

Comparison of applications of Smart City concept in the capital cities of V4

Simona Jaculjaková¹, Lukáš Trnka², Stanislava Turská¹, Jana Kurotová¹, Iwona Rybicka³

¹Department of Communications, University of Žilina, Žilina, 010 26, Slovakia

²Department of Road and Urban Transport, University of Žilina, Žilina, 010 26, Slovakia

³Faculty of Mechanical Engineering, Lublin University of Technology, 36 Nadbystrzycka Str., 20-618 Lublin, Poland

Abstract The article deals with the issue of Smart City concept in the capitals of the V4 countries. We have defined technical terms that are related to the issue. In the analysis of the current situation, we focused on individual areas in which the Smart City concept services are provided. Based on the analysis of the current state, we have concluded. The most frequently used applications in V4 capitals are those belonging to the three areas studied. These areas include transport, ecology and real-time services. We compared the individual applications provided to citizens in the capitals of the V4 countries. These applications are included in the three mentioned areas of the Smart City concept. Based on a detailed analysis, we defined the advantages and disadvantages of the three most used areas of the Smart City concept.

Keywords Smart City, Applications Smart City, Transport services, Environmental services

JEL O39, Q56, R11

1. Introduction

The term "Smart City" is often used in the technical field. It describes the application of complex systems that are integrated into the operation of urban infrastructure, transport, public safety, etc. We could look at the concept of Smart City as a city that try to implement innovative technologies that enable the construction and development of public infrastructure, public lighting, cycle paths, waste treatment solutions, public buildings, etc. These innovative technologies are implemented in transport, infrastructure building, service extension and security for citizens.[1]

On the other hand, we can see Smart City like the collaboration of all stakeholders. Subjects which are involved in Smart City are the inhabitants, entrepreneurs, public sector, academia and non-governmental organizations. These stakeholders co-decide on innovative urban change. It is necessary to create concept of Smart City in order to make innovations in individual cities.[2]

2. Analysis of the current state

We focused on areas that provide services for the Smart City concept. We focused on the specific description of service implementation, service stakeholders and individual examples of the use of the services in the monitored areas. Within the V4 countries (Slovakia, Czech Republic, Poland and Hungary), we have assessed which of the

above-mentioned areas of the Smart City concept are most often used in individual countries.[1]

An overview of smart urban services

The Smart City concept provides a wide range of individual services and applications that can be used in everyday life. In the table we can see in which areas can be concept used, which intelligent services can be provided and who can benefit from such services.[1]

Table 1. An overview of smart urban services

Description	Interested parties	Examples of use
General business services		
Establishing relationships between city and partners to deliver value-added services to stakeholders.	Local authorities or local government, citizens, local interest groups, suppliers and service providers, educational institutions and business communities.	<ul style="list-style-type: none"> • smart shopping • order online services • easier access to the labour market for citizens
Smart buildings		
Smart buildings take benefits from integration of communications and management systems	Citizens, local authorities or local government, suppliers and service providers, business communities and environmental organizations.	<ul style="list-style-type: none"> • optimized air conditioning, • management of general facilities

Education, health care and social services		
Creating applications that help to improve processes in these areas. These applications also provide better access to individual services.	Educational institutions, health and social service providers, citizens, local authorities or local government, local interest groups and charities and non-profit organizations.	<ul style="list-style-type: none"> • telemedicine • sharing medical records • tracking systems for the elderly • virtual exhibitions and lectures
Energetics Smart lighting		
Intelligent electronic systems that connect power networks.	Energy suppliers, regulatory agency, business communities and environmental organizations.	<ul style="list-style-type: none"> • lighting control system • smart grid apps • optimize network performance • compliance monitoring
Smart Grid, measurement of gas, water and electricity		
Smart meter that records the use of energy, water and gas for a certain unit of time.	Citizens, business communities and company shareholders.	<ul style="list-style-type: none"> • wireless communication for smart metering • on-line consumption information
Smart Utility, Water and sewer network		
Smart water and sewage management.	Providers of water and sewerage services, local authorities or local government, citizens, regulatory agency and environmental organizations.	<ul style="list-style-type: none"> • smart sewer system • waste bin monitoring • water network management system • compliance monitoring
Transport services		
Smart transport solutions.	Local authorities or local government, service providers, local interest groups and transport companies.	<ul style="list-style-type: none"> • bike sharing • applications for reporting potholes • taxi-calling apps • applications for reserve a parking spot in downtown
Environmental policy		
Green solutions implementing through smart devices.	Citizens, local authorities or local government and environmental organizations.	<ul style="list-style-type: none"> • waste and recycling apps • applications for air quality control • electric car ordering apps
Public security and crime		
Early warning system for citizens. Optimizing emergency response time and capacity.	Citizens, local authorities or local government, business communities, service suppliers and subscribers and local interest groups.	<ul style="list-style-type: none"> • city video surveillance system • IP monitoring system • distress signal
Real-time localization of services		
Providing reasonable information for the needs of citizens.	Citizens, local interest groups and business communities.	<ul style="list-style-type: none"> • strategic placement of city-dashboard with substantial information for citizens

The table shows services covering areas such as transport, public services, education, health and social care, ecology and public security. The development of individual applications and services is extended to various areas that help citizens in everyday life. Examples of Smart City services include smart building, smart logistics, smart public systems,

and so on. If cities want to implement these services it is necessary to build, smart networks, smart homes, building automation, bring individual applications like mobile payments etc.

