Bratislava Towards Achieving the Concept of Smart City: Inspirations from Smart City Vienna

Andrej Adamuscin(✉), Julius Golej, and Miroslav Panik

Slovak University of Technology in Bratislava,
Vazovova 5, 812 43 Bratislava, Slovakia
{andrej.adamuscin, julius.golej,
miroslav_panik}@stuba.sk

Abstract. The concept of smart cities arose against the background of economic and technological changes caused by processes of integration and globalization, which European cities have been forced to face common challenges in the context of competitiveness and sustainable development. These challenges have an observable impact on issues related to the quality of the urban environment such as housing, complete urban infrastructure, commercial sector and their environmental impact. This concept thus includes the overall quality of urban life through the built and unbuilt urban environment, urban economy, social environment, urban culture, human and social capital and participation of citizens in government and the city. In this paper authors are trying to outline the problematic areas of Bratislava to achieve Smart City concept, whereby they take inspiration from the neighboring city of Vienna, which in turn is considered as one of the top smart cities in Europe.

Keywords: Smart city · Bratislava · Vienna · Framework strategy · Renewal

1 Introduction

For the past 20 years Bratislava has undergone many dynamic changes. Disordered and uncontrollable new construction of buildings and renovation of existing housing stock without comprehensive strategy or insufficient implementation support system, both static and dynamic transport should be the main reasons such as these developing processes should be started to meet the highest requirements of contemporary modern European cities.

Bratislava as a sister city of Vienna, from which it is located approximately 64 km could thus in its direction just to take an example from Vienna which is considered among the top European and world smart cities for several years. To achieve this state could be helpful, inter alia, also a project EU-GUGLE and also prepared several concepts such as "Methodology for complex renewal of housing estates with a focus on housing reconstruction" or still uncompleted implementation of transport policy of the city of Bratislava.

A. Leon-Garcia et al. (Eds.): Smart City 2015, LNICST 166, pp. 812–820, 2016.
DOI: 10.1007/978-3-319-33681-7_72

1.1 Smart City Vienna

The "smartness" of a city describes its ability to bring together all its resources, to effectively and seamlessly achieve the goals and fulfil the purposes it has set itself. In other words, it describes how well all the different city systems, and the people, organizations, finances, facilities and infrastructures involved in each of them, are: individually working efficiently; and acting in an integrated way and coherent way, to enable potential synergies to be exploited and the city to function holistically, and to facilitate innovation and growth [1].

Recent years Vienna has become a leading smart and sustainable European city. The Austrian capital differs from most other metropolises through its good performance in so many areas: housing, public transport and other infrastructure services (e.g. waste separation, Spring Water Mains), education and universities as well as vast urban green spaces. [2] Vienna is the city with the world's best quality of living, according to the Mercer 2014 Quality of Living rankings, in which European cities dominate [3].

For the city of Vienna has been prepared a framework urban development strategy with a view into the 2050. The present Smart City Vienna framework strategy is directed at all target groups of the city: Vienna's citizens, enterprises, non-profit institutions and, last but not least, the public sector itself. [2] Smart City Vienna comprises first and foremost the aim of resource preservation. Development and modification processes in the sectors of energy, mobility, and infrastructure and building management are to dramatically reduce CO2 emissions by 2050 [2].

In fact Vienna recently created a public private entity, TINA Vienna which is tasked with co-developing smart city strategies and solutions for the city. Nowadays there are prepared more than 100 smart cities projects being developed throughout the city. [4] For example one of the mentioned projects is Citizen Solar Power Plant. With a goal of obtaining 50 % of their energy from renewables by 2030, the city partnered with the local energy provider, Vienna Energy, they developed a crowd-funding model whereby individual citizens can buy half or whole panels and receive a guaranteed return of 3.1 % annually [4].

Vienna is also testing out a range of electric mobility solutions from expanding their charging network from 103 to 440 stations by 2015 to testing EV car sharing and electric bike rentals. Vienna bike sharing program is fully accessible to visitors, not just residents. [5] Another important innovation has been in rezoning dense neighborhoods allowing for zero-parking residential buildings. Residents in these communities commit to not owning a personal vehicle.

Finally, Vienna is renovating a 40 hectare former slaughterhouse district and turning it into a much smarter use: an innovation district focused on media science and technology. By 2016, the city expects 15,000 people to working on startups in the Neu Marx Quarter district. [4] Furthermore, Vienna took the extra step of incorporating the strategy into law to minimize the risk of future mayors throwing the plan out to start over [5].

