THE ROLE OF SMART MOBILITY IN SMART CITIES

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Abstract

As a concept, Smart City represents a comprehensive system of services implemented throughout modern technologies whose purpose and goal are to improve the quality of life for the citizens. The Smart City concept and strategies are focused to improve the current services in cities, make the existing infrastructure more suitable, make the citizens participating, and ultimately, to enable sustainable development of the urban environment in the future. A key element of the concept involves day-to-day mobility, a necessary precondition for the prosperity of the urban environment. The global urbanization trends and the increased number of residents living in urban areas generate additional mobility. Therefore, managing transport demand to enable increased mobility, especially by using private cars, becomes a more complex and challenging task for traffic experts. The paper analyses the possibilities to apply the Smart City concept in the Republic of Croatia. The results indicate a very high acceptance to implement the Smart City concept, and the respondents perceive Smart Mobility as an integrated part of the Smart City. Three key segments of Smart Mobility are highlighted in the paper: intelligent use of information and communication technology, smart public transport, and smart parking technologies. Most of the surveyed cities are participating in projects related to Smart Cities, and they are willing to allocate certain funds to implement the concept.

Keywords: Smart City; Smart Mobility, Urban Area, Transport Demand Management, Republic of Croatia

1 Introduction

The Smart Mobility concept is rapidly gaining popularity in scientific community and real life. The increasing number of world population living in cities, global urbanization trends, and the influence on the climate change and the environment renders tasks in segment of urban mobility increasingly demanding for traffic planners. Most cities in the world are confronting to establish a sustainable traffic system, which is essential for maintaining and improving the urban environment. The economic prosperity of cities and the excessive private car usage cause negative consequences for cities in form of traffic congestion and delays, negative environmental impacts (noise, pollution), and ultimately the application of the regressive investment policies in transport infrastructure segment.

The following documents are fundamental for developing smart mobility in the European Union: White Paper 2001; European transport policy for 2010: Time to decide [1], Green paper 2007; "Towards a new culture for urban mobility [2], "Action Plan on Urban Mobility 2009" [3], WHITE PAPER 2011; "Roadmap to a Single Transport Area – Towards a competitive and resource efficient transport system" [4].

This paper will analyse the Smart Mobility concept, smart mobility indicators as key elements of Smart Mobility, good practices in the EU countries, and the current state of the Republic of Croatia regarding the subject. In Chapter 2, the definition of Smart Mobility will be explained, and what benefits the local government gains if they start to implement the concept in their

community. In Chapter 3, the Smart Mobility indicators and their importance for assessing the existing state will be presented, together with reasons to have different indicators in each city. Chapters 4 and 5 describe the current Smart Mobility state in EU countries and Croatia, their good solutions for better mobility, and the extent of implementing solutions in Croatian environment.

2 The Smart Mobility concept

A Smart City is an urban area using information and communication technologies, business models, and solutions to increase operational efficiency, share information with the public and improve both the quality of services and citizen welfare. The Smart Mobility is one of the important pillars of the Smart City concept. Using various technology solutions in every field of transport and traffic science, possibilities for implementing technology into transport sector is more and more increasing. The development of information and communication technologies is the key factor for creating a Smart City. Mobility in the cities has become one of the biggest problems for local municipalities. The Smart Mobility is a concept, where with various past and real-time data, and with the help of information and communication technologies, travel time is optimized, resulting in reductions of space usage, road congestion, road accidents and emissions of harmful gases. Figure 1 shows that Smart Mobility consists of various digital solutions. Digital solutions are focused on optimizing demand and supply of people and goods.
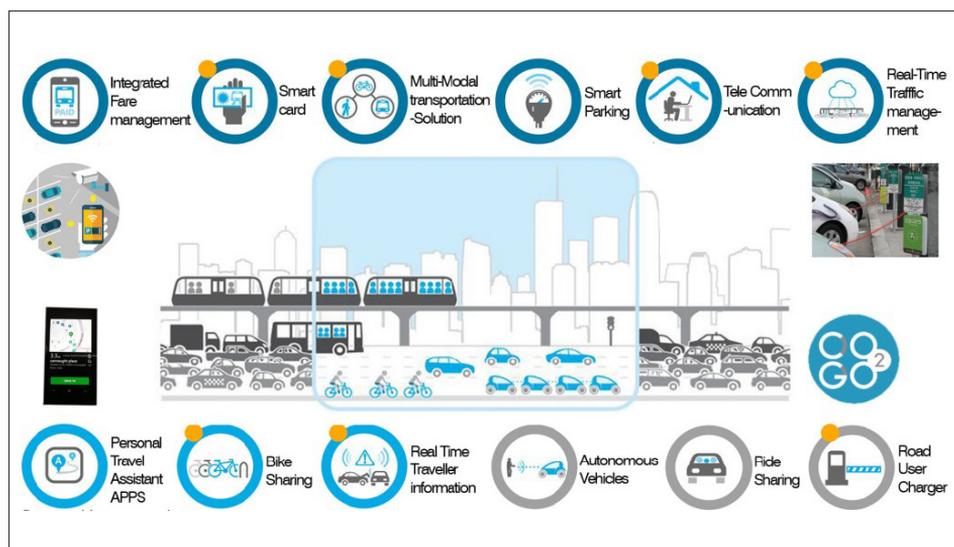