3. Methodology

The article is dedicated to the Smart City concept. We focused on defining the term Smart City. We analysed the current status of services which are part of Smart City concept after that. In practical part of this article we focused on the area's most commonly used in the Smart City concept in the V4 capitals. In these areas, we conducted a comparative analysis and found the most commonly used applications in the cities. Subsequently, we applied the method of deduction and synthesis on the basis of which we came to the individual conclusions.

4. Results

From the analysis of the current situation, we have reached the results that the most services are used in 3 areas: transport, ecology and services provided in real time. We focused on the most widely used applications by citizens, which are provided in the mentioned areas within the Smart City concept.

Table 2 shown that individual applications are mostly used mainly in the field of transport services. After comparing, we found out that the City of Bratislava uses applications for monitoring the current location of public transport, determining the fastest connection or downloading a public transport discount car. Prague uses applications that provide citizens a map of individual links in public transport connections, cycling routes or the possibility of reporting damaged road communications. In Budapest are being used apps which provide citizens with information on public transport links. Second most often used applications are for ordering TAXI services or bikes within the city. Warsaw offers apps that allow you to rent bicycles, choose the fastest public transport links and pay for a ticket or parking fee.

As part of the Smart City concept, individual capitals of V4 also deal with environmental services that help to improve the environment. In Bratislava, an application was created for citizens, to help recognize an unknown plant and classify it in the respective species. Such inclusion is accomplished by taking a picture of an unknown plant. Another application for environmental services is the waste sorting application. By taking picture, it is possible to find out how the trash can be recycled. In Prague, is an application that provides citizens opportunity to order an electric car for ride. Budapest offer app which can monitor air quality control or help with waste sorting.

Table 2. Application overview in V4 countries

Transport services			
Bratislava	Prague	Budapest	Warsaw
Hopin app provides citizens to track the current location of public transport. UBIAN app provides citizens the best possible transport links to their destination as quickly as possible. BMK digital provides option to download of public transport card and then citizen can use necessary discounts.	Doprava Pubtrant provides citizens a map of the connection and the most suitable public transport connection. Praha na Bicykli provides the best cycling trails and routes in Prague. Zmeňte to provides the ability to report damaged roads and sidewalks, by taking a picture of a problem.	BKK Fultár provides citizens overview with public transport links. Good Guy TAXI provides citizens ordering TAXI service and allows you to track your route and price. Mol BUBI provides citizens the option to rent a bicycle (bikesharing)	Veturilo provides citizens the option to rent a bicycle (bikesharing) Jakdojade provides citizens the fastest public transport links that get them to the desired location. moBilet provides payment of ticket or parking fee.
Environmental services			
Bratislava	Prague	Budapest	Warsaw
Pl@nt Net By using a camera app can get recognized to what species the plant belongs to. Green Bin If you take a picture of trash app can tell you how to recycle it.	Lítačka Through this app, a citizen can order an electric car for ride to support emission reduction.	Air Visual Provides information about air quality. OLIO APP Helps citizens to separate waste and shows the map with recycle bins.	Ekon Through this app, citizens will be sent dates and type of waste collection. Milión Stromov Through this app, citizens vote for places where should be planted trees.
Real time services localization			
Bratislava	Prague	Budapest	Warsaw
City Monitor Citizens can take a picture of malfunctioning public lighting, graphite on building etc. The photo will be sent to the local authority that will resolve the issue. Bratislava región provides citizens up-to-date information about restaurants, hotels, public events in the city.	Prague Visitor Guide This app provides up-to-date information about monuments, restaurants, hotels, public toilets and so on. Pražské výlety Provides tips and information about trips in the Prague. Aplikácia Moja Praha Provides citizens actual information about opening times of individual offices, pharmacy, etc..	Budapest City Guide Via this app, a citizen get up-to-date information about restaurants, hotels and cafes in five areas of Budapest.	City Paths Provides information and interesting facts about the sights of Warsaw. MPAY this app offers "Map to pocket". Through this app, citizens have a current city map with up-to-date information.

There are applications in Warsaw that are aimed at getting information about the dates of waste collection or the possibility of voting for the place where new trees should be planted.

Another area of apps which are V4 capitals using is real-time location services. These services provide up-to-date information that individual citizens can use in everyday life. Through these applications, citizens in Bratislava can report malfunctioning lighting, building damage and so on. Another app provides up-to-date information about restaurants, hotels, public events etc. In Prague there are created applications that provide citizens with an online guide to the city, information about the trip options, or information about the opening times of the pharmacy and medical facilities. In Budapest, there are real-time applications in the area of localization services that inform about the sights of the city. Another app provides up-to-date information about restaurants, hotels and cafes. Apps in Warsaw provide information about each city's sights. Among other applications we can include the following: map into a pocket through which a citizen gets current city maps.

