Manfred SCHRENK, Vasily V. POPOVICH, Peter ZEILE, Pietro ELISEI, Clemens BEYER (Eds.)

SMART ME UP!

HOW TO BECOME AND HOW TO STAY A SMART CITY, AND DOES THIS IMPROVE QUALITY OF LIFE?

22-24 JUNE 2016, HAMBURG, GERMANY

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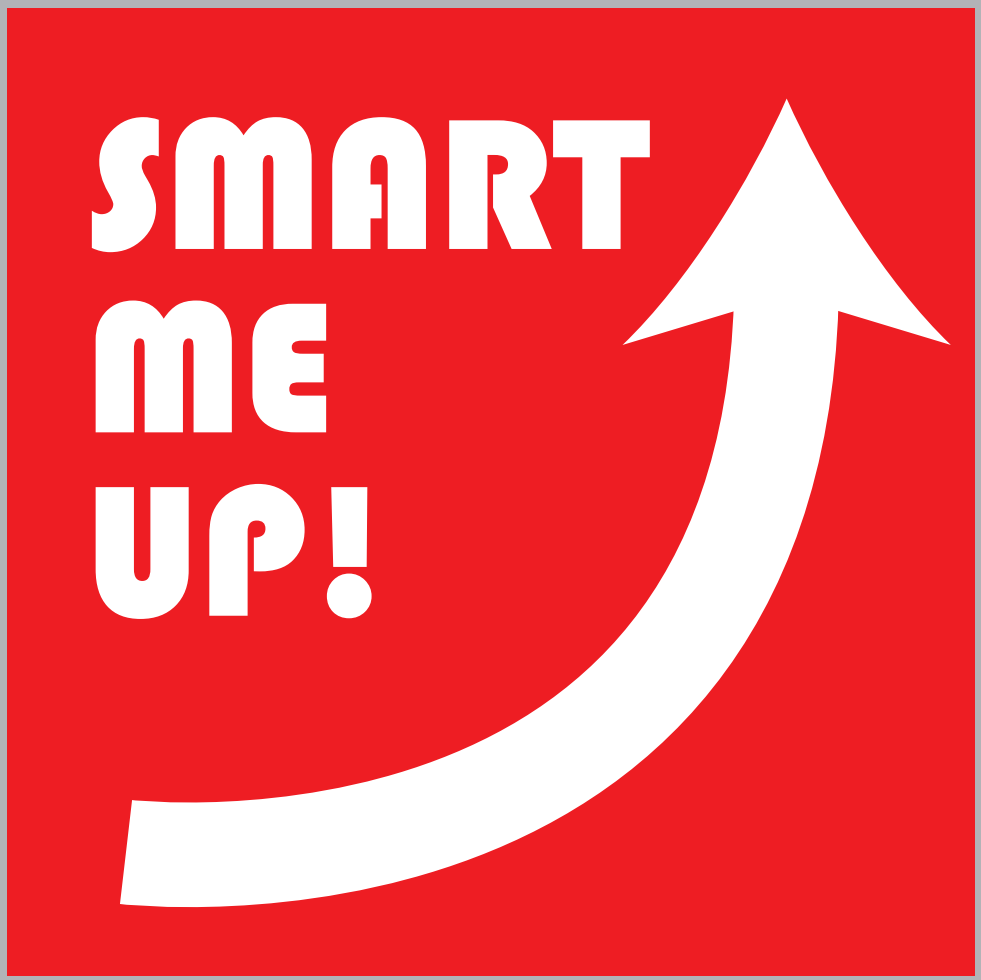

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reviewed paper

Belgrade: Smart Solutions for the Climate Change Challenges?

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1 ABSTRACT

Facing the multiplying challenges generated by contemporary processes, cities continuously redefine their physical and functional structure in order to improve their performances. The concept of smart city, targeting efficiency, liveability and sustainability of urban systems, has become one of preferred options for urban development based on the benefits of the latest technologies. However, the diversity of local circumstances often questions universal 'smartness' and applicability of the general model, demanding continuous modifications and high level of flexibility. Considering the environmental, socio-economic and technological elements of urban setting of Belgrade (Serbia), this paper will analyze the current state of 'smart' upgrading and suggest possibilities for its improvement, especially in the context of detected climate shift. The theoretical background of the problem, as well as the successful global examples, will be used as a starting point - both for the evaluation of the existing condition and the proposed guidelines for the 'smart' development.

