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IMPLEMENTATION OF SMART TOOLS IN BELGRADE'S TRANSPORTATION SYSTEM: LESSONS FROM COPENHAGEN AND MADRID

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ABSTRACT

Big cities confront several transportation issues, including traffic congestion, air pollution, public transportation, and so on. The most important aspect of any smart city initiative should be smart transportation systems. This system provides people with high-quality, environmentally friendly transportation based on their needs. As a result, the subjects covered in this study are diverse, including transportation models, information technology integration in transportation reform, and the development of environmentally friendly transportation modes. The goal of this research is to examine how digital technologies are used in the transportation systems of Copenhagen and Madrid. The research question for the study is: can digital technology use in transport assist Belgrade in resolving its transportation issues? At the outset of this research, we will provide smart transportation concepts from the cities of Copenhagen and Madrid as a starting point for smart transportation development. These cities' experiences could serve as a model for smart transportation systems. We'll look at a variety of strategy documents and plans that outline the current state of transportation, projected applications of ICT in transportation, and several transportation models that focus on environmental protection and reducing the use of fossil fuels and air pollution. This data should help Belgrade become a smart city in terms of transportation. Belgrade has started to deploy smart mobility solutions, but there is still a lot to learn from other cities that are forerunners in this field. We shall devise the ideal scenario for Belgrade that is best for its people.

Keywords: *digital tools, smart city, smart transport, eco-friendly model of transport, smart mobility*

1. INTRODUCTION

Large cities face a number of difficulties nowadays. The impact of digitization on urban life and its pervasiveness are the biggest problems. So, in this essay, we will talk about the idea of the smart city and its many facets, notably in the area of transportation. Smart mobility, smart urban mobility, sustainable urban mobility, intelligent transportation system, and more terms are used to describe it. According to the most widely used meaning of these phrases, they stand for a crucial element of any smart city endeavour that offers a high-quality, environmentally friendly transportation system based on the demands of the local populace. Social scientists are extremely interested in this specific topic for a number of reasons, including the requirements of these individuals. The broad use of digital and smart instruments in transportation is another feature that sets all smart transport efforts apart. Therefore, the primary goal of this essay is to investigate how Copenhagen and Madrid's transportation systems employ smart digital technology. The research question is: Can digital technologies used in transport assist Belgrade in resolving transportation issues?

2. METHODS

This research is theoretical and belongs to the field of political sciences and the narrowly scientific fields of public administration, local self-government, and public policy. Because of the specific area of our research interest, we can say that this research is multidisciplinary and includes knowledge from different areas beyond the mentioned scientific field. These different areas are: urban planning, digitalization and artificial intelligence, traffic engineering, economy, law, etc. In this research, we present the most significant scientific literature in this field using a multidisciplinary approach, but our crucial aim is to explain the implementation of these tools according to citizens' needs. In this research, we will use most of the basic scientific methods such as: literature review (analysing smart city projects, articles, and documents), case study, and comparative method. This paper starts with the concept of smart cities and different concepts of smart transportation systems and their implementation in Copenhagen and Madrid. After, we will discuss the possible solution in Belgrade, as one of the youngest smart cities in Europe.

