further research in this regard (Milošević et al., 2020).

3. METHODOLOGY OF RESEARCH

The methods used in research are methods of analysis and synthesis, methods of induction and deduction, method of specialization, as well as comparative method.

The research included 191 employees in the Secretariat for Traffic Belgrade, the City Administration of Niš, the City Administration of Trebinje, the Administration of the Capital Podgorica and the City Administration of Kragujevac and Herceg Novi, as well as the City Administration of Skopje. In the total sample of the research, 54% of male respondents and 46% of female respondents participated. The highest percentage of respondents is between 35-40 years of age - 42%, while the lowest number of respondents is aged 55 and over - 4%. Most respondents from the Republic of Serbia (35%) participated in the research, while the least from Podgorica, the Republic of Montenegro (5.7%).

Examples of implemented projects in the cities that were subject to the research are listed below:

- Belgrade: video surveillance of public squares, open data on public transport, parking sensors and information panels, projects of smart traffic;
- Herceg Novi: projects of implementation of smart exploitation of electricity, projects of smart roads, internet of things;
- Trebinje: video surveillance, e-patrol, management of public lighting, smart solar benches, smart irrigation;
- Kragujevac: cloud data centre, information on bus lines to destination at google maps, monitoring system on energy and water consumption of public buildings;
- Niš: information on bus lines to destination at google maps, public WiFi for internet access;
- Podgorica: projects for the introduction of smart roads, solar panels;
- Kragujevac: sensor data collection project, introduction of 5G network system, smart waste water;

- Skopje: projects for the introduction of smart traffic, e-patrol.

The research instrument is a survey questionnaire consisting of two parts. The first part of the questionnaire aims to determine the socio-demographic characteristics of the sample of respondents, in order to gain insight into the basic data concerning the gender and age structure, but also the city from which the respondents come. The second part of the questionnaire consists of 20 closed-ended questions. The largest percentage of answers were conceived according to the Likert scale. The questionnaire was originally composed by the author for the purposes of this paper.

The paper starts from the general hypothesis: *The concept of smart cities is equally developed in the observed cities of the Western Balkans*.

For the analysis of the collected data and with the aim of checking the accuracy of the hypothesis, the χ^2 test was used. The χ^2 test belongs to the group of non-parametric statistical techniques, which are ideal in cases when 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 stringent requirements of parametric techniques. The χ^2 test serves to investigate the relationship between two categorical variables. Each of them can have two or more categories. The test compares the frequencies or proportions 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, ie. on a table in which the categories of one variable are crossed with the categories of another.

Because, due to the large number of categories of variables that were the subject of the analysis, the assumption regarding the minimum number of respondents in each cell was violated, the scale of attitudes was summarized so that respondents who answered, "strongly disagree" and "partially disagree", "agree" are classified as "disagree", while respondents who answered, "mostly agree" and "strongly agree" are classified as "agree". For the variables for which it was not possible to perform the χ^2 test due to disturbed assumptions (and they do not refer to the scale of attitudes), crosstabulation was applied.

The research was published in June this year, and included a survey of employees in the city administrations: the Secretariat for Traffic Belgrade, the City Administration of Sarajevo, the City Administration of Niš and Trebinje, the Administration of the Capital Podgorica and the City Administration of

Kragujevac and Herceg Novi, as well as the City Administration of Skopje. Questionnaires were sent to employees in online form, and on that occasion, all respondents were informed that the research was anonymous, and that they could withdraw from participating in it at any time. Also, the respondents were informed that the obtained data will not be used for any other purposes, except for the purposes of research for the purposes of this paper. When the data were collected, their analysis was approached.

4. RESULTS AND DISCUSSIONS

In this part of the paper, the obtained research results are presented graphically and tabularly. Primarily, descriptive statistics were used to analyze the structure of the sample of respondents.

