

BENEFITS OF THE SMART MOBILITY AS AN INTEGRAL PART OF SMART CITY NOVI SAD

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Abstract: Smart cities are urban areas that use advanced technologies to improve the quality of life for their citizens. One key component of smart cities is smart mobility, which refers to the integration of transportation systems with information and communication technologies. This research paper investigates the benefits of smart mobility as an integral part of the smart city of Novi Sad. Through a literature review and case study analysis, we found that smart mobility has the potential to increase the efficiency and sustainability of transportation systems, reduce traffic congestion and air pollution, and improve accessibility and mobility for all citizens. In addition, smart mobility can support economic development and contribute to the overall competitiveness of a city. Our findings suggest that the implementation of smart mobility solutions in Novi Sad could have significant positive impacts on the city and its residents.

Key Words: smart mobility, smart cities, sustainability, technology, integration, economic development, pollution, competitiveness, traffic, innovation

1. INTRODUCTION

Smart cities are urban areas that use advanced technologies to improve the quality of life for their citizens. Smart mobility, which refers to the integration of transportation systems with information and communication technologies, is a key component of smart cities (Buczkowski et al., 2019). Smart mobility has the potential to increase the efficiency and sustainability of transportation systems (Li et al., 2018; Ma et al., 2017), reduce traffic congestion and air pollution (Kim et al., 2016; Zhou et al., 2015), and improve accessibility and mobility for all citizens (Chen et al., 2019; Van Arem et al., 2014). Smart mobility can also support economic development and contribute to the overall competitiveness of a city (Buczkowski et al., 2019). Becoming a "smart city" refers to the integration of technology and data in order to improve the efficiency, sustainability, and livability of a city. Some benefits of a city becoming a smart city include:

Improved efficiency and cost savings: Smart city technology can help cities to optimize the use of resources, reduce waste and inefficiencies, and save money. For example, smart street lighting systems can automatically dim or turn off lights when they are not needed, reducing energy consumption and costs. According to a study by the Smart Cities Council, "Smart cities can reduce energy consumption and costs by up to 50 percent."

Enhanced livability: Smart city technology can help to improve the quality of life for citizens by addressing issues such as traffic congestion, air pollution, and public safety. For example, real-time traffic data can be used to optimize traffic flow and reduce congestion, while sensor networks can be used to monitor air quality and alert citizens to potential health hazards. According to a study by the International Data Corporation, "smart cities can improve the livability of a city by 30 percent."

Increased sustainability: Smart city technology can help to reduce the environmental impact of a city by promoting energy efficiency, reducing waste and pollution, and encouraging the use of renewable energy. For example, smart buildings can automatically adjust heating and cooling systems to reduce energy consumption, while smart waste management systems can optimize garbage collection routes to reduce fuel consumption. According to a study by the European Commission, "Smart cities can reduce greenhouse gas emissions by up to 40 percent."

Better citizen engagement: Smart city technology can help to facilitate communication and collaboration between citizens and government officials. For example, online portals can be used to provide citizens with access to government services and information, while social media can be used to engage citizens in discussions about city planning and policy. According to a study by the Smart Cities Council, "Smart cities can increase citizen engagement by up to 50 percent."

Novi Sad would become the first Serbian fully smart city. Becoming smart would result in increasing city's appeal, attracting talent, and overall increase in development momentum. Through smart mobility solutions, Novi Sad would also increase the visibility of its efforts to give answers to challenges of modern era like increased pollution, traffic congestions and quality of commuting.

2. AIM OF THE RESEARCH

In this research, the benefits of smart mobility are being explored as an integral part of the process of Novi Sad becoming a smart city. Aim of the study is to understand and analyze data on transportation patterns, citizen behavior, public transport, and improvement indicators before the implementation of smart mobility solutions. This research offers introductory framework for operational, fiscal and performance understanding of smart mobility solutions. Upon this research, authors are hoping to increase level of awareness with the interested parties and join efforts of academia, public sector and private businesses in achieving goals of smart mobility. Not only gaps are identified, but groundwork for future, more in-depth studies has been set.

Finally, this research offers pointers on prioritization of implementation of specific services based on the needs of citizens of Novi Sad.

3. METHODOLOGY

Survey has been conducted with Novi Sad residents to gather qualitative data on their experiences, thoughts, and challenges with smart mobility solutions.

Through this research, aim is to provide a comprehensive understanding of the impacts of smart mobility on the city and its residents.

The survey included a combination of open-ended and closed-ended questions. Open-ended questions allowed respondents to provide detailed, qualitative responses about their experiences with smart mobility. Closed-ended questions provided more structured responses and were useful for gathering quantifiable data.

