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URBAN QUALITY OF LIFE AND SOCIOLOGICAL BENEFITS OF SUSTAINABLE MOBILITY

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Abstract: From the development of civilization, structure of large settlements have changed in accordance with the needs of the population and the level of scientific and technological development. Due to the COVID-19 pandemic, more smart services have been developed in countries around the world, including Serbia. Based on research and past experiences, the problem of implementing smart traffic and mobility has been identified as a priority with the aim of sustainability. Mutual interactions between different actors will be presented with the aim of understanding cities as structures that must be viewed in the future as smart urban ecosystems that change over time. The research methodology will include case studies and research of opinions of experts in the field of urban planning, mobility and sustainability, and an interview will also be conducted among residents. We propose modern solutions for designing cities as urban ecosystems that can overcome the increasingly negative impacts.

Keywords: creative city, innovation, mobility, smart city, urban ecosystem.
Field: Humanities

1. INTRODUCTION

"As population growth accelerates, researchers and professionals face challenges as they attempt to plan for the future. Urban planning is a significant component in addressing the key concerns as the world population moves towards the city and leaves the rural environment behind, yet there are many factors to consider for a well rounded community" (Vesco & Ferrero, 2015). In today's world, cities face increasing challenges in terms of sustainability and quality of life for residents. It is necessary to find innovative solutions for urban transformation, which will enable sustainability and at the same time improve the quality of life of citizens. Precisely in this context, the concept of cognitive cities and sustainable mobility is gaining increasing importance.

The aim of the paper is to research the ways in which cognitive cities and sustainable mobility can contribute to the improvement of the quality of life through the transformation of traditional cities and their adaptation to a new way of functioning. Cognitive cities rely on advanced technologies, such as artificial intelligence, machine learning and the Internet of Things, to achieve more efficient use of resources, traffic optimization and the provision of personalized services to citizens. On the other hand, sustainable mobility implies the promotion of alternative forms of transport, such as electric vehicles, bicycles and public transport, with the aim of reducing air pollution and traffic congestion.

On the other hand, sustainable mobility is a key element in achieving sustainable urban development. Traditional forms of transport, such as internal combustion cars, lead to air pollution, noise and traffic congestion. In addition, sustainable mobility focuses on the integration of different modes of transport, infrastructure development and urban planning so that walking, cycling and public transport are practical and efficient. „Governments and local authorities are increasingly involved in resilience-building strategies, seeking to design and implement sustainable solutions, which combine the maximization of tradeoffs between positive and negative effects of, for example, urbanization and climate change. Towards this end, there is a perspective change in the conception, planning, and development of the built, infrastructural, operational, and functional forms of urban areas" (D'Alpaos & Andreolli, 2020).

The task is to examine the connection between cognitive cities and sustainable mobility, focusing on the ways in which cognitive cities support sustainable mobility through the application of advanced technologies and smart systems, as well as the construction of cities and their transformation in a sustainability context. Present a case study of a specific city that has already implemented cognitive technologies and/or sustainable mobility in order to analyze the concrete results, challenges and

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benefits of that project. Through the achievement of these research goals, it is expected that a deeper understanding of the connection between cognitive cities, sustainable mobility and the quality of life of residents will be obtained. It is also expected to identify key factors, challenges and recommendations for the further development of this area and the implementation of green solutions in cities.

2. MATERIALS AND METHODS

This research uses a combination of qualitative and quantitative methods to provide a comprehensive insight into the topic of cognitive cities and sustainable mobility. The first step in the research is a review of relevant literature in the field of cognitive cities, sustainable mobility and quality of life. The analysis of existing case studies refers to the implementation of cognitive technologies and sustainable mobility in specific cities. These case studies provide concrete examples, results and challenges in implementing these solutions and can be analyzed comparatively. Interviews with experts in the fields of cognitive cities, sustainable mobility, urban planning will be conducted in order to gain a deeper perspective and understanding of these topics. Interviews are structured and focused on key research questions. Quantitative data, such as statistical data on traffic, gas emissions, the use of public transport and other relevant indicators, were taken from previous research. Taking measures on the terrain as a method precedes the conceptual urban planning project of the city segment.

After the collection and analysis of all relevant data, the results of the research will be systematized and analyzed. These results will be used to draw conclusions and give recommendations for the further development of cognitive cities and sustainable mobility in order to improve the quality of life of the residents. The choice of a particular city or region as a case study depends on the specific research objectives and criteria. Different cities and regions can be examples of good practice in applying cognitive technologies and sustainable mobility. Based on recognition for their innovative approaches and concentration on European soil, the examples chosen for comparative analysis are Amsterdam in the Netherlands, Barcelona in Spain, Varaždin in Croatia and Novi Sad in Serbia. Varaždin and Novi Sad are the closest due to their former affiliation to SFR Yugoslavia and similar socio-economic, political and cultural criteria, so they are comparable, while the other two European cities represent advanced and respectable examples of applying good practice.