1.2 Smart City Vienna Framework Strategy

The key goal for 2050 of Smart City Vienna is to offer optimum quality of living, combined with highest possible resource preservation, for all citizens. This can be achieved through comprehensive innovations (shown on Fig. 1).

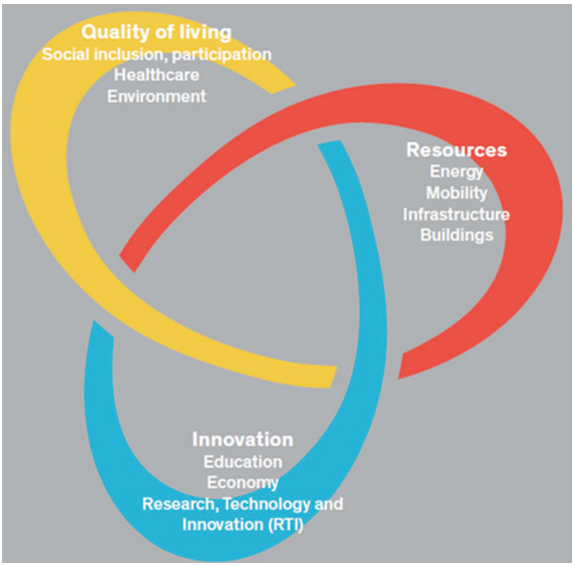

Fig. 1. The smart city Vienna principle [2] p. 17

The present framework strategy describes the key goals and principal approaches chosen to attain them. It represents guidelines for the numerous important specialised strategies of the city that define concrete multiyear plans for such areas as urban planning, climate protection, the future of energy supply or Vienna as an innovation hub [2].

The Smart City Vienna framework strategy is more comprehensive (but not exhaustive), pursues a long-term horizon (2050) and does not offer detailed packages of measures. However, concrete sub-projects with a shorter timeframe will definitely be formulated and implemented [2].

2 Methodology for Smart Cities

According global advisory committee for Smart Cities Benchmarking was developed 62 indicators across the Smart Cities Wheel (shown on Fig. 2).

Each of the six components of the Smart Cities Wheel are assigned a set of indicators reflect an attempt to create a proxy for measuring each of the sub-components of the Wheel. Each component contains 3 subcomponents. Therefore there are 18 total subcomponents in the model, and with 62 indicators, that leaves an average of almost 3.5 indicators per subcomponent (shown on Fig. 3).

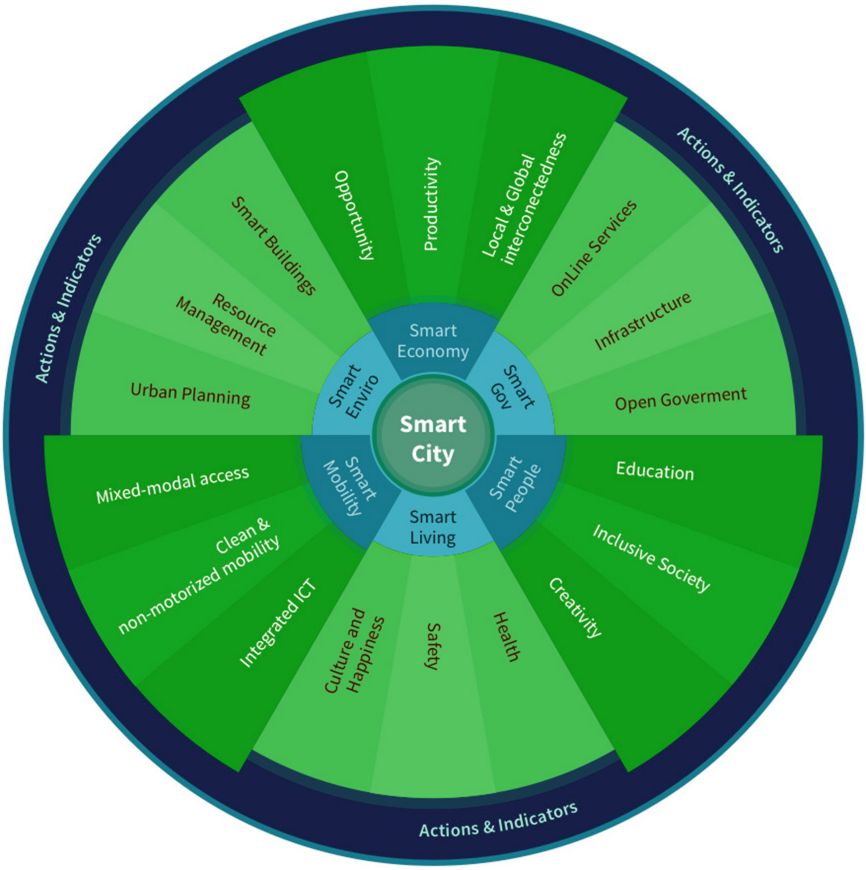

Fig. 2. Smart cities wheel [6]