On that occasion, it was concluded that 54.2% of males and 45.8% of females participated in the research (Figure 1).
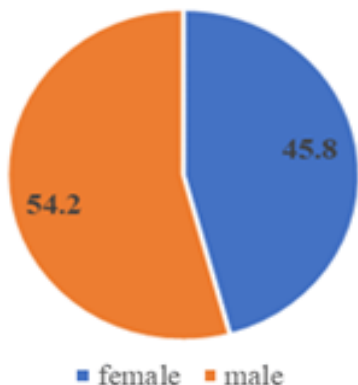

Figure 1. Distribution per gender

When it comes to the age of the respondents, it is concluded that the sample is dominated by persons aged 35-45 years (41.8%), and the least is a person aged 55 and over (3.9%) (Figure 2).
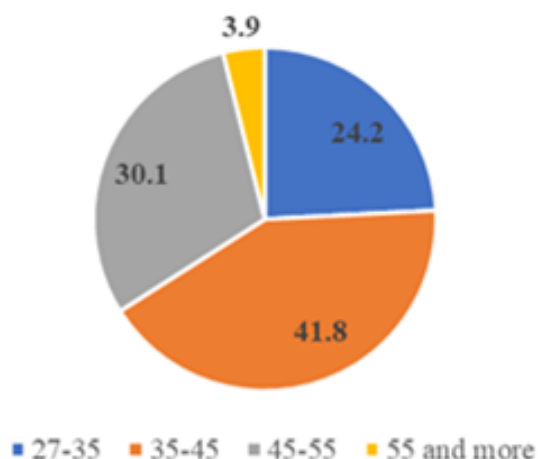

Figure 2. Distribution per age

Most respondents come from Belgrade, Republic of Serbia (15.2%), followed by Herceg Novi, Republic of Montenegro (14.7%), while the least respondents come from the capital of the Republic of Montenegro, Podgorica (5.8%) (Figure 3).

When asked if you are familiar with the concept of smart cities, the largest percentage of respondents answered that it is or partially is (87%), while 5.9% are not familiar, and 7.2% are not sure in their answer to this question. According to the percentage of respondents who gave positive answers, it can be concluded that relevant conclusions can be drawn from further data (Figure 4).

The next question from the survey questionnaire was aimed at determining whether the respondents believe that it is possible to introduce innovations in the cities they come from that would classify it in the category of smart cities. The largest percentage of respondents expressed the opinion that they mostly or completely agree with the above (84.3%), while a small percentage completely opposes this possibility (3.9%) (Figure 5).
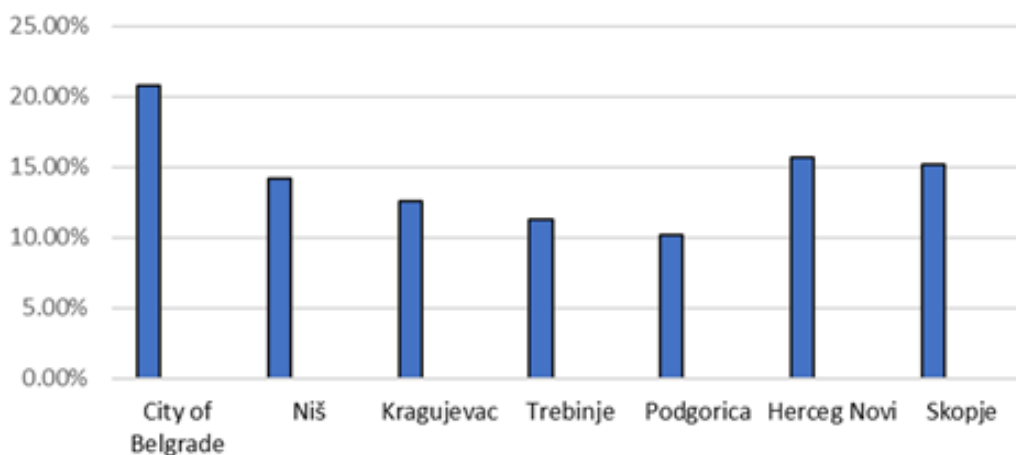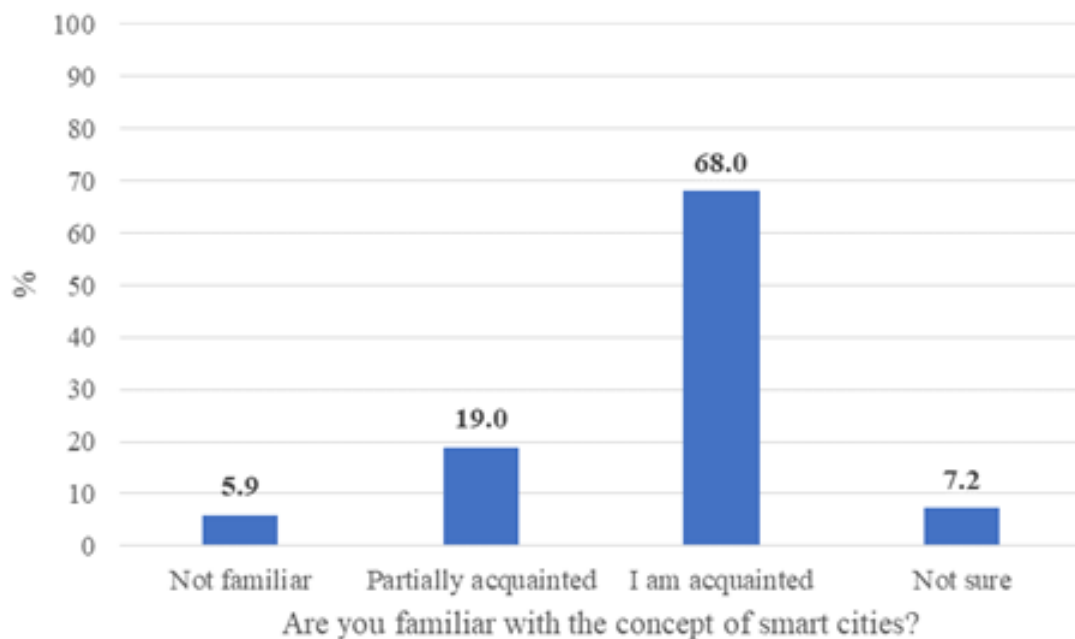