Amsterdam is often cited as an example of successful implementation of cognitive cities and sustainable mobility. The city is known for its innovative approaches in the integration of technologies, an intelligent transport system and sustainable mobility with the aim of improving the quality of life of its citizens. Amsterdam has implemented smart technologies to optimize public transport. It is known for its developed cycling infrastructure. A cognitive approach is used to monitor cyclists and identify areas with higher congestion or risk of accidents. This information is used to optimize bike paths, install additional bike parking spaces and direct cyclists to less congested routes. Ride-sharing and carpooling are present, as well as electric vehicles and charging infrastructure. The city has developed a dense network of charging stations throughout the city, and a cognitive approach is used to monitor and manage the availability of charging stations. Amsterdam is an example of how transport innovation, smart infrastructure and personalization of services can be combined to create a sustainable and attractive city for all (Brinkman, 2011; Lee & Hancock, 2012; Mora & Bolici, 2016).

Barcelona is an example of a city that has integrated cognitive technologies and sustainable mobility into its infrastructure. The city uses sensors and data to monitor traffic and optimize the public transport systemS. Barcelona also promotes the use of bicycles and the development of cycle paths, and cognitive technologies are used to improve the safety of cyclists. The strength of Barcelona's smart city strategy relied on its cross-cutting approach (Josep-Ramon, 2017). „Cities aspiring to become smart need to proceed with great caution and adopt an approach that allows them to look beyond technology and consider other non-technical yet crucial factors. This is what the City of Barcelona has done during the development of its smart city strategy, thanks to an approach in which the technological component has been rightly combined with several "human factors" (Nam & Pardo, 2011) which have been essential to the success of the initiative. These include leadership and political commitment, which have been provided by the municipal administration since the starting phase. In this way, it has been possible to manage the complex organizational context that has allowed for the planning and implementation of the strategy. An interdisciplinary environment in which sectoral and departmental separation has been eliminated in favor of cross-collaboration" (Mora & Bolici, 2016).

The city of Varaždin has created planning documents of urban planning and strategic development, where the influence of the Smart city concept was in relation to its components Smart Mobility and Urban

Mobility. Priority is given to pedestrians and cyclists due to the effect of zero emissions of harmful gases as well as low costs and general health. As one of the few cities in the Republic of Croatia that has an established public transport system, the plan includes the mobility and safety of pedestrian and cyclist traffic, logistics, and bus transport (Cvitković et al,. 2023), as well as environmental protection. It was also later established that reconstruction and revitalization of the urban street furniture is needed in order to move safely through the city (Šimunović et al., 2018). As part of the plan "Increasing the attractiveness and quality of non-motorized traffic", the plan and development of the expansion of the pedestrian zone and bicycle infrastructure, as well as urban furniture and streets, was prepared. Everything was monitored by a campaign with the involvement of the public and experts (Cvitković et al,. 2023). The phases have not been completed yet, to reduce motorized traffic and increase non-motorized traffic. However, it was noticed that the measures and objectives of the Plan were not defined precisely enough, although the measures around the objectives were precisely formed (Kodžaga et al., 2023).

In Serbia, Smart City is still a very new concept and the implementation of technology in this form of infrastructure is proceeding very slowly. E-administration is a system that has proven to be very successful in implementing the modern concept of smart administrations. In addition, the research also dealt with the development of the 5G network on the territory of Serbia, but also with other technologies in the cities of Niš, Belgrade, Kruševac and Pančevo (Prigoda et al., 2021). The "Smart Cities of Serbia" project can be the beginning of thinking in the direction of the implementation of technology in all segments of society, including cultural heritage. The "Smart Cities of Serbia" project can be the beginning of thinking in the direction of implementing technology in all segments of society (Stojanović, Radosavljević, 2023). „Presumably, the arrival of modern telecommunications in the countryside might provide new local economic opportunities and slow migration to cities. But it could just as likely accelerate migration by plugging ever-larger rural areas into the social and economic life of the city" (Towsend, 2013). The strategy is in line with the goals and requirements of the European Network of Healthy Cities of the World Health Organization (WHO), of which the City of Novi Sad has been a member since December 2012. Within the key topics of the VI phase of the WHO European Network of Healthy Cities (2014-2018), special attention is paid to creating healthy living and working environments, healthy urban planning and design, healthy transport, climate change and housing.

