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INDICATORS OF MOBILITY IN THE URBAN ENVIRONMENT – SMART CITY CONCEPT "CITY OF VARAŽDIN"

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Abstract

Every day we witness global urbanization that leaves mark on the environment and climate. This alone poses a challenge to numerous scientists and experts when it comes to urban planning and solving mobility problems in urban areas. In order for the urban environment to continue to develop, a sustainable transport system must be ensured. Precisely that will be showed at the example of the city of Varaždin. The indicator that will be addressed in this paper is Smart Mobility. It is extremely important to pay attention to mobility indicators in the transport sector, because they are the crucial basis for obtaining consistent and comparable data, establishing a knowledge base, establishing the possibility of communication with the rest of the environment, enabling the identification of good practice, enabling the monitoring of the implementation of projects that are being implemented as well as monitoring process of improvement and progress.

1. INTRODUCTION

The concept called "Smart City" is one of most popular concepts for the cities right now in Europe and all around the world [1]. In the very beginnings in Republic of

Croatia, especially in big cities, Smart City concept grows in popularity. As all around the world, cities in Republic of Croatia are also facing with strong structural changes which are caused by economical, political and environmental challenges. [2] We can define Smart City concept as an investment in people (society), modern ways of transport (sustainable mobility) and ICT which will have for result higher quality of life [2]. As far as is currently known, especially the concept of Smart city rests on foundations of sustainable development, respectably creating more environmentally friendly social and economical community. Within the concept of Smart city traffic and mobility are the key points for cities to function in qualitative ways. With that said, new ideas generate that can ensure better availability, safety and efficiency in city menagment. At the list of priorities cities have confirmed that becoming Smart city is their high priority. In that way they achieve numerous benefits, which some are: sustainability, efficiency, better society inclusion which automatically means better quality of life [3]. There is a six characteristics and indicators according to Colldhal [4] which refers to Smart City (Figure 1): 1. Smart Mobility, 2. Smart Economy, 3. Smart Governance, 4. Smart Environment, 5. Smart People and 6. Smart Living.

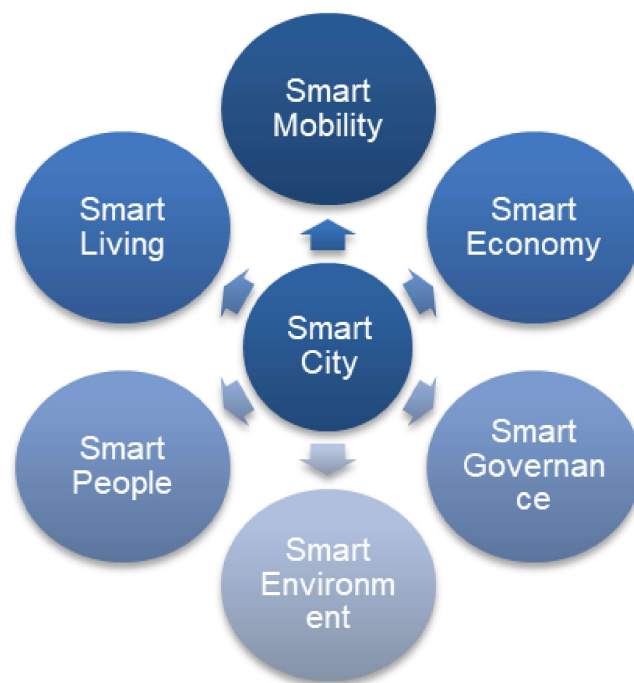


Figure 1: Smart City model - 6 characters [3]

The city of Varaždin is one of the urban areas in the Republic of Croatia that wants to be declared as Smart city. The city itself has developed the „Urban Mobility Plan of City of Varaždin – City Walk“ which represents the backbone of the further development of the city within the Smart City concept [5]. Smart mobility indicators that are observed through this work are traffic, people, goods and information.

2. SMART MOBILITY INDICATOR – THE SMART CITY OF VARAŽDIN

For many years, the city of Varaždin has been investing in the development of transport infrastructure in order to achieve positive effects on urban mobility and create a desirable environment for living. Before actively taking steps to transform the city of Varaždin into a Smart City, spatial planning and strategic development documents were created, through which the characteristics within the Smart City concept were influenced, that is, in this case, Smart Mobility in correlation with Urban Mobility. The city of Varaždin has set itself the task of making walking and cycling key components of the development and development of a sustainable transport system. The mentioned types of mobility are characterized by zero emission of harmful gases as well as low costs, and at the same time they contribute to maintaining the health of the individual because they lead a more active lifestyle.[6] Smart Mobility at this point means the area of a Smart City which representing Smart Mobility and broadly defined, the components which comprise not only the traditionally understood transport of people and goods, but also the dissemination of information by digital means. The main role of the Smart Mobility indicator area is to connect all the city's resources [7]. At this point Smart Mobility indicator means people, information and goods [7].