Figure 3. Distribution per city

Figure 4. Distribution according to the answer to the question "Are you familiar with the concept of smart cities?"
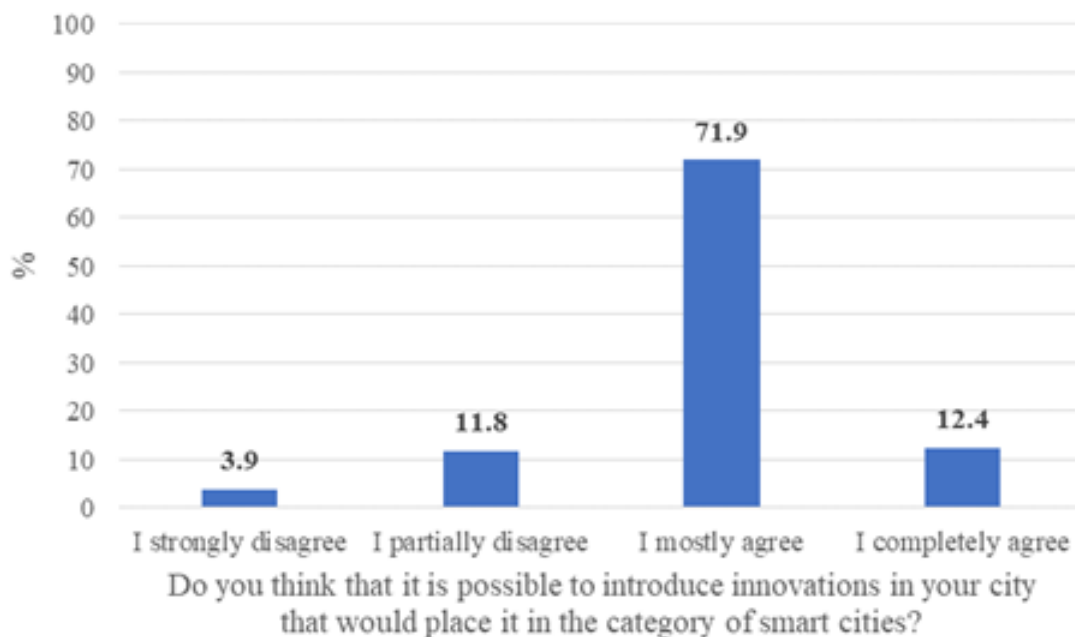

Figure 5. Distribution according to the answer to the question "Do you think that it is possible to introduce innovations in your city that would place it in the category of smart cities?"

The Table 1 shows the percentage of respondents' answers to the questions from the questionnaire under numbers 3, 4, 5 and 6.