Keywords: Belgrade, climate changes, development, evaluation, evaluation

2 INTRODUCTION

Modern cities, as the nodes of highest concentration of people and activities, represent both the generators of environmental problems, as well as the innovative hubs addressing their solution. Adjusting to climate shift and reducing effects of carbon-intensive life are not easy tasks, but it is obvious that urban areas have to modify their performances and development priorities in order to mitigate the accumulated negative effects of global warming and ecological degradation, creating improved models of urban life and its setting - material and virtual, artificial and natural.

The increasing number of contemporary urban concepts targets different aspects of environmental sustainability and energy transition - from low-carbon, carbon-neutral, zero-carbon cities, to eco-smart and ubiquitous-eco sustainable cities - while their catchy names, proposed elements and accompanying visual material suggest new modes of future urban existence. Based on the extensive use of Information Communication Technology (ICT) they all envision a high-quality urban environment which interacts with its users via electronic infrastructure, enabling an increased efficiency, adjustability and higher level of environmental awareness. The concept of smart city integrates all these elements but the level of its application still depends on the potentials, awareness and/or preferences of local contexts - in technological, economic and social sense.

Focusing on the relationship between the smart city concept and increasing environmental challenges triggered by climate changes, this paper will discuss recent global trends and consider their application (current and future) in Belgrade. Distinguishing two main areas of 'smart' upgrading - urban efficiency and environmental awareness, the analysis will identify the preferred channels of ICT support - directed both to personal and public interfaces.

3 GLOBAL WARMING AND SMART RESPONSES

Climate change, with its direct and indirect impacts on living environment, have generated numerous problems in cities affecting their activities, spatial typologies, urban systems and public health. Considering the scale and intensity of these changes the contemporary society has launched a number of formal and informal initiatives in order to mitigate the effects of global warming, but also to increase the level of adjustability and resilience of cities. The European cities face similar problems, additionally complicated by the inherited urban structure. The 'smart approach' has been recognized as one of possibilities, especially in a domain of efficiency (energy consumption and public services), general sustainability and quality of life, but

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also as a tool for urban renewal and an element of urban competitiveness. Therefore, it is not surprising that during the last decade a number of European cities have initiated application of the Smart city concept in order to decrease unemployment by increasing the accessibility of services, to synchronize public investments in innovative technologies and to balance the use of available resources (EC, 2013). The smart support has also been used for the protection of living environment - on the level of energy consumption/transition and pollution control. For example, the concept of smart city represents one of the EU measures embedded in important documents and strategies aiming at the increase of renewable energy resources (20%), the decrease of GHG emissions (20%) and the increase of energy efficiency (20%) (EC, 2010). The relationship between the sustainability of cities and their level of 'smartness' is enabled by the ICT, and its role in climate change mitigation and adaptation becomes more important every day.

The definitions describing the concept of smart city are numerous, but they mostly underline its importance for the quality of life (Kuffner, 2012), economical development and general progress (Giffinger at al., 2007; Pike Research, 2011), connectivity and integration between different infrastructural levels (Hall, 2000; Harrison at al., 2010). The smart elements introduced in cities are not only related to local development, but also influence regional networks and their functioning. One of the main features of this concept is the bottom-up approach in implementation process (directly targeting local communities), while city government mainly conducts large-scale projects (e.g. Greenfield investments - CAICT, 2014) and has to be included in more sensitive urban interventions, especially in old historical cores. The application of 'smart' concept can be described as a process, continuously implemented on different levels, in order to enable an adequate response to urban problems and challenges, while simultaneously providing high-quality and resilient environment (DBIS UK, 2013). However, each city has to established so-called 'open model' of governance which needs the appropriate tools and technical support. This model should provide easily accessible open information networks with open data, their visualisation, as well as the possibility for the simulation of governing/management process, participation of citizens and good connectivity on general level of governance (CAICT, 2014). ICT infrastructure facilitates this process, providing better accessibility to all urban services, for all groups of users. Simultaneously, the digitalization enables immediate identification of changes, the transmission and processing of data is efficient, which creates an accurate report on all urban modifications and threats generated by the carbon intensive way of life and climate shift. Consequently, due to application of readily-available technologies and real-time systems via various e-networks and platforms, gadgets and applications, the (re)action becomes faster leading to the reduction of carbon-footprint.