3. SMART CITY CONCEPT

During the times of crisis at the beginning of the 1970s, cities as local governments gained prominence, and it became obvious that rising social issues should be solved locally. Therefore, cities have become important developers of new policies and public practise in the creation of new entrepreneurial institutions, tools, and work techniques (Djordjevic, 2012, p. 173). As important developers of public policies at the local level, cities need to change their role. Some authors highlight the human dimension of the cities. For decades, many urban planners excluded the people from urban planning, and a common feature of almost all cities is that the "people who still use city space in great numbers have been increasingly poorly treated" (Gehl, 2010, p. 3). Urban planners called "modernists" rejected the city and city space and focused on the individual buildings. This ideology became dominant in the 1960s and continued to affect many urban areas in the last five decades (Gehl, 2010, p. 4). It took a lot of time before urban planners understood the importance of human dimensions in urban planning. At the beginning of the new millennium, the majority of the world population became urban rather than rural. The cities' growth is rapid, and human dimensions become the necessary new planning dimensions. That led to four key objectives such as "lively," "safe," "sustainable," and "healthy city" (Gehl, 2010, p. 6). It is hard to find a clear definition of this concept. First, the meaning we give to the world "smart" gives rise to different phrases such as "intelligent city," "knowledge city," "wired city," and "digital city." The second issue is the difficulty in understanding the phrase "smart" (Cocchia, 2014, p. 18). Giffinger et al. (2007, p. 11) identify the six key characteristics of smart cities, such as a smart economy, smart people, smart transportation, a smart environment, and smart living. Dameri (2013, p. 2549) defines "smart city" as "a well-defined geographical area in which high technologies, such as ICT, logistics, energy production, and so on, cooperate to create benefits for citizens in terms of well-being, inclusion and participation, environmental quality, and intelligent development."

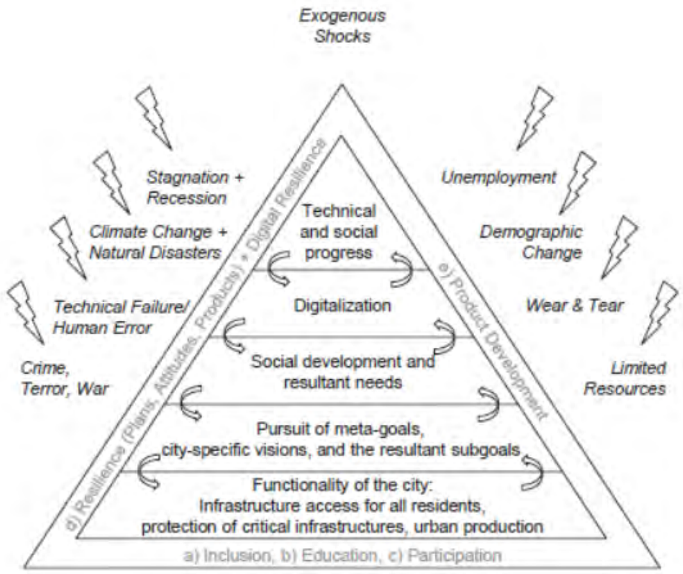

Figure 1: Challenges facing cities. Source: (Etezadzadeh, 2016: 43)

The smart city concept is well connected with the Fourth Industrial Revolution, called the Digital Revolution. It encompasses the use of mobile Internet, low-cost sensors, artificial intelligence, and machine learning (Schwab, 2016, p. 11–12). There are many megatrends that follow the Digital Revolution, but one of the most important is the emergence of the Internet of Things. Haller et al. (2009, p. 15) defined IoT as "a world where physical objects are seamlessly integrated into the information network, and where the physical objects can become active participants in business processes." People gained smart tools for everyday communication as a result of digitalization, and their entire lives migrated to the internet. But how does digitalization change cities? In Figure 1, you can find the many challenges facing cities as the consequence of digitalization. First of all, cities need infrastructure that is effective and efficient. So, the different fields such as energy, transportation, the security sector, health care, education, etc., will probably undergo radical changes. These changes include the use of data collection points installed in the cities for the purpose of measuring the traffic volume on the streets, the capacities of bus stops, the collection of environmental data from streetlamps, and the fullness of waste containers (Etezadzadeh, 2016, p. 43). These sensors provide the mass of information that needs to be transformed into informative data. Received data could be utilised in different areas, such as optimising water pipe pressure control, bus fleet deployment, the allocation of police patrol cars, and also to promote or enable entrepreneurship, etc. (Etezadzadeh, 2016, p. 44). After collecting and processing the data from different smart sensors, the question about using this data arises. It is precisely the question of how to use this data in relation to the efficient and effective functioning of cities. Digitization thus enables cities to become more transparent, secure, and functional, but at the same time more vulnerable to possible sabotage (Etezadzadeh, 2016, p. 45). So, it is very important to keep track of who has access to this information to prevent it from being used wrongly.