When it comes to the implementation of Smart City projects in the field of communal energy, energy efficiency, renewable energy sources in the observed cities, from the presented data it is concluded that 73.2% of respondents generally or completely agree that such projects have been implemented or are ongoing.

Similar data were obtained when answering the question on the implementation of projects related to the built environment; namely, 85.6% of respondents generally or completely agree that such projects exist or have been implemented in the previous period.

The fifth question from the questionnaire was aimed at examining whether projects in the field of public security, communal order (which includes smart intersections, collecting data on unsafe points in the city, etc.) were implemented or are being implemented in the observed cities. It was found that 73.9% of respondents generally or completely agree that the projects exist or have been implemented, but in this case 14.4% of respondents did not agree with the above. Such a situation points to the fact that in some cities there are no such projects, which will be discussed in more detail in the future.

When it comes to projects in the field of civic participation (digitization of services, improved cust-omer services, smart governance, etc.), 60.1% of respondents mostly or completely agreed with their existence and/or implementation, while respondents who answered that they do not agree in completely in a slightly higher percentage than in the previous questions - 18.3%.

The conclusion that can be reported when looking at this group of questions is that projects that seek to innovate cities are planned, implemented or have already been implemented in the highest percentage, but that there are still respondents who are not informed or in their cities there is no such practice (Table 1).

Table 1. Questions 3-6

	%			
	I strongly disagree	I partially disagree	I mostly agree	I complet-ely agree
Has your community implemented or is implementing a Smart City project in the field of communal energy, energy efficiency, renewable energy sources?	10.5	16.3	37.0	35.9
Does your city implement a Smart City project related to the built environment (responsible planning and construction practices; central monitoring and management system; smart street lighting network, etc.)?	3.3	11.1	60.1	25.5
Has your city implemented or is implementing a Smart City project in the field of public safety, communal order (smart intersections, data collection on unsafe points in the city, etc.)?	14.4	11.8	36.6	37.3
Has your community implemented or is implementing a Smart City project in the field of civic participation (digitization of services, improved customer services, smart governance, etc.)?	18.3	20.9	37.3	23.5

The next question was to determine the existence of possible difficulties in the process of implementing initiatives and projects in the field of smart cities. It is concluded that between the most common difficulties dominates insufficient resources – 41.8%, followed by lack of expertise and practical knowledge in project planning, implementation and monitoring – 26.8%. The next is insufficiently well-identified development challenges and strategic priorities – 13.7%, but there is also a lack of cooperation between different levels of government – 17.6% (Figure 6).

- The problem of insufficient resources
- Lack of expertise and practical knowledge in project planning, implementation and monitoring
- Insufficiently well recognized development challenges and strategic priorities
- Lack of cooperation between different levels of government

Figure 6. Distribution according to the answer to the question „Do you face any of the difficulties in the process of implementing initiatives and projects in the field of smart cities?”

Table 2 shows the respondents' answers to questions 8, 9 and 10. The eighth question was related to determining the attitudes of respondents on whether in their country there is a permanent education of employees in the administration on topics in the field of smart cities and related areas. Unfortunately, it was found that only 11.1% of respondents gave a positive answer, while as many as 35.3% are not familiar with the above, 23.5% believe that this type of education does not exist, and 30.1% are unsure of their position on the above. This situation is not at all favorable if we keep in mind the importance of educating employees on a relevant topic such as the application of the concept of smart cities, as well as the fact that one of the segments that make up this concept are people who are ready for lifelong learning and achieving higher levels of knowledge.

When it comes to the existence of legal frameworks that regulate the development of smart cities in the surveyed countries, the situation is much more favorable - as many as 41.8% of respondents gave a positive answer. However, there is a high percentage of those respondents who pointed out that they are not familiar with the above (28.8%), which brings us back to previous issues about the importance of education of employees in administrations and beyond.

Also, the largest percentage of respondents answered that they are not aware of whether there are special institutions in their country that are in charge of development, implementation and monitoring of the concept of smart cities (49.0%). Only 19.0% of respondents gave a positive answer, while 22.9% of them are not sure (Table 2).