Nowadays, the range of 'smart' projects covers different activities and types of urban spaces and systems - from technological centres, green urban areas, smart electric grids, to electric vehicles (busses, cars) and networks of public transportation (bicycles, trains, taxis etc.), but there are six key factors which define level of urban 'smartness' - smart economy, smart citizens, smart city government, smart mobility, smart environment and smart living (Giffinger et al, 2007). All of them could be used for climate change adaptation and mitigation, as carriers and transmitters of ideas, knowledge and experiences - on local, regional and global level. CAICT (2014) also emphasizes the list of 'smart' services which could have a direct and indirect impact on the condition of living environment and, consequently, provide some efficient solutions for climate change challenges targeting systems of traffic, public safety, health monitoring, consumption of water and energy, as well as virtual learning.

There are a number of cities which implement the smart city concept on the level of planning documents and strategies, but also in real space (Barcelona, Stockholm, Copenhagen, Amsterdam, Vienna etc.). Simultaneously, there is a parallel level of action related to research, modes of application and support, especially in the sphere of 'smart living environment' which tackles the issue of climate change, pollution, rational and sustainable management of resources and environmental protection. One of good examples is the city of Vienna, the most advanced city in 2012/2013 according to the report of UN Habitat (2013) and ranked as the first one (seven years in a row) on the list which evaluates quality of life (Mercer, 2015). The initiative ‘Smart City Vienna’ was launched in 2011 and its main idea was to use advanced technological support in order to decrease consumption and production of energy until 2050, but without limiting any mode of mobility and consumption (VCA, 2014: 7). It is also important to notice that the objectives of this initiative are related to the problems of global warming aiming at the decrease of CO2 emission (in accordance with EU strategies), the reduction of energy consumption via use of renewable resources and the promotion of multimodal transportation (and consequent reduction of car traffic). It simultaneously

strengthens the position of the city as an important node of research and technological development. The initiative also emphasizes the role of public participation, as an important element for decision-making and implementation of related programs.

4 SERBIA – TOWARD THE SMART SOLUTIONS?

The general application of the smart city concept in Serbia is still in the initial phase, but the issues of global warming have been in the focus of professional and legislative attention during the last decade. However, the application of different documents related to climate change is still insufficient mostly due to weak administrative support unable to facilitate implementation of adopted strategies and measures on national, but also European level (Pucar, 2013; Bajić Brković, 2013). One of the main problems is low awareness of generated problems and environmental threats, but there are other limitations as well – the lack of the national GHG inventory and a slow pace of procedures focused on new strategic documents. Therefore, the integration of smart elements into the process of climate change adaptation and mitigation is still on hold although there are some attempts in this direction. For example, in 2015 the City of Novi Sad and its Office of local economical development have organized a meeting with entrepreneurs, presenting possible activities and benefits within the smart city concept (Novi Sad, 2015). Furthermore, several researches have been conducted considering selected 'smart' features, but without real integration into general development policies. An example of this practice was the analysis of 'smart' traffic networking between Belgrade and Pančevo conducted by Italian researchers (Bielsa, 2012). Currently, Serbian cities are not included into the European association 'Connected Smart Cities Network)' (CSCN, 2015), but the example of Novi Sad clearly demonstrates that this situation might be changed in near future.