Cities play a vital role in local development providing a high education level, specialized jobs and advanced services. When assessing living conditions and wellbeing in cities, economic indicators alone are generally unable to evaluate the inherent complexity of the 'quality of life' issue in urban environments. With rapid urbanization, shortage of infrastructures and services emerged in metropolitan regions of developing countries, leading to disadvantaged settlements, urban poverty, lower citizens' satisfaction, and an overall decline in life quality (Stojanović, 2021). According to the Strategy for Development of the Green Space System of the City of Novi Sad 2015-2030, green areas contribute to preserving and improving the physical and mental health of people by creating a more humane environment that has a stimulating effect on people, provides space for physical activity and gathering of different categories of the population. Green spaces have a positive effect on the microclimate of the urban environment, contributing to the regulation of temperature, humidity and air movement. They can contribute to the improvement of the air quality of the environment in the city, as well as to the reduction of noise levels and have significance in the field of formal and non-formal education. In recent years, the City of Novi Sad has been working on planning documentation and projects important for the development of green infrastructure, while a special reason for the analysis is the proclamation of Novi Sad as the European Capital of Culture 2021 and the European Youth Capital 2019, in order to contribute to already agreed projects for the arrangement of public spaces.

„Qualitative upgrading inevitably includes adequate interpretation, as a relevant educational function that provides personal experience and new experience each time" (Sančanin et al., 2023). The analysis of priorities was carried out based on the analysis of the views of the professional public, the local population and the available planning documents using the Analytic Hierarchy Process method. Individual green infrastructure facilities of importance for the city of Novi Sad were analyzed using the priority system, as well as the connection of priority zones with green corridors.

3. RESULTS

Based on the results of the research, according to the opinion of the professional public and the local population, the priority should be the construction of green corridors in the inner city core and connections with park areas. Also, the connection of urban park zones into a single system, as well as the

connection of park areas with city picnic areas and recreation locations. Novi Sad is at the initial level of using memory mobility, and the first step towards sustainable traffic solutions is the construction of green corridors, pedestrian, bicycle and public traffic. The first smart technologies were introduced precisely in this infrastructure typology.

Green areas on the territory of Novi Sad are characterized by the presence of traditional public green areas. After the categorization of green areas according to the Study of Green and Recreational Areas, they were prioritized. As the most important green areas, the population saw park areas, green areas in the residential area, as well as greenery along roads and thoroughfares. Green areas around cultural-historical buildings and public buildings are among the more important objects of green infrastructure, while marginal vegetation represents the lowest order of priorities.

Sunny Quay, in addition to the role of protection from high water, it is arranged and used as a recreational path, or promenade. There are only unpaved walking paths whose terraces determined by park users (pedestrians and cyclists). The bike path along the Sunny Quay makes the section the longest and most popular cycling routes in Europe, 4,400 km long (so-called “Euro Velo 6” routes). The University Park has an installed station for cyclists, intended for recreation and bicycle repair.

The plan presents spatial guidelines and rules for paved areas of the park (plateaus, paths, etc.), as well as the concept of landscaping with different areas of vegetation. Accurately defined parterre arrangement of the park, with the obligatory layout of paths and plateaus and details was done through “Urban-Architectural Study of Quay Part near University Park in Novi Sad Based on Bioclimate Principles” (Figure 1).

According to “Plan generalne regulacije Univerzitetskog parka u Novom Sadu”, there are three main entrances to the park that are in line with the existing roads in the area. In addition to the basic pedestrian approaches to the park, the ground floor landscaping project should forms a connection between the park area and the promenade along the river. Other access routes to the park will be formed depending on the spatial arrangement of pedestrian paths within the park itself park. The park will be divided into smaller units of different sizes along the projected paths, which should be characterized by a variety of decorative types of vegetation and different parterre treatments, while preserving the ambient whole of the area. In addition to the direct protection of valuable natural sites, connecting the “blue-green” corridors creates a whole series of functions that enrich the urban space and the quality of life of citizens (Ristić, 2015).