Table 2. Questions 8-10

	%			
	I strongly disagree	I partially disagree	I mostly agree	I completely agree
Has your community implemented or is implementing a Smart City project in the field of communal energy, energy efficiency, renewable energy sources?	10.5	16.3	37.0	35.9
Does your city implement a Smart City project related to the built environment (responsible planning and construction practices; central monitoring and management system; smart street lighting network, etc.)?	3.3	11.1	60.1	25.5
Has your city implemented or is implementing a Smart City project in the field of public safety, communal order (smart intersections, data collection on unsafe points in the city, etc.)?	14.4	11.8	36.6	37.3
Has your community implemented or is implementing a Smart City project in the field of civic participation (digitization of services, improved customer services, smart governance, etc.)?	18.3	20.9	37.3	23.5

Table 3 provides an insight into the obtained data concerning the examination of respondents' attitudes in relation to their understanding of the importance of introducing certain segments of the smart city concept in their city, as well as determining whether city administrations encourage the installation of public-owned digital infrastructure, civic initiatives and urban goods. In both cases a very positive picture was obtained; namely, the largest percentage of respondents see the importance of introducing the concept of a smart city (81.0%), and also 66.1% of respondents express the view that there are incentives regarding the installation of digital infrastructure (Table 3).

Table 3. Questions 11-12

	%			
	I strongly disagree	I partially disagree	I mostly agree	I completely agree
Innovations such as smart parking or smart street lights would significantly contribute to improving the quality of life in my city.	2.0	17.0	49.0	32.0
In my city, the installation of public-owned digital infrastructure that serves service providers, civic initiatives and urban goods is encouraged.	15.7	18.3	28.8	37.3

The next question aimed to determine whether the respondents were familiar with the concept of sustainable urban development and the principles of environmental protection related to smart cities. On that occasion, positive results were obtained - 52.9% of respondents point out that they are fully acquainted. However, there is a small percentage of respondents who are not sure of their position or are not familiar with it (47.1%). Therefore, it is necessary for employees in the administrations of the surveyed cities to receive additional education and trainings on this issue in order to acquire broader knowledge and be able to contribute to better preservation of the urban environment (Figure 7).
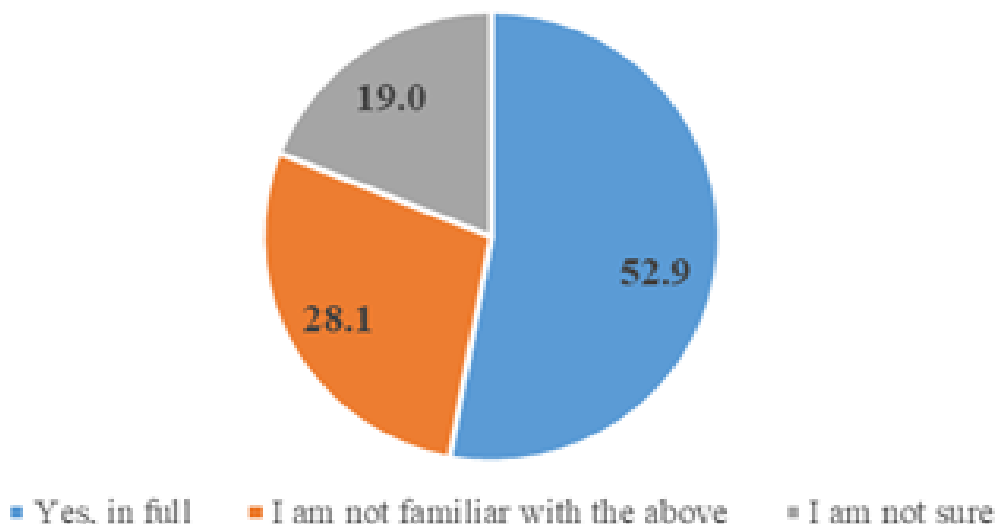

Figure 7. Distribution according to the answer to the question"Are you familiar with the concept of sustainable urban development and the principles of environmental protection related to smart cities?"

