Smart Infrastructure in Bratislava

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Abstract. After the fall of former political regime in Slovakia in 1989, Bratislava has undergone many dynamic developing changes that were not too positively influenced the appearance and functions of the city. Spontaneous and unsystematic development in this period seems to continue even after 25 years. Conversely, a significant decline is becoming increasingly marked in the urban infrastructure, of which insufficient attention is paid. This is because infrastructure for developers is often only enforced expenditure and the city does not have sufficient financial resources to meet requirements on its renewal. Moreover, the infrastructure requirements from before 30 years are now heavily modified and it is currently inadequate and capacity insufficient. Here we can mention for example a significant parking problems in many parts of Bratislava mainly caused by the substantial increase in the level of motorization to the period when the present transportation infrastructure was planned. Of course, in Bratislava there are also some positive examples, to which the authors of this paper focuses, that are currently considered significant by the fact that towards the Bratislava closer to the concept of Smart City. In these selected examples it is also important the implementation of existing ICT technologies that form an integral part of the modern Smart Cities. The Aim of the paper is also propose improvements to the current solutions.

Keywords: Urban infrastructure · Smart city · Bratislava · Urban mobility · Knowledge infrastructure

1 Introduction

In the urban context, the physical infrastructure is understood as an integral part of every urbanized area. It constitutes an important segment ensuring economic and social system functions as well as material and technical background of the city. Urban infrastructure may be compared to the human cardiovascular system, that is quite complicated vascular (network) system, which plays a crucial logistical tasks - allows movement and distribution of energy, services, capital, etc. in urban living organism.
   Generally we can urban infrastructure subdivided on:

- Transport infrastructure, including private transport, urban public transport, cycling, pedestrian traffic, tram or other rail transport, air and water transport;
- Technical Infrastructure, which includes all utilities, i.e. electric, water, gas and sewerage networks, or further distribution of waste management; optionally

telecommunications networks; including all structures related to the operation of these networks (e.g. water towers, transformer stations, substations or pipelines);

- Social infrastructure, which includes homes and housing stock, education, health, social welfare, culture, sports, recreation and services for the population;
- Public areas (all areas to be used in the public interest).

For the past 25 years Bratislava has undergone many dynamic changes. Disordered and uncontrollable urban development without comprehensive strategy or insufficient implementation of support system - both static and dynamic transport infrastructure [1] should be the main reasons such as these developing processes should be started to meet the highest requirements of contemporary modern European cities. The technical state of transport infrastructure is closely linked to the technical state of most of the technical infrastructure, which is often conducted in the corridors of roads.

The new millennium is marked by new technologies and ever increasing demands for comfort and enhanced quality of living. Every day of a human beings life is extremely valuable and to use it fully, it is necessary to accelerate and simplify the performance of routine activities by the deployment of central management systems, providing more efficient operation and reduce energy consumption and optimisation, which means concept by implementation of the newest smart technologies [2].

Bratislava in recent years has tendency to move towards the European modern smart city. It certainly can take as an example the nearby city Vienna that its programs and policies at least the last past five years is ranked among the most modern and most innovative cities in Europe. Right here, authors want on selected examples show how Bratislava in recent years is moving closer to achieve the Smart City concept.

2   Smart Urban Mobility

Urbanisation is accelerating at pace, placing new, intense pressures on city resources and infrastructure. Urban Mobility will be one of the toughest challenges for cities around the globe. In many cities, existing mobility systems are already inadequate, yet urbanisation and increasing populations will increase demand still further. Cities have traditionally sought to solve such challenges by adding new capacity to match demand. However, a capacity-building approach alone is neither efficient nor sustainable [3].

Mobility describes the ability of people and goods to move around an area, and in doing so to access the essential facilities, communities and other destinations that are required to support a decent quality of life and a buoyant economy. Mobility incorporates the transport infrastructure and services that facilitate these interactions [3].

There is a need for substantial changes in Europe's transport systems, as well as in the mobility behaviour of people and businesses in urban areas. Solutions concern the creation of an efficient and integrated mobility system that allows for organising and monitoring seamless transport across different modes; increasing the use of environmentally-friendly, alternative fuels; creating new opportunities for collective mobility. The proposed solutions lead to a decreased environmental impact [4].