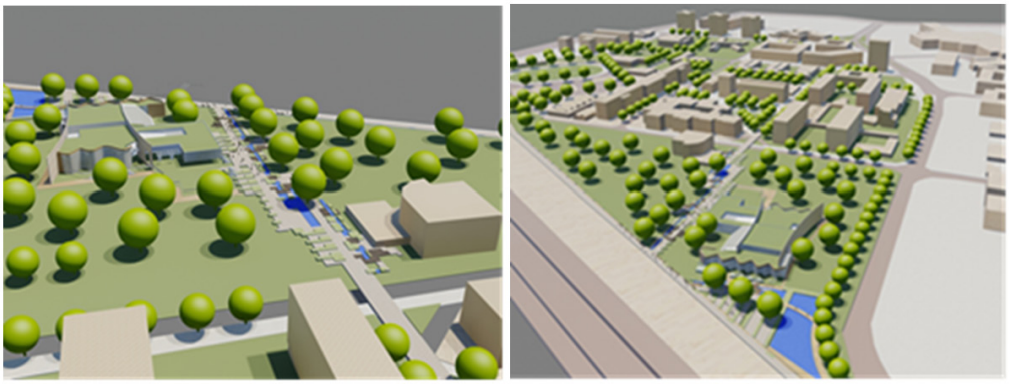

Figure 1. Example of how the banks of the Danube could be connected to the city by “blue-green” corridors through the University Park. Source: Stojanović at al., 2010.

4. DISCUSSIONS

In order for the concept of green infrastructure to take root in the Republic of Serbia, it is necessary to adopt a number of measures, at different levels, starting from the state level and ending at the level of local self-governments. In addition, various social measures can contribute to the development of the concept of green infrastructure, as well as the development of certain expert measures. Research on cognitive cities and sustainable mobility has significant implications for the future of these concepts. The future of cognitive cities and sustainable mobility depends on further technological development, policy support, inclusiveness, interdisciplinary cooperation and continuous monitoring of results. Continued research and implementation of these concepts are key to realizing more sustainable, efficient and innovative cities in the future.

Analysis of the results of the implementation of cognitive technologies and sustainable mobility can provide insight into the effects and benefits that these initiatives bring to the city and its residents. Reducing CO2 emissions, improving traffic efficiency, improving user experience, increasing the use of sustainable forms of transport, impacting quality of life, reducing noise, improving air quality, greater traffic safety and better access to services. The economic effects are not negligible, among other things, the reduction of fuel and vehicle maintenance costs, the creation of new business opportunities and the improvement of the city's tourist attraction. The analysis can assess the economic gains that have been achieved as a result of these initiatives. The analysis of the results of the implementation of cognitive technologies and sustainable mobility should take into account various indicators and measure the achievements in relation to the goals set for the projects. This will enable the evaluation of the success of the initiatives and the identification of areas that require further improvement.

Green sustainable development will contribute to the preservation of health, the population, will have significant socio-economic benefits, will have a positive impact on education, culture and general awareness of future generations, while the surrounding spaces and locations and places for living will have new value. In accordance with the existing modern risks to health and the environment, the possibility of using various contents within all categories of greenery for the purpose of passive and active recreation is very important. The multi-functionality and connection of all categories into a single network enables a variety of use by all residents and visitors of the city throughout the year. On the one hand, with the pronounced contradiction between regional ecological protection and economic development, as well as between the growing ecological demands of urban residents and the destruction of natural ecosystems, the construction of urban ecological corridors is very challenging. „On the other hand, with contemporary urbanization and ecological civilization development, the standards and requirements for the construction of urban ecological corridors are set higher and higher. Constructing an urban ecological corridor is therefore particularly important, and must adopt a spatial approach that balances the relationship between ecological protection and economic development" (Peng et al., 2017).

5. CONCLUSIONS

„An ecological corridor, with both ecological and cultural functions, is a symbol of urban ecological or green civilization, and has therefore become one of the major topics in the fields of landscape ecology, urban ecology, and

ecological planning" (Peng et al., 2017). Green areas have a positive effect on the microclimate of the urban environment, contributing to the regulation of temperature, humidity and air movement. They can contribute to the improvement of air quality in the city environment, as well as to the reduction of noise levels, and are important in the field of formal and informal education. Cognitive cities and sustainable mobility play a key role in improving the quality of life of residents. The implementation of cognitive technologies in traffic management, route optimization and provision of personalized services to residents brings numerous benefits. The development of green cities can contribute to the improvement of social inclusion and the quality of well-being. The strengthening of public transportation systems, for instance, can reduce disparity by increasing access to the service and contribute at the same time to the reduction of traffic congestion in peripheral areas. Traffic reduction and the improvement of pedestrian and cyclist conditions can sustain social cohesion. Green areas stimulate social interaction and improve well-being.

Cognitive cities enable more efficient use of resources, reduction of CO2 emissions and improvement of traffic efficiency, resulting in less congestion, reduced travel time and negative environmental impacts. However, the integration of cognitive technologies into the infrastructure of cities also brings challenges. Aspects of data privacy, training residents to use new technologies, and investing in infrastructure to support sustainable mobility need to be considered. Overall, cognitive cities and sustainable mobility have the potential to transform cities and improve residents' quality of life, while creating attractive tourist destinations. Further research and implementation of these innovative concepts are crucial for achieving sustainable and prosperous urban development in the future.

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