66.0% of respondents generally or completely agree with the statement that smart cities are the way to a sustainable future and improving the quality of life of citizens, while the attitude of complete or partial disagreement is 34.0% of respondents. These results suggest that most respondents see the importance of implementing the concept of smart cities, as well as a positive impact on their lives (Figure 8).
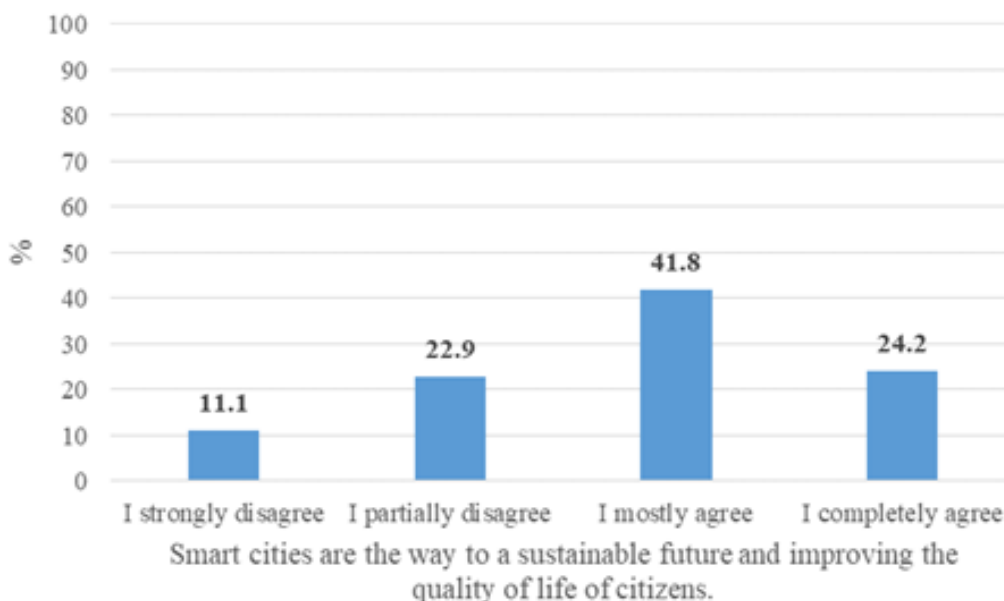

Figure 8. Distribution according to the answer to the question "Do you agree with the following statement "Smart cities are the way to a sustainable future and improving the quality of life of citizens?"

CONCLUSION

The topic of smart cities, those that are resilient, adaptable, that are catalysts for sustainable development and are seen as an adequate and logical choice for the necessary urban transformations of local communities around the world, has met with a response in the Western Balkans. It cannot be concluded that all countries have entered the implementation process equally and at the same time, but changes are visible in many cities in the region. Some of them stand out for their mobility and sustainability, while in others the application of the smart city concept is still in its infancy.

Constraints of the conducted research may be that not all the cities in covered regions were involved in the study. There are cities in Serbia like Novi Sad and Šabac that in recent yearshave implemented projects related to the smart cities concept, but the focus group to conduct the research was not set.

The presented data indicate the fact that the respondents from Belgrade, Kragujevac, Trebinje and Herceg Novi have the most knowledge and the most transparent insight into the data concerning smart city projects, while the respondents from Podgorica are the least familiar with the examined issues on several grounds. It is expected that the respondents who come from the capitals are mostly familiar with the concept of smart cities and the application of their development strategy, but among the most informed were employees from smaller cities – Kragujevac, Trebinje and Herceg Novi.

Viewed from the side, these are the three cities with a highly developed awareness of the importance of the smart city concept, but out of them two cities that are highly developed in terms of tourism have a significant number of tourists per year (Picardal et al., 2020; Noori et al., 2020). For example, Trebinje recorded a record 101.227 overnight stays in 2019, which is a very high attendance for a city of about 31.000 inhabitants (Directorate of Statistics, 2021). Employees of institutions from these two cities show a high level of education in the field of application of the concept of smart cities, as well as the fact that they are familiar with most of the examined topics. If we look at the effects so far in these cities when it comes to the implementation of the concept of smart cities, it is concluded that they can serve as examples of good practice in the field of effective strategies.

On the other side, awareness of outcome of the projects and their environmental impact are still below the half, which means that environmental issues in project implementation require much more attention for the sustainability of the smart cities concept.

The general conclusion is 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, respondents' familiarity with the way projects are financed and implemented, which can be a major obstacle to the further development of these cities in terms of the smart city concept. Trust in institutions and transparency of data that 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 is hampered. This can be solved only by the participation of citizens in the process of creating a more efficient and mobile, but also a healthier urban environment.

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