The data were transformed by using a mathematical formula called a z-score, which permits the comparison of data in different units (e.g. %, tons of GHG emissions, etc.). Each of the 6 components is then assigned a maximum of 15 points and the results are transformed in a way that the highest performing city in each category is assigned 15 points. Thus, if one city were to lead in each of the six components, the city would obtain a maximum score of 90 points. Of the 62, 16 of them are also directly mapped to the new sustainable cities ISO standard (ISO 37120) [6].

2.1 Mercer's Quality of Living

Mercer's Quality of Living reports provide valuable information and hardship premium recommendations for over 460 cities throughout the world, the ranking covers 223 of these cities [3].

Living conditions are analyzed according to 39 factors, grouped in 10 categories:

Dimension	Working Area	Indicator	Description
Environment	Smart Buildings	Sustainability-certified Buildings	Number of LEED or BREAM sustainability certified buildings in the city (Note: if your city uses another standard please indicate)
			% of commercial and industrial buildings with smart meters
			% of commercial buildings with a building automation system
		Smart homes	% of homes (multi-family & single-family) w/ smart meters
	Resources Management	Energy	% of total energy derived from renewable sources (ISO 37120: 7.4)
			Total residential energy use per capita (in kWh/yr) (ISO 37120: 7.1)
			% of municipal grid meeting all of following requirements for smart grid (1. 2-way communication; 2.) Automated control systems for addressing system outages 3.) real-time information for customers; 4.) Permits distributed generation; 5.) Supports net metering
		Carbon Footprint	Greenhouse gas emissioned measured in tonnes per capita (ISO 37120: 8.3)
		Air quality	Fine Particular matter 2.5 concentration (µg/m3) (ISO 37120: 8.1)
		Waste Generation	% of city's solid waste that is recycled (ISO 37120: 16.2)
			Total collected municipal solid waste city per capita (in kg) (ISO 37120: 16.3)
		Water consumption	% of commercial buildings with smart water meters
			Total water consumption per capita (litres/day) (ISO 37120: 21.5)
	Sustainable Urban Planning	Climate resilience planning	Does your city have a public climate resilience strategy/plan in place? (Y/N) If yes provide link.
		Density	Population weighted density (average densities of the separate census tracts that make up a metro)
		Green Space per capita	Green areas per 100,000 (in m2) (ISO 37120: 19.1)
Mobility	Efficient Transport	Clean-energy Transport	Kilometers of bicycle paths and lanes per 100,000 (ISO 37120: 18.7)
			# of shared bicycles per capita
			# of shared vehicles per capita
			# of EV charging stations within the city
	Multi-modal Access	Public Transport	Annual # of public transport trips per capita (ISO 37120: 18.3)
			% non-motorized transport trips of total transport
			Integrated fare system for public transport
	Technology Infrastructure	Smart cards	% of total revenue from public transit obtained via unified smart card systems
		Access to real-time information	Presence of demand-based pricing (e.g. congestion pricing, variably priced toll lanes, variably priced parking spaces). Y/N
			% of traffic lights connected to real-time traffic management system
			# of public transit services that offer real time information to the public: 1 point for each transit category up to 5 total points (bus, regional train, metro, rapid transit system (e.g. BRT, tram), and sharing modes (e.g. bikesharing, carsharing)
			Availability of multi-modal transit app with at least 3 services integrated (Y/N)
Government	Online services	Online Procedures	% of government services that can be accessed by citizens via web or mobile phone
		Electronic Benefits Payments	Existence of electronic benefit payments (e.g. social security) to citizens (Y/N)
	Infrastructure	WiFi Coverage	Number of WiFi hotspots per km2
		Broadband coverage	% of commercial and residential users with internet download speeds of at least 2 Mbit/s
			% of commercial and residential users with internet download speeds of at least 1 gigabit/s
		Sensor Coverage	# of infrastructure components with installed sensors 1 point for each: traffic, public transit demand, parking, air quality, waste, H2O, public lighting
		Integrated health + safety operations	# of services integrated in a singular operations center leveraing real-time data. 1 point for each: ambulance, emergency/disaster response, fire, police, weather, transit, air quality
	Open Government	Open Data	Open data use
		Open Apps	# of mobile apps available (iPhone) based on open data
		Privacy	Existence of official citywide privacy policy to protect confidential citizen data
Economy	Entrepreneurship & Innovation	New startups	Number of new opportunity-based startups/year
		R + D	% GDP invested in R&D in private sector
		Employment levels	% of persons in full-time employment (ISO 37120: 5.4)
		Innovation cities index	
	Productivity	GRP per capita	Gross Regional Product per capita (in US$, except in EU, in Euros)
	Local and Global Conexion	Exports	% of GRP based on technology exports
		International Events Hold	Number of international congresses and fairs atendees.
People	Inclusion	Internet-connected Households	% of Internet-connected households
		Smart phone penetration	% of residents with smartphone access
		Civic engagement	# of civic engagement activities offered by the muncipality last year
			Voter participation in last municipal election (% of eligible voters) (ISO 37120: 11.1)
	Education	Secondary Education	% of students completing secondary education (ISO 37120: 6.3)
		University Graduates	Number of higher education degrees per 100,000 inhabitants (ISO 37120: 6.7)
	Creativity	Foreign-born immigrants	% of population born in a foreign country
		Urban Living Lab	# of officially registered ENOLL living labs
		Creative Industry Jobs	Percentage of labor force (LF) engaged in creative industries
Living	Culture and Well-being	Life Conditions	Percentage of inhabitants with housing deficiency in any of the following 5 aereas (potable water, sanitation, overcrowding, deficient material quality, or lacking electricity)
		Gini Index	Gini coefficient of inequality
		Quality of life ranking	Mercer ranking in most recent quality of life survey
		Investment in Culture	% of municipal budget allocated to culture
	Safety	Crime	Violent crime rate per 100,000 population (ISO 37120: 14.5)
		Smart Crime Prevention	# technologies in use to assist with crime prevention, 1 point for each of the following: livestreaming video cameras, taxi apps, predictive crime software technologies
	Health	Single health history	% of residents w/ single, unified health histories facilitating patient and health provider access to complete medical records
		Life Expectancy	Average life expectancy (ISO 37120: 12.1)