At this point, authors' deals with selected aspects of urban mobility, which tend to shift Bratislava to achieve Smart City concept. The first area is so-called bike-sharing

system as an important tool for alternative urban transport and reflects a growing pressure for green mobility. Another area of research is the use of Information and Communication Technologies (ICT) in public transport and in parking.

2.1 Bike-Sharing System

At the beginning it should be said that the city bike-sharing program does not exist. However, in Bratislava arose a community bike-sharing program called White Bikes - public bicycle rental system. The project is organized by the Association "Cyk-lokoalicia" and use is conditional upon completion of the training - how to use the bikes. Currently is available fifty white bikes (Fig. 1) and 70 registered users. All bikes come from the Netherlands from Park De Hoge Veluwe [5].

The main motivation is not sharing of bikes, but their presence in the city and even at night. The aim is to promote cycle transportation and thus get rid the roads of onslaught of cars. The entire system is set up via SMS and is based on the approval process. If someone wants to use a bicycle, it is necessary to always register and receive the training [6].

The whole system works so that the White Bikes can borrow only Bratislava citizens, the third sector, non-profit organizations, or anyone who works for the municipality of Bratislava. Bicycles are free to lend. It's a reward for active Bratislava citizens consider that they are doing something for their city. However, in the future it is planned the collection of fees due to the fact that bikes have been returned back. The aim of the bike-sharing project is that bikes were seen in the streets, so that they truly can benefit people. There is currently 25 positions, where bicycles can be stored in Bratislava.

Fig. 1. Bike-sharing program White Bikes [12]

The authors see the greatest negatives in:

- The need for registration and approval process,
- The need to undergo training,
- Lack of storage sites.

Authors Innovation: We suggest the automatic functioning of the system. It would be necessary to transform the SMS system to a system based on a smartphone application. The location information of the bicycle would be sent automatically based on the GPS and was marked to the dynamic map which will be available for all online users. So they know where they can take a bicycle. The user would be identified based on the IP address of the mobile device, which would they entered on the station store. Bicycles should be equipped with GPS devices to track the current location in order to prevent theft. Financing would be secured by the municipality of Bratislava, NGOs and by voluntary contributions.

2.2   SMS Parking System

Since 2010, drivers can on marked parking areas of the Bratislava centre pay parking fees via mobile phone - through SMS, without further registering. Electronic parking card driver immediately receives in a return SMS, while the price is currently set for 1 Euro per hour. Vehicles which have paid parking through SMS-Parking System are registered in a protected database system and when checking the paid parking by authorized persons, so there is no risk of any penalty.

Parking system in Bratislava by using SMS, after several years shows no significant problems. So we do not have thus any significantly complaints. At this point, we just advised the option to purchase parking at different time periods. Today, after the expiry of the time 90 min, it is necessary once again to extend the parking by sending a new SMS.

2.3   SMS Tickets for City Public Transport

Since 2008, in Bratislava it is possible to travel by public transport by using electronic SMS ticket. SMS ticket can be bought through Slovak mobile operators. The price of SMS ticket is € 1 per 70 min or € 4.50 per 24 h (including baggage). Discounted tickets or any other time alternative tickets are not provided via SMS.

It should be added that the SMS ticket has stagnated for years and it is not developing further.

Authors Innovation: Improving of this provided service authors see mainly in the fact that it could be possible to purchase all possible types of tickets, including discounted for students and for all time alternatives. Nowadays, of omnipresent Wi-Fi networks and of the mobile internet, we suggest other way of ticket buying which could be realized through internet applications, respectively by using of the QR code. The QR code is an open standard, two-dimensional barcode, which would be accessible on the

bus stops. After capturing the code buyers would be redirected through the application on public transport website where they could simply buy tickets.

Inspectors in the vehicle should have a connection to the Internet through smartphone applications and by online real-time payment they could immediately found buying tickets based on the IP address of the devices. This would help to avoid the above problems which arise when tickets are paying through SMS.

3 Smart Knowledge Infrastructure

Edwards (2010) defined knowledge infrastructures as "robust networks of people, artefacts, and institutions that generate, share, and maintain specific knowledge about the human and natural worlds." [7] Under this definition, knowledge infrastructures include individuals, organizations, routines, shared norms, and practices [8].