4. SMART TRANSPORTATION SYSTEMS

One of the most important questions at the beginning of our research is: What are the components of the smart city concept? Earlier, we gave some definition of this concept, but we didn’t say anything about the crucial characteristic of smart cities. Giffinger et al. (2007, p. 11) found the six key characteristics of smart cities: smart economy, smart people, smart transportation, and smart living. So, now we can claim that the development of smart transportation systems could be one of the important aspects of every smart city project. Various authors said that a smart transportation system lies within the four pillars. The first pillar is shared mobility, which includes carsharing, carpooling, e-hailing, and demand-responsive transportation. The second pillar includes the use of different sensors in cars such as lane assist, automated cruise control, blind spot sensors, etc. that can prevent traffic collisions and increase traffic security. third pillar is electric transportation, which includes the use of electric and hybrid cars (Audouin & Finger, 2019, p. 4). The last pillar is integrated mobility, which entails the merging of two or more separate public or private transportation services for travel purposes. Integrated mobility spawned the idea of mobility as a service, which is described as "a digitally supported distribution model bundling several transport options together and enabling the user to plan their trips, select the transport option that best suits their need, and finally book and pay for it via an app" (Audouin & Finger, 2019, p. 5).

A smart transportation system demands a multidisciplinary approach. As a new concept, there are lots of scientific debates about this concept. Also, it is hard to find the best definition of this phrase, so we need to collect research data from various authors. Garau et al. (2016, p. 36) have noticed a lack of a clear definition of this concept in the literature. Papa and Lauwers (2015, 543) describe this concept as a "buzz phrase in the planning and transport fields in the last decade." There are two stages in the evolution of smart mobility. The first phase is techno-centric smart mobility. This approach has spread since 2000, and it has focused mainly on the technological aspect and provides a vision of smart mobility that can maximise its efficiency through the widespread use of ICT (Papa and Lauwers, 2015, p. 545). The second phase is a consumer-centered aspect of smart mobility characterised by a strong emphasis on the human side. This phase has spread since the second half of the 2000s, and according to it, the human component (Papa and Lauwers, 2015, p. 546). The technology is user-oriented. Its needs are explored over and over again, and user feedback is used to improve digital tools. This definition means that smart urban mobility brings a revolution to previous modes of mobility. Therefore, the emphasis is on the accessibility, efficiency, attractivity, and sustainability of this concept. Smart urban mobility outlives the limitations of traditional transportation systems and brings the alternative modes of transport mentioned earlier in the text. Garau et al. (2015, p. 614–615) talk about six variables: [1] public transport; [2] cycle lanes; [3] bike-sharing; [4] car sharing; [5] private mobility support systems; and [6] a public transport support system. Based on these variables, he created the specific indicators and determinate units listed in Figure 2. The first four variables identify the relation between two units per specific indicator, while the last two use the binary system [yes/no].

The smart mobility concept is directly related to the sustainable urban mobility concept. The European Commission recommends to the member states the adoption and implementation of a Sustainable Urban

Mobility Plan. This plan is a strategic document designed to satisfy the mobility needs of people and business in cities and their surroundings for a better quality of life. SUMP is based on the following principles: [1] Plan for sustainable mobility in the "functional urban area"[1]; [2] Cooperate across institutional boundaries; [3] Involve citizens and stakeholders; [4] Assess current and future performance; [5] define a long-term vision and a clear implementation plan; [6] develop all transport modes in an integrated manner; [7] arrange for monitoring and evaluation; and [8] assure quality (Rupprecht Consult, 2019, p. 9). There is a significant difference between traditional transport (TTP) and sustainable urban mobility planning (SUMP). First of all, while the TTP focuses on traffic, the SUMP focuses on people. Over traffic flow capacity and speed, the SUMP prioritised accessibility and quality of life, including social equality, health and environmental equality, and economic viability. TTP only covers the administrative areas, but SUMP tried to cover a functional urban area based on travel-to-work flows. While TTP demands dominant traffic engineers, the SUMP demands interdisciplinary planning teams. That is well connected with the involvement of stakeholders and citizens in SUMP using a transparent and participatory approach and systematic evaluation of impact to facilitate learning and improvement (Rupprecht Consult, 2019, p. 10).