Fig. 3. Smart cities benchmarking indicators [6]

- Political and social environment (political stability, crime, law enforcement, etc.)
- Economic environment (currency exchange regulations, banking services)
- Socio-cultural environment (media availability and censorship, limitations on personal freedom)
- Medical and health considerations (medical supplies and services, infectious diseases, sewage, waste disposal, air pollution, etc.)
- Schools and education (standards and availability of international schools)
- Public services and transportation (electricity, water, public transportation, traffic congestion, etc.)
- Recreation (restaurants, theatres, cinemas, sports and leisure, etc.)
- Consumer goods (availability of food/daily consumption items, cars, etc.)
- Housing (rental housing, household appliances, furniture, maintenance services)
- Natural environment (climate, record of natural disasters)

The scores attributed to each factor, which are weighted to reflect their importance to expatriates, allow for objective city-to-city comparisons. The result is a quality of living index that compares relative differences between any two locations evaluated.

For the indices to be used effectively, Mercer has created a grid that allows users to link the resulting index to a quality of living allowance amount by recommending a percentage value in relation to the index [3].

3 Bratislava

Until the fall of former political regime in 1989 was in Slovakia, including Bratislava for several years realized mass production of affordable housing. This construction was marked by the poor quality of buildings, especially as regards their energy performance. This poor technical condition mainly of prefabricated apartment buildings in many cases persists to these days, also thanks to still unrealized coherent concept of housing estates renewal. Renovation of buildings in Bratislava is provided on individual and un-conceptual basis. Renewal is performed only on separate apartment blocks, without connectivity to their immediate surroundings. Despite to this state for Ministry of Transport, Construction and Regional Development has been developed a comprehensive study of housing estate renewal in the recent past: "Methodology for complex renewal of housing estates with a focus on housing reconstruction".

Within this study was developed analysis of the current state of housing estates renewal in Slovakia - architectural, urban, administrative aspects and existing planning tools of complex housing estates renewal. There were analyzed European documents in the field of urban development (Leipzig Charter, Toledo Declaration, the Territorial Agenda 2020, the Europe 2020 Strategy) as well as the research was performed on the selected model of foreign examples. Finally was realized the draft of methodology process of preparing strategic documents for housing estates renewal with emphasis on housing reconstruction at urban level, with an emphasis on an integrated approach and feasibility plans. [7] It should be added that putting this methodology into practice is heavily dependent on a momentary political will.