But the essence of Knowledge Infrastructure are in particular information whether in the form of data, findings, experience or other forms. Smart solutions involve data gathering, real-time processing, data analytics and visualisation. Using data ultimately aims to support better decision and enable innovation. New technologies and availability of data, and the near-universal uptake of mobile devices, therefore offers an opportunity to innovate in order to make our urban areas more adaptive and resilient [9].

Among the selected aspects of Knowledge Infrastructure the authors chose an area that the essential nature is in dissemination of information.

3.1 Tourist Info-Points

Bratislava is visited each year approximately 500 000 tourists. From several surveys conducted on a sample of foreign tourists many times was indicated that one of the significant problems in Bratislava are currently limited possibilities of obtaining information about the city. Tourists' awareness in Bratislava is distributed through Tourist Information Centers (TIC). There are actually four centers in Bratislava.

Authors Innovation: The issue of obtaining tourist information in Bratislava authors see in strategically placed of Tourist Information panels – Info-points in the form of kiosks with the interaction touch screen monitors (Fig. 2) and Internet access. In addition to the Internet connection these Info-points could offers the possibility of free internet access through Wi-Fi. Info-points should be mobile, deployed in the most frequented tourists' sites, including all bigger business centers and major transport hubs and other frequented places.

3.2 Free Internet Connection

Signal coverage area for wireless ICT facilities are located in the building of Municipality of Bratislava; also in three large squares in the center and one is on the Danube embankment. Internet connection are free of charge and has no limits to the public. The public Wi-Fi could be used quite comfortably, because in the vicinity of these areas are benches.

Fig. 2. Example of Info-point panel in Gronau, Germany [13]

Internet kiosks are urban pilot project of introducing the Internet for the public in the city center. There are currently three terminals based on PCs that serve to the public for free of charge. Other possibilities are "hot spot areas" in cafes, shops, restaurants and bars that offer a limited time of free connection [10]. There are now more than 120 of such places throughout the city. Free Wi-Fi is also accessible in public transport in a fifty buses [11].

Authors Innovation: As an innovation we propose building of the so-called "Power boxes", designed for free charging of ICT facilities on public areas such as on squares, stations and other frequented places and important transport hubs.

Of course, the city should be striving to improve the Wi-Fi service in the form of quality improvement of the signal but also increasing places of coverage.

3.3   e-Governance

Municipality of Bratislava launches e-governance project in 2015. It is a project of electronic council, which contributes to saving the environment and optimize the work of the City Office. The official website of the city will be available invitations and materials for meetings, profiles of deputies and information about their individual vote, or resolution of the City Council. The new application will serve all - as citizens, as well as local authorities and the deputies.

4   Other Smart Infrastructure

4.1   Smart Public Lighting

It would be mainly on communication for pedestrians as well as joint public spaces that meet the assembly function like squares, parks; or parking lots. It is the concept of a public street lighting with modern LED lighting, which would use alternative solar energy with built-in twilight switches that turns on and off automatically; and with intelligent control and management of public lighting. Furthermore, this smart lighting would regulate the light intensity by means of motion sensors - if the pedestrian roads in the same time will be empty, then the light intensity will be automatically reduced to a minimum set limit. Once someone came to that communication, via motion sensors would be increased the light intensity.

5   Conclusion

Bratislava in recent years, striving to become smart modern metropolis. Unfortunately, initiative that develops toward this current global trend is far from sufficient state. Because of some elementary but very important deficiencies such as the city parking policy, or the creation of spatial plans at zonal levels, whether completion of the city core transport system, Bratislava cannot be classified among the European elite metropolis such as near partner city Vienna.

Of course we agree with several "minor" initiatives in the aforementioned examples. However, even here it is important to have a rather critical stance towards certain concepts. Providing of information and working with them is the typical Slovak long-term problem. Lack of information in the form of data (such as non-existent databases on static and dynamic traffic), or their non-transparent publishing often leads to a distorted view of the relatively important facts.

Therefore we think that the first step towards achieving the concept of Smart City might be just the creation of informational databases and their transparent disclosure from the municipality.

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