Variables	*Indicators*	*Specific Indicators*		*Unit*
Public transport	I_{PT}	I_{BND}	Bus network density	km/100km^2
		I_{DPT}	Demand for public transport	passengers per year/inhabitants
		I_{TLC}	Traffic lights centralized	n°/total
Cycle lanes	I_{CL}	I_{CLD}	Cycle lanes density	km/km^2
		I_{CLI}	Cycle lanes for ten thousand inhabitants	km/10.000 inhabitants
Bike sharing	I_{BS}	I_{BSD}	Bicycle station density	n°/km^2
		I_{BPI}	Bicycle per thousand inhabitants	n°/1.000 inhabitants
Car sharing	I_{CS}	I_{CI}	Car for ten thousand inhabitants	n°/10.000 inhabitants
		I_{SI}	Station for ten thousand inhabitants	n°/10.000 inhabitants
Private mobility support system	I_{PMSS}	I_{VMS}	Variable message sign	yes=1,00; no=0,00
		I_{STA}	SMS service for traffic alerts	yes=1,00; no=0,00
		I_{EPPS}	Electronic payment park systems	yes=1,00; no=0,00
		I_{AMD}	Applications for mobile devices	yes=1,00; no=0,00
Public transport support system	I_{PTSS}	I_{EBSS}	Electronic bus stop signs	yes=1,00; no=0,00
		I_{ETPS}	Electronic ticket payment system	yes=1,00; no=0,00
		I_{RSWT}	Information on routes, schedules and waiting times	yes=1,00; no=0,00
		I_{TPC}	Travel planner for the route calculation	yes=1,00; no=0,00
		I_{TTO}	Travel tickets online	yes=1,00; no=0,00

Figure 2: Variables and indicators to evaluate smart mobility Source: (Garau et al, 2015, p. 615)

1 Functional urban areas are small urban units belonging to the LAU2 category. "It could identify urban cores and use travel-to-work flows to identify hinterlands with highly integrated labour markets with the cores" (OECD, 2013, p. 2);

5. SMART TRANSPORATATION SOLUTION IN COPENHAGEN AND MADRID

This research paper is focused on a case study of Copenhagen and Madrid. These cities are benchmarking by implementing smart solutions in transport and could serve as models for Belgrade’s transportation reform. We focus on three different areas in this study: [1] the transportation model; [2] the role of ICT in transportation reform; and [3] different transport modes and projects in transportation reform.

At the beginning, we need to note the status of these cities on the globe. The Smart City Index for 2021 ranked Copenhagen at 7th place, which put it in the first group with the highest Human Development Index (HDI) quartile. Madrid took the 34th place and belongs to the second group in the second HDI quartile (IMD World Competitiveness Center, 2022, p. 9). The Global Liveability Index for 2022 places Copenhagen second, but it also shows some issues in Madrid's liveability because the city is part of a group of the biggest movers down in the last 12 months, placing it 43rd (The Economic Intelligence Unit, 2022). The reasons for these changes could lie in actual pandemic situations.

5.1. The transportation models of Copenhagen and Madrid

The transportation model includes the total share of different modes of transport. In this part, we will examine current trends in observed cities with an accent on planned reforms. The overall share of different modes of transport in Copenhagen is: walking (21%); cycling (28%); public transport (21%); and private cars (30%) (The City of Copenhagen, 2020, p. 3). The city authorities of Copenhagen developed a comprehensive strategy from 2011 to 2025 called Copenhagen, a Cyclist City. To achieve a neutral level of air pollution, Copenhagen has also developed a green mobility package. This package includes [1] urban development: the city is developed and designed in a way that makes green means of transport the first choice; [2] green means of transport: the green transport systems are extended; [3] transport system: the road network is adapted to smooth traffic flow; [4] incentive: the green means of transport are made more attractive by better information and incentives for choosing them; and [5] innovation: the development of transport technology and new concepts makes green growth possible (The City of Copenhagen, 2013, p. 6). In each area, several activities need to be done to achieve better results from the strategy. Thus, in the area of urban development, the adoption of a city plan is envisaged, which implies that the share of transport is made up of a minimum of one third by bicycle, a minimum of one third by public transport, and a maximum of one third by car (The City of Copenhagen, 2013, p. 9).