Like the various research areas, the Smart City concept has some advantages and disadvantages in each of the monitored areas. For this reason, we have carried out a detailed analysis of the advantages and disadvantages of the Smart City concept in these areas.[3,4,5,6]

Advantages and disadvantages of transport services

The advantages of transport services include:

- get up-to-date information,
- save time when travelling by searching for the fastest traffic connection,
- more transparent timetables,
- participation of citizens in enhancing the city.

The disadvantages of transport services include:

- high cost and difficulty to implement the applications,
- the citizens of the city have to be online, if they want to using app.

Advantages and disadvantages of environmental services

The advantages of environmental services are:

- involving citizens in enhancing the city and improving the environment,
- help with waste sorting and reducing the amount of poorly sorted waste,
- air quality control in the city,
- the use of electric cars reduces emissions.

The disadvantages of environmental services are:

- high cost and difficulty to implement the applications,
- the citizens must be online, if they want to use app,
- when using waste sorting applications, each waste item must be scanned separately.

Advantages and disadvantages of real-time location service

The advantages of real-time location service are:

- get up-to-date information,
- citizens participation on city improvement,
- obtaining information about leisure activities,
- getting to know the city's culture,
- improve orientation in the city.

The disadvantages of real-time location service are:

- high cost and difficulty to implement the applications,
- individual applications are targeted only to certain parts of the city
- the citizens must be online, if they want to use app.

The Smart City concept brings various advantages and disadvantages. When analysing the monitored areas in detail, we found that the Smart City concept has several advantages. For this reason, it is necessary to implement and participate in the implementation of modern digital cities that will help citizens in everyday life.

5. Conclusions

The Smart City concept is a modern way to modernize individual cities and move towards digitalization. This concept is broad-spectrum and therefore has a wide range of possibilities to use individual services in different areas. Multi-party collaboration must be created to build up such a modern city. Cooperation with IT experts, research organizations, the governments of the countries, the European Union and so on is essential. The basis for creating a Smart City is getting information from citizens who should be involved. It is important to create places that will serve citizens to increase their living standards, to improve the city's overall economy and to regulate negative environmental impacts.

As part of the analysis of the V4 capitals, we have come to the conclusion that their participation in the implementation of the Smart City concept is positive. These countries are trying to implement new ways to contribute to the development of the digital city. They use a variety of services, applications that citizens really use and are also practical for their daily lives. Compared to other foreign countries, these countries are still at the beginning of the Smart City concept. At the same time, we must state that their progress is visible. The development of the Smart City concept in the V4 countries needs to be constantly supported.

ACKNOWLEDGEMENTS

The paper was created within the framework of the VEGA [1/0518/19] Research of the digital economy development and its impact of the competitiveness of enterprises in the knowledge based society.

REFERENCES

- [1] Novotný, R., Kuchta, R., Kadlec, J.: Smart City Concept, Applications and Services, Online Available: <https://www.omicsonline.org/open-access/smart-city-concept-applications-and-services-2167-0919-117.php?aid=33684&fbclid=IwAR3nC2cdWJ3PAMewJimYIi6Nax8ZTrkLpEH1qvpNQ7BTp6HIYmM2PcXUSNI>, 2014.
- [2] Smart Cities: The future of cities in Europe, Online Available: <https://euractiv.sk/section/digitalizacia/linksdossier/smart-cities-buducnost-miest-v-europe/>, 2017.
- [3] Top 11 apps that will make your capital's life easier and more diverse, Online Available: <https://bratislava.dnes24.sk/top-11-aplikacii-ktore-ti-ulahcia-a-spestria-zivot-v-hlavnom-meste-279263?fbclid=IwAR3i9mRoZ2yNBu50eqsSa1NN9o5wh1w9Uv8JkMbIPC3MN-ZR0mZDakWWB9M>, 2017.
- [4] 7 Must-Have Apps For Visiting Prague, Online Available: <https://theculturetrip.com/europe/czech-republic/articles/7-must-have-apps-for-visiting-prague/?fbclid=IwAR174tCGoa6dZSozeaRJ-YWktZrxVyKyoXqNvb-MSOPHqjWXnZoXpapakXA>, 2017.
- [5] 6 handy mobile apps to help you navigate Budapest, Online Available: https://welovebudapest.com/en/toplists/6-handy-mobile-apps-to-help-you-navigate-budapest/?fbclid=IwAR2n-GlC-I57_aJhbMEx4OWM6v9FafYIBEjveb1AltaLCGwl86iMiBKLGfw, 2015.
- [6] WARSAW-towards a Smart City, Online Available: https://content.knightfrank.com/research/1500/documents/en/warsaw-towards-smart-city-april-2018-5462.pdf?fbclid=IwAR2n-GlC-I57_aJhbMEx4OWM6v9FafYIBEjveb1AltaLCGwl86iMiBKLGfw, 2018.