Now, the Slovak capital has a chance to move forward within a project aimed at demonstrating the feasibility of nearly-zero energy building renovation models. Bratislava is the only eastern European city to participate in the EU-GUGLE project, which stands for European cities serving as a Green Urban Gate towards Leadership in sustainable Energy. The aim of the project is to create a concept of energy performance and securing the energy efficiency of buildings when using them, as well as the reduction of energy intensity within the city's district in which the building is located. In other words, the project will take into consideration not only the reduction of energy consumption in the buildings, but will simultaneously deal with other aspects of a sustainable environment, like the interconnection of the building with public space, green areas and sustainable forms of mobility. The latter includes mass public transport, bicycles and moving on foot. Bratislava was chosen in a strong competition of 45 European cities and the city is cooperating with Vienna in this project, while the Austrian capital is serving as a district leader. Over the five years of the project (2013–2018) Bratislava with other European cities will join efforts to combine the latest research results in smart renovation of groups of buildings at the district level and use this knowledge to renovate the living space. The main task of this project is to bring to Bratislava new, sustainable technologies that will reduce emissions caused especially

by heating apartment blocks. Within this project, Bratislava can receive up to €2 million to renovate 40,000 square meters of total floor area, i.e. up to €50 per square meter to cover the costs of the renovation. Out of the total floor area, 20,000 square meters should account for buildings owned by the Bratislava municipality, while the remaining 20,000 square meters should account for privately owned housing represented by owners' associations or apartment block administrators. The European Commission will refund the renovation costs only after the works are completed and have achieved the target parameters [8].

Also very important is the issue of transport infrastructure. Physical lifetime of transport infrastructure depends primarily on the building materials and old design of transport capacities. The materials that were used for its construction currently do not meet the quality requirements due to the infrastructure was not subject to more fundamental recovery process during its lifetime. Moreover, the infrastructure lifetime is significantly influenced by the intensity of its use. Its implementation largely falls within the period of implementation of residential buildings and public facilities in housing estates, when at least in a position of static transport capacitively was sufficient for the then demands.

The issue of parking in Slovakia is a long-term problem, whether in existing buildings or with new development projects where parking costs are only kind of forced expenditure on which developers often want to save money. Bratislava is one of the European metropolises, which seeks for the solution for several decades. Problem that Bratislava was not ready for, is a major building boom which caused a further increase in both passenger and freight transport in the city center. This means that the constantly increasing level of motorization brings to Slovakia and especially in densely populated urban areas around the capital - Bratislava even higher space requirements. That becomes the most valuable quantities especially in the inner-city environment. This fact makes new demands on the urbanization of our cities, the professionalism of solutions to traffic problems and high standards to ensure a quality environment. One of the most serious current problems closely related to urban space in Bratislava is the traffic situation, especially the issue of static traffic [9].

Another important issue in the field of comprehensive transport solutions in Bratislava is the fact that there is insufficient traffic data database and the city does not have sufficient details of current conditions of its urban road network. City of Bratislava is lacking the scheduled surveys and their results, which would be able to determine the disproportion of the current state and predict its development [10].

The list of projects that have an ambition to contribute to the solution of traffic problem in Bratislava is quite long. Solving problems with static traffic in Bratislava could be implemented using comprehensive regulation through traffic signs. In practice this means charging for parking at a time of increased congestion and the designation of paid parking zones with the road signs. Paid parking zones could improve the environment and conditions for non-motorized road users, as well as improving the quality of transport services. One of the solutions to the problems with static traffic could be building a semi recessed and recessed parking, garage houses, increase recessed parking with one or two floors. Addressing of static traffic in different districts of the city lies in cooperation with the magistrate of the capital. Cooperation includes the selection of appropriate areas that would capacitive mean an increase in parking

areas for individual districts. Solution of this complex issue could be also implemented through PPP projects. Another solution is a free parking not only on the borders of the city, but also outside, for example in Malacky, Pezinok or Senec. The condition is to create high quality service suburban bus line, which will operate at appropriate intervals. Another solution of problem of static transport in Bratislava could be seen in the construction of smart parking spaces by installing smart parking sensors placed directly on the parking places. Drivers would be allowed to easily find a free parking place and would contribute significantly to the reduction of emissions in the city [9].