In 2022, the city of Madrid will adopt the urban mobility strategy called the Madrid 360 Sustainable Mobility Plan. This plan continues the Madrid 360 Environmental Sustainability Strategy with the aim to transform Madrid into a city that is more sustainable from the environmental and mobility points of view, as well as from a social, territorial, and economic standpoint. This Plan combines a traditional policy of the promotion of sustainable mobility (walking, cycling, and public transport) with more innovative strategies based on intermodality and new technologies (Plan de Movilidad Sostenible Madrid 360, p. 15). The city developed a good distribution model based on mobility motivation. They use different travel purpose travel to work, travel by leisure, shopping, studying, health care. By crossing the data from the table, we get the total share of each type of transport in Madrid: walking (34,3%); cycling (0,4%); public transport (35,8%); and private vehicles (29,5%) (Plan de Movilidad Sostenible Madrid 360, 2022, p. 55). Also, this data is comparable with the distribution model by territory. They merge walking and cycling in one category, and the other two categories stay the same. The total amount is about the same, but if we look at the Almendra, there is a big difference. Almendra is the urban core of Madrid and could be defined as a functional urban area. The total amount of active modes of transport (walking and cycling) in this area is 53%; public transport has a 34% share, and private vehicles are below average with 13% of the share (Plan de Movilidad Sostenible Madrid 360, 2022, p. 48). As a result, the Madrid's critical strategic goal is to reduce the number of private vehicles while increasing the number of eco-friendly modes of transportation. From a practical standpoint, we cannot expect Madrid to become a cyclist city in the future, but we can hope that they will find the best scenario for increasing the number of people using this mode of transportation. Environmental Sustainability Strategy quotes two scenarios, one for 2030 and another for 2050, that are divided into two groups: sustainable and extended. Both groups and scenarios talk about the importance of decreasing the share of private vehicles in transport. We will discuss the scenarios for 2030. More realistic is a sustainable scenario with 30% of nonmotorized (walking and cycling) modes of transport in total, 40% of public transport, and 30% of private vehicles. The extended scenario talks about an almost impossible decrease in the total share of private transport at an optimistic 9% (Roadmap to Climate Neutrality by 2050, 2020, p. 27). The crucial aim of this strategy is to become a climate-neutral capital by 2050.

5.2. The role of ICT in transportation reform

The importance of ICT in transportation reform is a second topic. In this topic, we will discuss smart transportation solutions in observed cities. We start with Copenhagen and its development of central units that monitor 360 traffic lights and prioritise buses and bikes, enabling them to move freely (The City of Copenhagen, 2013, p. 19). Also, Copenhagen participates in the EU C-Mobile Initiative to regulate traffic flow. This app provides users with information about the velocity they need to ride a bike or drive to go through the green at the next traffic light. This application gives warnings about the construction zones on our route or slippery roads. The most important feature of this application is its security because the application is hands-free and provides information visually or via audio signals. This project aims to develop safer, more efficient, more sustainable, and economically viable transport in Europe with the minimum environmental impact. This project involves defining a C-ITS (Cooperative Intelligent Transport System) infrastructure that supports various technologies such as mobile internet and wireless internet access in vehicles (802.11p standard) and that allows a large number of citizens to use the advantages of these services (Ferrandez, 2018, p. 1). This project implies cost-benefit analyses. Specifically, we can distinguish the four packages within this project and relate to them the different groups of costs. These packages are: [1] urban efficiency that includes rest time management, motorway parking availability, and urban parking availability; [2] infrastructure for vehicle safety that includes road work warning, road hazard warning (incl. traffic jams), emergency vehicle warning, and signal violation warning; [3] traffic efficiency that includes green priority, green light optimal speed advisory (GLOSA), dynamic eco-driving, cooperative traffic lights for pedestrians, Flexible infrastructure (HOV, peak-hour lanes), in-vehicle signage (e.g., dynamic speed limit), mode and trip time advice (e.g., by incentives), and probe vehicle data and [4] vehicle-to-vehicle safety that includes emergency brake light, cooperative (adaptive) cruise control (Urban ACC), slow or stationary vehicle warning, motorcycle approaching indication (including other VRUs), and blind spot detection and warning (VRUs) (Mitsakis, 2017, p. Considering the costs and benefits of this system, we can conclude that the short-term costs are high when building infrastructure, but that the extended-term benefits outweigh the costs, and it is more efficient to switch to an intelligent transportation system through the introduction of smart solutions.