Authors recruited a convenience sample of Novi Sad residents to participate in the survey. A total of 190 respondents completed the survey (62.1% males). Participants were between 18 and 65 years old, 80.6% were from 35 to 54 years old. A detailed structure of a sample by an educational level is presented in Table 1.

Table 1. A structure of participants by an educational level

	Frequency	Per cent
High school	31	16.3%
College	17	8.9%
Graduate studies	92	48.4%
Postgraduate studies	28	14.7%
PhD level	22	11.6%

To analyze the data from the case study and survey, the following methods were used:

Descriptive and inferential statistics: Authors calculated frequency and percentages of the respondents' answers. The correlations between particular answers were tested with Cramer's V.

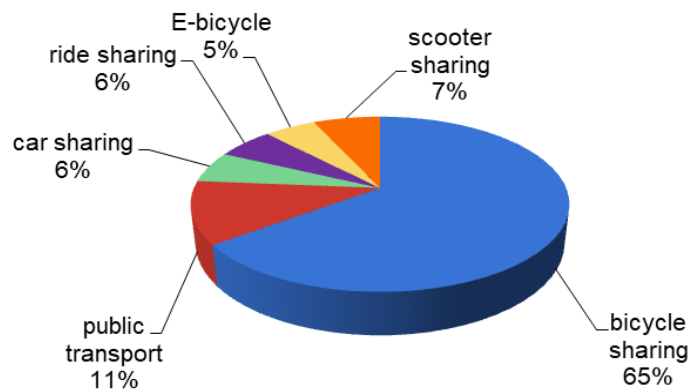
4. RESULTS AND DISCUSSION

Results showed that 93.7% of the sample is familiar with smart mobility, and 97.8% are willing to use smart mobility solutions. Graph 1 presents the smart mobility solutions that first come to participants' minds when thinking of smart mobility. Obviously, findings match well known fact that Novi Sad is a city of bicycles and that there is a culture created around it. One of the aims of authors is to deliver exact data on the bicycle usage, numbers, and time of usage. About two-thirds of the sampled citizens need the frequent use of innovative mobility solutions (65%), and about a quarter would use these solutions several times per month. Cramer's V was used to test whether these answers are related to educational level or age. No correlation was found between educational level and frequency of potential usage of smart mobility solutions ($\phi C(12)=.24$, $p=.55$) and no correlation between frequency of usage and age ($\phi C(15)=.21$, $p=.93$). These findings reflect the fact that citizens have an equal need for smart mobility solutions regardless of educational level and age.

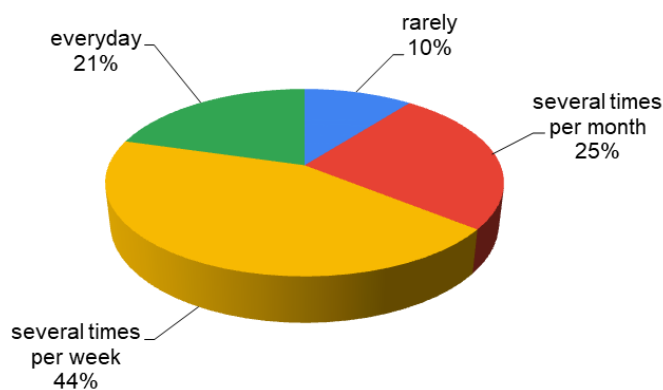
Asked about the obstacles to implementing smart mobility in Novi Sad, 55.3% of the respondents stated that there needs to be more information. In comparison, 31.6% believe there are currently no available solutions. However, the most significant finding is that only 2% believe that the solutions are too expensive. The remaining respondents give sporadic reasons, such as the need for a platform, user inattention, maintenance problems, and lack of infrastructure. Such results are promising because, in a digital age, providing information is less expensive than it used to be.

Graph 3 presents the distribution of answers to the benefits of implementing smart mobility solutions. About one-third of the respondents think that smart mobility increases general living convenience, while 30% emphasize a