Another important issue is the participatory budget of the city and the city districts. Bratislava as the first Slovak city began experimenting with the introduction of participatory budgeting since 2011. Citizens were given the opportunity to decide directly on the reallocation of public finances and on the form of public space and services. Participatory budgeting process takes place throughout the year and is open to all citizens. In the first phase are collected suggestions and ideas from people on the use of public finances. They are then sorted and processed into projects. Since the idea is always more than a means to implement them, citizens must also decide which of their ideas are supported and which are not [11].

It took place at participatory budgeting at the city level for a number of deficiencies and irregularities in recent years. They arise in the event of a communication strategy that would attract as many residents into the process; or administrative support, which would work systematically on the involvement of citizens and work on the drafts; and especially mismatch about the rules for the conduct of participatory budgeting process.

Municipality of Bratislava launches e-governance project in 2015. It is a project of electronic council, which contributes to saving the environment and optimizes 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 [12].

4 Conclusion

In order to Bratislava achieve the Smart City concept it needs to develop and implement mainly a comprehensive concepts a policies in the field of residential and non-residential buildings, transport infrastructure, technical infrastructure, public spaces but also in the field of sustainable economy and governance. Of course, main condition to achieve this effective sustainable development is the implementation of the latest materials, technologies and innovative concepts in each of these areas, whether in the field of urban development, ICT and construction and architecture, etc. In this would help to Bratislava a generous funding from the European funds, the potential of which the city does not know sufficiently take full advantage. This could help the generous funding from the European funds, the potential of which the city does not know to sufficiently take full advantage. Precisely in these areas Bratislava could take inspiration from the sister city of Vienna, which actual projects and its approaches to them could be considered as an exemplary direction of sustainable development of a modern European city.

References

1. ISO/IEC JTC 1, Information Technology. Smart Cities, Preliminary Report 2014. ISO 2015, Published in Switzerland. http://www.iso.org/iso/smart_cities_report-jtc1.pdf
2. Smart City Wien, Framework Strategy. City of Vienna. Vienna City Administration (2014). ISBN 978-3-902576-91-0
3. 2014 Quality of Living Worldwide City Rankings – MERCER Survey. United States, New York (2014). http://www.mercer.com/newsroom/2014-quality-of-living-survey.html#City-Rankings
4. Cohen, B.: The 10 Smartest Cities In Europe. 2014. Fast Company & Inc, 2015 Mansueto Ventures LLC. http://www.fastcoexist.com/3024721/the-10-smartest-cities-in-europe
5. Cohen, B.: The Smartest Cities In The World. 2014. Fast Company & Inc, 2015 Mansueto Ventures LLC. http://www.fastcoexist.com/3038765/fast-cities/the-smartest-cities-in-the-world
6. Cohen, B.: The Smartest Cities In The World 2015: Methodology. 2014. Fast Company & Inc, 2015 Mansueto Ventures LLC. http://www.fastcoexist.com/3038818/the-smartest-cities-in-the-world-2015-methodology
7. Finka, M., Golej, J., Jamečný, Ľ., Ladzianska, Z., Ondrejička, V., Baloga, M., Schweigert, M., Tóth, A.: Metodika komplexnej obnovy sídlisk s dôrazom na obnovu bytových domov: 1. 2. 3.etapa. Bratislava: STU v Bratislave. Ústav manažmentu, 248 p. (2012)
8. Liptáková, J.: Making Bratislava a Smart City. The Slovak Spectator (2014). http://spectator.sme.sk/c/20049863/making-bratislava-a-smart-city.html
9. Špirková, D., Golej, J., Pánik, M.: The issue of urban static traffic on selected examples in Bratislava in the context of economic sustainability. In: 2014 International Conference on Traffic and Transport Engineerin, ICTTE 2014, Belgrade, Serbia, 27–28 November 2014. ISBN 978–86-916153-1-4
10. Methodology of traffic capacitive impact assessment of investment projects. The Annex to Decision of the Mayor of the capital city of the Slovak Republic, Bratislava. 16 p. (2014)
11. Vittek, P.: Aby aj o peniazoch rozhodovali ľudia. P E R E X, a. s (2014). http://nazory.pravda.sk/osa/clanok/322462-aby-aj-o-peniazoch-rozhodovali-ludia/
12. Samospráva spúšťa digitálne zastupiteľstvo. Hlavné mesto SR Bratislava (2015). http://www.bratislava.sk/samosprava-spusta-digitalne-zastupitelstvo/d-11048590/p1=11049947