The City of Madrid also implemented the intelligent system that maintained the traffic lights. For the creators of the local public policies in Madrid, the traffic regulation at road intersections and for pedestrians has vital importance. In cooperation with the IMESAPI, Madrid developed the system that provides the regulation of the traffic lights, speed control, regulation of the pedestrian crossings, visualisation of the system, etc. Also, they provide services such as traffic management centres, the control of traffic management, and the control of parking in restricted areas such as: public transport stops, bus lanes, intersections, video detection, licence plate recognition, traffic light detection of crossing in red, radars, Automatic Incidence Detection (DAI) systems for tunnels, etc. (imesAPI, 2022). Madrid participated in the C-Roads platform as a joint initiative of EU Member States and road operators for testing and implementing the C-ITS service. This pilot in Madrid called Calle 30 Road will be implemented in two phases called Day 1 and Day 1.5. In the first phase, there will be slow vehicles and traffic ahead warnings, road work warnings, weather conditions, emergency brake lights, speed limits, etc. In the second phase, there is a plan to ensure traffic information and smart routing. These services will be implemented by using hybrid communications technologies (mobile and ITS-G5) with autonomous vehicles that analyse the integration of C-ITS services (C-Roads Spain, 2022).

5.3. Different transport modes and projects in transport reform

The third important factor is the development of various modes of transportation and initiatives in transportation reform. In January 1995, Copenhagen established the first large-scale bike-sharing system in Europe, called Bycyklen. This initiative included 1,000 specially designed bicycles that were placed all around the city at the designated city bike rack [eight at the beginning]. The Bycyklen has continued to operate with more than 2,000 bicycles and 110 city bike racks. This system belongs to the second generation of bike-sharing known as the coin-deposit system. The main components of this system are [1] different bicycles, usually by colour and unique design; [2] designated docking stations in which bikes can be locked, borrowed, and returned; and [3] a small deposit to unlock the bikes (Shaheen et al., 2010, p. 160). This system had significant issues during 2013. The city launched a new CityBike programme in October 2014, developed by using the Internet of Things that included using electric-assisted bikes that have a GPS tracker and tablet computer embedded on the handlebar [Behrendt, 2016, p. 159]. The crucial design study is the Copenhagen wheel for an IoT version of e-bikes called Copenhagen Wheel (Outram, 2009, p. 4). Another important project in Copenhagen is a cycle superhighway called "Commuter Way," where commuters have the highest priority. The first MaaS application in Copenhagen was Car2Go, established in 2014. The second application, Drive Now, appeared a year later. In 2019, both applications merged into Share Now, supported by the EU. Over 500 vehicles from various manufacturers, including Mercedes-Benz, BMW, Mini, Fiat 500, Smart, and electric vehicles, are available via Share Now. Value-seeking, convenience, lifestyle, and sustainability are four motivating patterns identified, while environmental consideration is observed only as a benefit (Schaefers, 2013, p. 73–75).