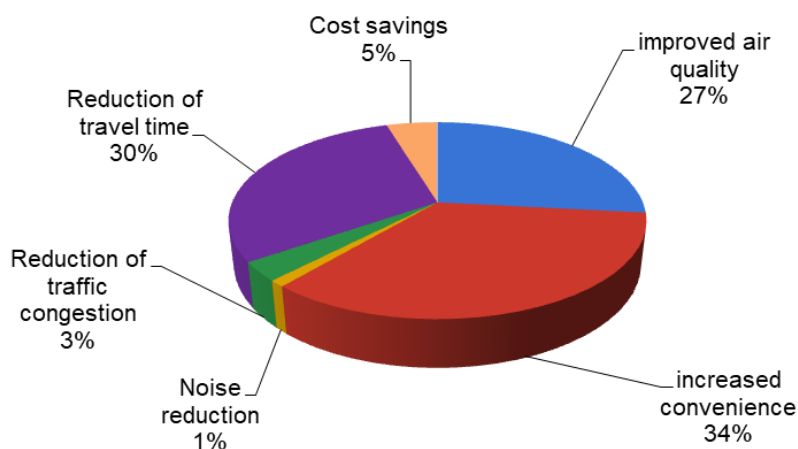
decrease in travelling time, and 27% of respondents point out lower air pollution. Interestingly, travelling time is a more frequent answer than cost savings (only 5%), meaning that Novi Sad residents are ready to use smart city solutions regardless of cost. This readiness is probably a consequence of the perennial problem of traffic jams, increased air pollution and the desire to ensure a higher quality of life in the city.



Graph 1. Distribution of answers about what is smart mobility



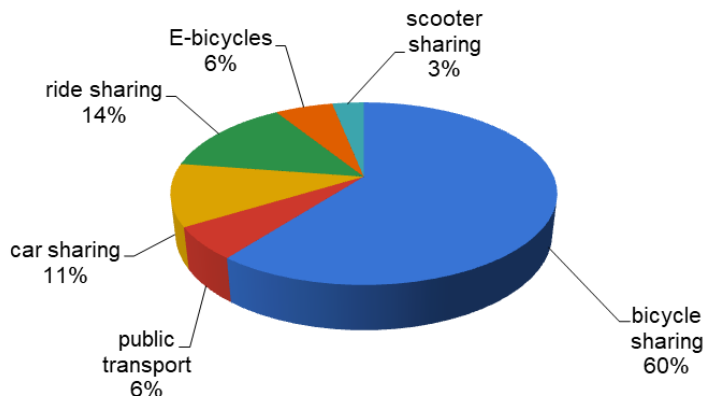
Graph 2. Distribution of potential usage of smart mobility solutions



Graph 3. Distribution of smart mobility solutions benefits

Results show that Novi Sad residents have adequate appeal towards smart mobility solutions. Although they are familiar with the smart mobility concept, they need more information about specific solutions, their implementation,

and additional benefits. The respondents showed high motivation for the smart mobility solutions, giving an advantage of a general increase in living conditions, a reduction of commute time, and a decrease in air pollution over cost savings. Analyzes showed that the need for smart mobility solutions is present regardless of the educational level and age of the respondents. They are primarily interested in bicycle-sharing services (60.5%) and car and ride-sharing (almost 25%; Graph 4). Although there is a bicycle-sharing system, Novi Sad citizens need this service to be more transparent or available.



Graph 4. Distribution of smart mobility solutions that respondents are the most interested in

5. CONCLUSION AND THE FUTURE OF THE STUDY

In summary, the research suggests that smart mobility can be an integral part of the smart city of Novi Sad, with significant benefits for citizens and their efficiency in movement, significant decrease in usage of personal vehicles and readiness to cut down on personal expenses related to mobility.

The high level of motivation reported by survey respondents indicates that smart mobility can also improve the quality of life for city residents regardless of their educational or age group, confirming that interest in introducing smart mobility solutions touches all segments of lives and all demographic groups in the city. This being proven, smart mobility solutions should be treated strategically high in the agendas of public decision makers.

To analyze the effects of smart mobility on transportation patterns, air quality, and economic indicators in Novi Sad, there is necessity to access data from the following sources:

- City of Novi Sad Transportation Department: Traffic congestion data, including average commute times and number of vehicles on the road.
- City of Novi Sad Environmental Protection Agency: Air quality data, including levels of particulate matter and other pollutants.
- City of Novi Sad Department of Economic Development: Economic indicators, including GDP and employment rates.

With this data authors will try and offer financial, time and operational frame to implementation of certain smart mobility solutions with the aim to improve transportation patterns, air quality, and economic indicators as part of efforts to transition Novi Sad into smart city.

Further efforts may be needed to address challenges to the adoption of smart mobility, such as cost, additional education on what smart mobility solutions stand for and availability of solutions in hand.

Finally, hassle freeness of the process of usage of smart mobility solutions plays vital role in successful implementation of it. Authors will further investigate and offer most resilient model of onboarding, registration, payment and technology for the smart mobility solutions implementation in Novi Sad – smart city.

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