2.1. The current state of smart and urban mobility in the city of Varaždin

In the last few years, the city of Varaždin has been investing significant funds in the development of bicycle and pedestrian paths, which is certainly justified considering that they are working on the Smart City concept under the Smart Mobility component. Varaždin is one of the important destinations for daily trips and is one of the few cities in the Republic of Croatia that has an established public transport system. The city has developed an urban mobility plan, which outlines the current state of the city in terms of mobility and traffic safety when it comes to pedestrians and cyclists, as well as bus transportation [6]. In the Urban Mobility Plan, the city of Varaždin covered every segment of traffic, including city logistics and traffic safety, as well as environmental and nature protection, as well as the public and private sector in terms of service providers which indicates that the Plan covers every segment of sustainable development and that the city is really moving towards a "Smart City". In 2017, an analysis was carried out in the Plan, where Šimunović and his colleagues presented a conclusion in which it is emphasized that it is necessary to pay attention to the quality of existing sidewalks, lighting, and that it is necessary to carry out an analysis of the curbs that are part of the city streets because they represent a potential danger and prevent safe movement through the city [5]. It is stated that the bicycle paths are not sufficiently well connected to each other, but also that there is a very high level of danger to cyclists from motor vehicles [5]. In support of this, traffic accidents are one of the "typical" Smart City factors that traffic experts deal with when it comes to the Smart City concept, because through it they try to reduce them, as well as reduce the traffic jams caused by them. In this case, the analysis of road accidents revealed that there were no fatalities in road accidents where cyclists were involved, but there were those who were seriously and lightly injured, while in road

accidents where pedestrians were involved, 1 person died, and the most common reason was inappropriate speed of a motor vehicle (collision with a pedestrian).[5] Namely, in 2017, a traffic count was carried out in the city of Varaždin at characteristic points, and in the same year the "Urban Mobility Plan of the City of Varaždin - City walk" was drawn up, then the count was carried out at the same characteristic points (12 of them) in 2023, when Evaluation of the said Plan was carried out, which showed the current state of the city of Varaždin in terms of urban mobility. The obtained results are shown in table 1.

Table 1. Comparison of peak loads in 2017 and 2023 on the traffic network of the city of Varaždin [6]

	Street	Peak load 2023 (EJA)	Peak load 2017 (EJA)
1.	Koprivnička street (before crossroads with Međimurska)	7436	9650
2.	Međimurska street (before crossroads with Koprivnička)	12210	12703
3.	Optujska street (around house number 67)	14337	10358
4.	Brač Radića (at the old entrance to the hospital)	9328	8880
5.	Jelkovečka street (around house number 89)	5247	5351
6.	Zagrebačka street (at the Hyundai saloon)	14850	12806
7.	August Cesarec street (at the park)	11594	7928
8.	Preradovićeve street (at the gymnasium)	1991	6332
9.	Preradovićeve street (at the street market)	5390	4582
10.	Vrazova street (at the McDonalds)	12936	12786
11.	Zrinski i Frankopana street	12980	13358
12.	Gospodarska street (at the Vindija)	14135	-

The table shows that in certain parts of the city there was an increased load compared to 2017 for example Zagrebačka street and Optujska street. Also, increase is visible on the first city ring, and is especially noticeable in Augusta Cesarca Street. The plan defines the goals and measures that need to be implemented in order to contribute to the realization of the Smart City concept in the

Smart Mobility component, and the goal that is observed through the work is: "Increasing the attractiveness and quality of non-motorized traffic". In this case, the planned measures for the fulfillment of the stated goal were: preparation of the elaboration of the expansion of the pedestrian zone and incorporating the bicycle infrastructure and defining the stages until 2026.; draw up an elaboration of the construction and renovation of pedestrian routes and define the stages until 2030; create a traffic study of the bicycle network, within which the phasing of the addition and expansion of the bicycle infrastructure and network will be defined until 2030; preparation of the elaboration of the construction and renovation of pedestrian routes and define the phasing until 2030 (completed); preparation of the elaboration of the bicycle network, within which the phasing of the addition and expansion of the bicycle infrastructure and network will be defined until year 2030. preparation of studies on the introduction of a bicycle service system on call, implementation of campaigns with the engagement of an external specialist contractor (completed), regular replacement of old and installation of new lighting fixtures with LED technology (completed) and implementation of campaigns with the engagement of a public expert [6]. Only 3 measures were implemented, which was not enough to reduce motorized traffic and increase non-motorized traffic.

2.2. Proposals and measures for a more sustainable and smarter city

Given that the "Urban Mobility Plan of the City of Varaždin - City Walk" has defined goals that aim to influence the creation of more sustainable traffic (zero emissions, low costs), based on the previously presented data, it is evident that additional measures should be taken, i.e., measures should be implemented to fulfill general and specific goals defined by the Plan [5]. 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. Taking into account that one of the defined goals is: "Increasing the attractiveness and quality of non-motorized traffic", based on the data from Table 1, it can be seen that not much has changed in this direction, considering that motorized traffic has increased significantly in certain previously mentioned sections [6]. In order for the given goal, which is actually a combination of measure and goal, to be fulfilled, it is necessary to define it more clearly, as this will facilitate the implementation of the planned measures. If the stated goal could not be met, it is suggested to count the traffic more often in order to get a more precise picture of the real situation, if all the proposed documents as measures to fulfill the goal could be prepared as high quality as possible and obtain concretely visible results.

3. CONCLUSION

The city of Varaždin is one of the few cities that has prepared the necessary strategic documentation that supports the Smart City concept and achieves it. Since the aim of the work was to show whether anything is being done in the City of Varaždin regarding the characteristics related to the Smart City concept of Smart Mobility, it is

evident that it is being done. Significant funds are allocated by the City to improve the transport system in order to meet the goals prescribed by the strategic documents and thus realize the Smart City concept. For now, it is still necessary to implement a large number of prescribed measures in order to improve the current situation and increase the sustainability of the transport system. This is indicated by the presented data on the number of motorized traffic as well as the number of traffic accidents involving non-motorized traffic. In the spirit of environmental awareness, but also of human health, it is necessary to implement measures primarily closely related to non-motorized traffic, and then also to motorized traffic, which will at the same time meet the conditions of the Smart City. The city of Varaždin has good prerequisites to become a Smart City in the full sense of the word in the foreseeable future.

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