The city of Madrid established the bike-sharing system called BiciMAD. This system starts operating in 2014. During the first two years, they put 168 into operations. Nowadays, there are 2,964 bicycles, 6,315 anchors, and 264 stations (BiciMAD, 2022). Madrid developed strategies to increase the number of bikes in transportation because the total amount of cycling in the transportation model is low. Also, in Madrid there are the lot of MaaS platforms such as well-known ShareNow since 2015 with a fleet of 950 vehicles, of which 300 have four seats. Madrid has one of the most extensive carsharing platforms in Europe. There are also Free2Move, Wible, Zity, GoTo Global, and Ubequo, in addition to Share Now (Madrid Destino Cultura Turismo, 2022). All of these services have available mobile application. The city has also created the Smart Mobility application, which covers all services that are present in Madrid.

6. SMART TRANSPORT SOLUTIONS IN BELGRADE

Finally, we can discuss how smart transportation solutions will be implemented in Belgrade. In December 2020, Belgrade accepted the SUMP. Belgrade's data varies from that of the other cities in the sample because the city's transportation model contains 49.93 percent public transportation, 24.32 percent passenger cars, 24.25 percent pedestrians, and only 0.75 percent bicycles (Transport Model of Belgrade, 2015). Belgrade has a high proportion of public transportation in total transportation, which is positive. As a result, the development of Belgrade's plan as a bicycle city is now unattainable since it requires a change in the habits of Belgrade's residents. This is a similar situation to what we have in Madrid. However, in recent years, Belgrade's streets have seen an increase in the number of bicycles, particularly in the city's recreational areas. Since the Second World War, Belgrade has not developed a systematic bicycle policy. When authorities anticipated the expansion of this mode of transportation in recreational regions in the 1980s, one attempt was undertaken. The location of Belgrade in a region with a moderate continental climate is advantageous for the growth of this method of transportation. Thus, Belgrade's growth plan envisions a 30 percent overall share of bicycles and walking and the building of 100 kilometres of new cycling pathways (Sustainable Urban Mobility Plan, 2020, p. 57). This plan considers three potential scenarios: the worst-case scenario, which is to do nothing and consequently see a decline in the number of eco-friendly modes of transportation overall; the second, which is to take action in order to stop the spiral of growth and put it into reverse; and the third, which is to see significant increases in eco-friendly modes of transportation over the ensuing years while putting a strong emphasis on changing citizens' habits and behaviours. The City of Belgrade has opted for the third scenario, which implies a complete reform of the transport system with an emphasis on increasing the share of bicycles, walking, a stable share of public transport, and reducing the share of private motorised vehicles in total transport (Sustainable Urban Mobility Plan, 2020: p. 131–133). The Sustainable Mobility Plan gives a vision of the city of Belgrade as an adaptable, sustainable, quality, rational, efficient, and tolerant city. Therefore, the plan assumes an increase in walking (25%), cycling (4%), maintaining a high proportion of public transport (48%), reducing private cars in transport (20%), etc. (Sustainable Urban Mobility Plan, 2020: 137–138).

The City of Belgrade is in the initial phase of implementing smart solutions. The implementation of the park and ride system is one of the peculiarities. The Sava Centre, an international convention, cultural, and economic centre with a variety of multifunctional events, is in close proximity to the park and ride facility. The city centre and other areas of Belgrade are easily accessible to passengers using public transportation. Owners of personalised Belgrade city cards who also own cars are eligible for free use of this facility; however, they must register on the parking service website. Other users can pay for this service via SMS. The disadvantage of this system is that there is no possibility of combining public transport and parking for users who do not own a personalised Belgrade card. A possible solution is the introduction of a smart urban card that can be used for driving, bike rentals, entering museums, etc. Since 2019, Belgrade has included seven electric vehicles called Vrabac in the public transport system in the central pedestrian zone, one of which is adapted for disabled persons. At the end of last year, we started with the creation of the first public bike sharing system. It is planned to build 150 public bike racks and 100 km of bicycle paths (Danas Online, 2021). Belgrade started a park and bike programme that allows riders to pick up a bicycle for use at regular parking prices. This programme is available in six garages and parking lots of the public parking service and means that the user can take a bicycle with a regular parking ticket and return it to the garage after use. It is also crucial to emphasise the development of the so-called "smart traffic lights," a system for adaptive control of traffic lights. Siemens Mobility and the City of Belgrade worked together on this project. In three years, it is intended to build more than 300 intelligent traffic lights. This objective is delayed by the coronavirus pandemic hence the project's completion is not anticipated until 2024. Through sensors, this system gathers information on precisely what is occurring in real time and adjusts to meet the needs of the moment. Accordingly, if there are more automobiles, the green lights will stay on for a longer period of time while the pedestrian traffic lights will remain red until the first pedestrian approaches and activates the traffic signal. This system also favours using public transportation (Srbija Danas, 2021). The inhabitants of Belgrade were outraged by the smart traffic light system. Traffic congestion are brought on by improper use of this mechanism. Citizens' lack of knowledge of the system is one of the main causes of these issues. People frequently touch the pedestrian crossing button, but the green light does not turn on. Then, right when they expect it to, it turns on for automobiles. Additionally, it occasionally happens that drivers do not come close enough to the stop lane for the smart system to recognise the presence of the car. Belgrade should make significant investments in training its citizens to use these sophisticated tools.