Figure 1 The Smart mobility concept [5]

3 Smart Mobility indicators

Smart Mobility is a part of the Smart City concept, based on optimizing transport sector in urban areas. Optimizing the mobility could be done by introducing new information and communication technologies. To achieve this optimization, the goals of smart mobility need to be determined first. The goal of Smart Mobility is to reduce the economic, environmental and time costs (in every mode), and therefore, to achieve these goals, setting the indicators becomes crucial. There are many indicators that can be suitable for Smart Mobility, but only

few of them can be chosen if the data wants to be collected efficiently. The indicators must be chosen for every city separately. The reason for choosing the indicators for every city individually lies in the fact that every city has specific urban area characteristics, population, socio-economic characteristics, specific city administration, transport problems and financial framework.

Among the many others, there are three methodologies for choosing the right set of indicators standing out. The Sustainable urban mobility document [6] describes that cities need to choose a set of 22 mobility indicators. By choosing that number of indicators, cities can detect real needs both in passenger and the freight sector. The Future of Urban Mobility 2.0 [7] describes, by ranking 84 cities, 19 different indicators for determining urban mobility state. A Framework for Urban Transport Benchmarking [8] describes the examples of best practices for choosing indicators in public transport. The SMART principle (Specific, Measurable, Achievable, Relevant and Timebound) helps to determine the optimal set of indicators for assessing the level of quality in transport systems.

Table 1   Example of indicators for smart mobility [9]

Factors evaluated	Smart City (SC) or Conventional City (C)	Description
(MO1) Sustainable Mobility Urban Plans (SUMPs)	SC › 2	With SUMP
	C = 2	Without SUMP
(MO2) Integrated payment method in multimodal transport systems	SC › 2	Smart card payment, smartphone payment
	C = 2	Common tickets
(MO3) Deployment of alternative modes	SC › 2	Integrated payment in Public Transport
	C = 2	Bicycle registration
(MO4) ICT in traffic control	SC › 2	ICT technologies integrated
	C = 2	Basic control

At planning the sustainable urban mobility process, smart mobility indicators must be set. The concept of smart mobility (a holistic concept) widely used is focused on citizen needs, quality of life and health in the city, during the planning and implementation phases. The chosen measures, serving as guidelines for achieving the sustainable goals, should be measurable by indicators. The indictors are based on measuring the rate of implementing information and communication technologies. Table 1. shows an example – four evaluated factors as representatives to measure the extent of smart mobility.

An overview of the current state of mobility and improvement measures can be obtained only through high-quality indicators. Shortcomings that must be removed regarding to the indicators are the absence of systematic data collection in urban environment, incapability of the current data to follow EU and world trends, and insufficient data processing in many cities.

4 Examples of good practice in EU countries

Smart Mobility has started in implementing phases in various cities in EU countries. The leading countries in the European union in this segment are the Netherlands, Sweden, Denmark and Germany. In transport and mobility sector, the opinion on what kind of infrastructure is adequate for mobility of people has changed in the past 20 years. The old way of thinking – building roads or other infrastructure and increasing their capacity will solve mobility needs is replaced with the new one – how to use various solutions (especially information and communication technologies) to optimize the performance of the existing infrastructure and transport systems. Table 2 shows the examples of best practices in smart mobility in the Netherlands.

Implementing smart technologies into real transport sector brings significant improvements in road safety and impact on the environment in general. The implementation of the technologies is expected to increase in future years, depending on budgets and funding because of higher awareness to use new and modern technologies in optimising system performance.

Public transport and parking management are the fields of urban mobility that have many possibilities to implement information and communication technologies. Developing technologies such as Internet of things, smart cards and chips, cloud computing, mobile devices, various software, data collection software and management have various possibilities to increase possibilities, performance and attractiveness of public transport and parking management. Smart cards have simplified and accelerated fare charging process, and thus expanded possibilities for its users (more charging schemes, one card for multiple services, etc.). Smartphone apps can be used as means of payment, but also as a source of information about real-time traffic, public transport, or parking facility status.