The digital sphere is mostly used for information and knowledge exchange targeting the improvement of environmental consciousness. The institutionalized example of this practice is the web-site of the Serbian Environmental Protection Agency (SEPA), which also hosts Ecoregister - the National Metaregister for Environmental Information and the National Register of Pollution Sources. There are also digital platforms focused on available resources and services. They use GIS technology and available databases to provide up-to-date information about various urban systems (mostly traffic), but the level of their interactivity is very low. Nevertheless, some municipalities use simple web-platforms to interact with their citizens, mostly focusing on daily urban problems. On the other hand, the non-institutional flows are more open to environmental issues incorporated in different web-sites, web-services (e.g. BUDIEKOFINa.COM), portals, the digital editions of magazines (e.g. Ekologija magazin, Stakleno zvono), social media and mobile applications. Although most of them only transmit and disseminate information on environmental problems, raising environmental awareness and influencing eco-behaviour, there are some emerging e-platforms inspired by the trend of carpooling/rideshare, which directly and indirectly affect the level of traffic congestion, air pollution and fuel consumption (regional web-site Timskavoznja.com)

5 BELGRADE AS A SMART CITY?

Belgrade, the capital of Serbia, has introduced some elements, which could be recognized as 'smart', but most of them serve as information platforms for citizens and/or tourists or the portals oriented towards e-government. The first group includes internet sites and applications for more efficient coordination and orientation, but also for better experience of the city, while the second one provides different kind of information and allows issuing of online certificates for the citizens of Belgrade. In general, it could be said that these web-sites and mobile apps increase general efficiency of movement and certain urban services, but their impact of environmental issues (if any) is unintentional and mostly inexistent. However, sites and apps related to wayfinding (for ex. 'Airport Nikola Tesla Belgrade' site and app, applications 'Belgrade Talking', 'Belgrade Map', 'Belgrade City Guide', 'Belgrade Travel Guide' etc.), guiding users through the city and enabling their understanding and experience of urban space, could be upgraded with selected data-bases or specific instructions related to eco-awareness and some innovative approaches to environmental quality and safety. There are also several specific services - mobile apps (e.g. 'Osmatrač' - Observer and 'Beograd uživo' - Belgrade live) enabling continuous monitoring of different parts of Belgrade, such as the important traffic junctures, streets, squares and parks, which could be combined in the future with real-time data about the intensity, safety and environmental condition of selected spots.

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Fig. 1: Applications 'Observer' and 'Belgrade Live', a possible base for the future smart urban performances: the use of real-time data as a tool for improving the environmental quality and efficiency of urban services.

There are also several web-sites and mobile application more specialized and focused on urban mobility. 'Belgrade Plan Plus' represents the official and most used internet site for wayfinding in Belgrade. It offers a digital map with streets, connections and important places. 'Bus Plus', the internet site and mobile application is used as a payment tool for the public transport in Belgrade in the form of a smart ticket system in which consumer can upload money for transport fees, depending on the type of card (personalized, paper and electronic card). Simultaneously, there are several apps and sites concerning the public transportation in Belgrade and its timetable. For example, 'BG voz' is the internet site and mobile application about Belgrade train system. It offers information about arrivals, departures, nearest stations, or the progress of expected train. 'Red voznje - Beograd' has a similar content, but it covers all types of transportation.

Fig. 2: Applications 'Belgrade Talking', 'Belgrade Map', 'Belgrade City Guide', 'Belgrade Travel Guide' - providing a better experience and movement in the city.

Fig. 3: Applications dealing with public transportation, time-table and preferred connections.

Several apps in Belgrade offer information about parking places, zones, and capacity in different areas of the city (e.g. 'StartStop Parking Servis Beograd', 'BelParking', 'Parkiraj Beograd PS' and 'Moj Parking'). The application 'Moj Parking' (My parking) is especially interesting because it also provides information on parking capacity and places for disabled.

Fig. 4: Applications focused on the problem of parking - capacity, availability, routes and prices.

Obviously, the service provided by these interfaces does not link environmental effects of transportation and its efficiency (or mode), but it could be used as a starting point for the introduction of more integrated services and tools, which would connect different types of data and support synchronized management of urban systems. In that case, it would be possible to collect simultaneously data from both users and monitoring units, to process them, suggest alternative options, modify routes or time-tables, while decreasing congestion and pollution.

However, there is also one mobile application, initiated by a recent trend introduced in numerous cities, which could definitely have a direct impact on environmental quality. 'CAR:GO' is the first ride-sharing service/app in Belgrade, based on the user's location and preferences, with exclusive pre-payment system.

Fig. 5: The interface of the application 'CAR:GO' - the first ride-sharing service in Belgrade.