The new city administration got off to a fresh start with adjustments to transportation. The mayor suggested outlawing single-occupant car operation during rush hour. Traffic experts think that while this plan may not necessarily be bad, more needs to be done to address other infrastructure issues, such as relocating cars off of the streets and into massive parking structures or charging for vehicle entry into the city centre. The mayor's first plan to reduce air pollution is still a good one, but it is useless to discuss it without good public transportation (Miljuš, 2022). In 2015, the business Car4Use started the first car-sharing programme in Belgrade. At 19 locations throughout the city, they provide 30 Fiat 500s and 30 Fiat Pandas to residents. Although this concept initially received a lot of media coverage, the general public was not very enthusiastic about this form of transportation (Balkan Green Energy News, 2020). Car: Go is a ride-sharing programme available in Belgrade. This Uber-like service for Serbia first launched in 2015 with the express purpose of modernising the Serbian transportation industry. Additionally, a group of people established the association "Car: Go" in 2019 to offer smart mobility in a smart city. Eventually, there will be friction with the taxi business. In order to oppose unfair competition, leaders of the taxi business insisted on a tight licencing process and a cap on the number of taxi licences that might be issued (Kovačević, 2021: 270–271). There are projects in Belgrade to change the city's transportation system with a focus on smart mobility, but the city and its residents still have a lot of work to do to put these innovative ideas into practise. Therefore, the creation of smart transportation in Belgrade necessitates intelligent decision-making with a focus on community involvement.

7. CONSLUSION

A smart city initiative is spreading across the globe. Therefore, the use of smart tools in cities has become unavoidable. The citizens' needs are the most important factor in creating cities, so we shape cities, and cities also shape us. Observed cities in our research are facing almost the same issues, but urban tradition, political regime, and political culture shape their response to actual megatrends. Cities need infrastructure and finance to implement smart solutions. However, cities need smart people and good governance to implement this solution. The observed city should serve as a benchmark for Belgrade. Their good plans and obstacles should help Belgrade find the best scenario for the implementation of smart tools. Belgrade could become a smart city if we decide to be smarter and use our resources in accordance with citizens' needs. Therefore, the academic community needs to cooperate in finding the best solution for our citizens. We need to involve the different stakeholders and citizens and put policies in place to fulfil the citizens' expectations and needs. Belgrade could not become a cyclist city like Copenhagen, but we need to do more to increase the use of bicycles, especially in residential zones. Our advantage is that we have a high proportion of public transportation, but our disadvantage is that we also have a high proportion of private cars transporting one or two passengers. Belgrade must improve its transportation by adopting cars that run on acceptable fuels. Also, we need to encourage people to use carsharing, especially electrical vehicles. If our citizens accept our proposal, maybe we can become the green capital in the nearest future. So, the implementation of the digital tools should help Belgrade solve a lot of problems in transport, and today's city is not possible without smart tools, smart governance, and smart people.

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