The existing technologies implemented in public transport are: smart card, e-vehicles, autonomous vehicles, software for planning an organizing public transport network, data collecting devices, software for data processing, various real time information systems, smart public transport stops, etc. The existing technologies implemented in parking facilities and parking management are: apps for optimizing available car parks, devices and sensors for counting available on-road parking spaces, smart cards for charging parking fees, software for parking management, etc.

Table 2   Smart mobility indicators – examples in the Netherlands [10]

Smart mobility solution	Solution explanation
Smart corridors	Creating the most intelligent motorways in Europe by using latest ITS solutions in cooperative and transport systems.
Intelligent junctions	Smoothing the traffic flows and reducing door-to-door travel times by interactive communication between cars, lorries, public transport vehicles, bicycles and emergency services with one another as well as with traffic lights and other beacons and sensors.
Joint deployment	Motorists receiving detailed information on roadworks over a secure WiFi connection, and cars serving as mobile sources of traffic information and passing these data on to traffic control centres
WEpods	Autonomous vehicles on public roads, following a fixed route – the so-called WEpods (without a steering wheel or pedals) travel between Ede-Wageningen railway station and the campus.
Truck platooning	Truck Platooning comprises many trucks equipped with state-of-the-art driving support systems – one closely following the other. This forms a platoon with the trucks driven by smart technology, and mutually communicating.
FREILOT project	Communication between the traffic lights at the busy arterial road and the lorries enabled the system to provide the drivers with speed advice, displaying the remaining time to green.

5   Smart Mobility in the Republic of Croatia

Smart City and Smart Mobility as concepts are relatively new in Croatian cities. Smart mobility concept in the Republic of Croatia is at its beginnings, and currently, the cities have implemented only a few smart mobility solutions (smart bus stops, smart cards and displays, apps for real-time data). The Department of Urban Transport at the Faculty of Transport and Traffic Sciences has conducted research in 2017 regarding the current knowledge and implementation of Smart Mobility and Smart City concepts in Croatian cities. In cooperation with the Association of Cities, research has been conducted on 23 percent of all cities in the country (128 cities). The research has detected the following: there is an involvement in the imple-

mentation of the Smart City and Smart Mobility concepts, and thoughts about defining the concept, relations between Smart City and Smart Mobility, characteristics of the smart mobility, the existing and future implementation of the concept, and funding and participation in related projects. The research has showed the following results:

- 32 % of participated cities are involved in the implementation of the Smart city concept, and 64 % are planning to start;
- There are three components of the smart mobility: ICT technologies (86,2 %), smart public transport (65,5 %) and smart parking (58,6 %);
- The implemented Smart City solutions are: Air quality control (33 %), traffic control (22 %) and smart parking (11 %);
- ICT technologies (60,7 %), smart parking (50,0 %), traffic control (39,3 %) and smart public transport (32,1 %) are smart mobility solutions that the observed cities will be implementing in future;
- Most of the surveyed cities will allocate certain financial resources especially for Smart City and Smart Mobility solutions (51,7 %).

The city responses indicate that Smart Mobility is an integral part of the Smart City. Accordingly, all components of Smart Mobility should be compatible with the Smart City concept. Some of smart mobility solutions that implemented in cities in the Republic of Croatia are: Nextbike (public bike sharing service), Uber, various taxi apps, apps for optimizing the usage of on-street car parks (smart parking in Split, m-parking in Zagreb, parking in Rijeka), smart card in public transport (Zagreb, Osijek, Rijeka, Sisak), smart logistic solutions and developed SUMPs for a few Croatian cities.

6 Conclusion

Smart mobility is the key element of transport systems in future cities. The increasing sciences activities and development in the transport and urban mobility sectors lead to smart mobility improvements. The existing research shows that various cities in the European union are trying to implement the Smart City concept in their urban areas. Developing sustainable urban mobility plans and detecting needed Smart Mobility indicators are two crucial parameters for implementation in specific urban areas. In the global urbanization process and economic prosperity, Smart Mobility contributes significantly to developing the Smart City concept. According to the study carried out by the Faculty of Traffic Sciences, the cities in the Republic of Croatia are at only in the beginning of implementing the Smart City concept. There is a need for harmonized databases on urban mobility indicators, so that developing Smart City concept would be easier. Further steps in researching smart mobility should manifest as adjusting the databases of indicators to most recent methodologies, developing sustainable urban mobility plans for each city and ensuring financial resources for smart city and smart mobility solutions.

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