Apart from these interfaces which have to be further developed in order to include more environmental features, the Center for environemental improvement has developed several applications (e.g. 'MORECAST', 'UV indeks Srbija', 'Blue Green Map of Serbia') which include information about weather, precipitation, UV radiation, the ozone layer or natural resources. They provide another kind of information which could be used both by citizens and tourists, raising environmental awareness and stimulating trend of biophilia.

Fig. 6: The applications focused on weather data and natural resources - 'MORECAST', 'UV indeks Srbija', 'Blue Green Map of Serbia'.

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Finally, there is an attempt to integrate an urban system (transportation) with environmental monitoring - 'Libelium World - EkoBus Project'. In this initiative, EkoBus system has been developed in collaboration with Ericsson, which has been deployed in the cities of Belgrade and Pančevo. The system utilizes public transportation vehicles to monitor a set of environmental parameters over a large area, as well as to provide additional information for the end-user - the location of the buses and estimated arrival time to bus stops.

EkoBus is a part of SmartSantander project which proposes a unique city-scale experimental research facility in support of typical applications and services for a smart city. This project is funded by the European Union through its Future Internet Research and Experimentation (FIRE) program. Project Consortium consists of different companies and universities such as: Telefonica, Alcatel-Lucent, Ericsson, the University of Cantabria and the University of Surrey. This unique experimental facility should be sufficiently large, open and flexible to enable horizontal and vertical grouping with other experimental facilities. It also stimulates development of new applications by different users including the experimental advanced research on IoT technologies and a realistic assessment of users' acceptability tests. The project uses Waspmote (which is also used to control public transportation and monitor environmental parameters in several other cities in Serbia and Europe) and it provides data on six parameters - temperature, relative humidity, Carbon Monoxide (CO), Carbon Dioxide (CO2), Nitrogen Dioxide (NO2) and GPS location. Sensor nodes make measurements and periodically send results to the server application for further analysis and database storage. Web and Android application collect information from the nodes and perform their visualization (location of the vehicles and atmospheric measurements). It is also possible to request information about the arrival time of the next bus on a certain line to a certain bus stop via SMS or USSD and to receive that information via SMS. The GPRS module is responsible for this feature. The analysis of the stored data is used for various traffic calculations and predictions (Libelium, 2012). However, this system still has to be fully developed, applied and integrated in other environmental programs on the city level in order to achieve the expected impact on environmental quality.

6 CONCLUSION

The integration of smart features into the process of urban development is still in its initial phase in Serbia and Belgrade, but some examples demonstrate a number of possibilities for their use, especially in the process of mitigation and adaptation to climate change. The advanced technology, particularly ICT, represents the basic foundation for the necessary upgrading, which should be conducted both on the institutional and non-institutional level, creating easily accessible and manageable interfaces oriented toward the public or personal users. Additionally, the link between the smart city concept and the anticipated aims of environmental adjustments could be established on all levels, allowing multidisciplinary targeting of environmental awareness, as well as the efficiency of urban systems and energy transition.

The international examples offer a large scale of emerging or already verified 'smart' platforms - web-sites, mobile apps, social media, public interfaces etc. - demonstrating a number of possibilities for the elaborated and well-conducted integration of digital features into urban spaces. However, their use has to be stimulated on all levels, via national strategies and programs, as well as by local governments and urban policies. Only a comprehensive approach could provide the expected benefits for the living environment, but it also represents a necessary condition for further innovation in this area, as well as a new feature of urban competitiveness.

One of the problems in the local context of Serbia represents a discrepancy between official documents targeting environmental issues (and their smart solutions) and actual actions leading to the improvement of the general situation. The aims are vaguely defined and it is necessary to formulate precise objectives and their (measurable) indicators. The list of locally applicable 'smart' measures and tools should be also developed, providing guidelines for the efficient implementation and monitoring of their outcomes.

Although Belgrade still has to develop the smart approach to its numerous environmental problems and use it for the greener management of urban systems, the existing applications and platforms could serve as a starting point for improving the content and accessibility of databases, their integration with other urban systems and synchronisation and instant processing of collected information. The introduction of more advances technological solutions is certainly a necessity in the next phase, but the raised ecological awareness, as well as the availability of smart responses to environmental problems, should lead to a better understanding of proposed measures and their efficient implementation.

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