Smart City Concept of Selected Cities in the Czech Republic

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Abstract

The article deals with Smart City concepts and strategies of selected cities in the Czech Republic. The concept of Smart City has become a point of interest in scientific publications and in public sector over the past ten years. It is a concept of applying sustainable development of cities principles based on the use of modern technologies to improve quality of life and make governance more efficient. This concept is widely used in the field of transport, which can be more effectively addressed by using appropriate information and communication technologies. The article presents an approach to this issue in the Czech Republic with a focus on recommendations and methodologies provided by the Ministry of Regional Development. The concepts and strategies of selected cities are analysed and then compared, with a particular focus on transport in the context of recommendations and methodologies.
KEY WORDS: *sustainable urban mobility plans, Smart City concept, sustainable development*

1. Introduction

Sustainable urban development poses a major challenge to the planet's future in the 21st century, relative to the contribution and adaptation to climate change, natural resource consumption, energy transition (oil transition), population mobility, well-being and security, pollution, global economic growth [1, 2]. In the context of Smart City, urban traffic can only be dealt with as a single unit, i.e. by comprehensive regulation of freight, individual, public, cycling and pedestrian traffic. The European methodology for Sustainable Urban Mobility Plans (SUMP) serves this purpose. The last decade has transformed societies in an unprecedented way. The development of communication technologies is deeply reflected in almost all people's activities. Information technologies greatly influence the way people do business, how people organize human societies and how people care about the environment: the three pillars of sustainability. The transport sector is one of the fastest growing economic areas in Europe and worldwide. The article presents an approach to this issue in the Czech Republic with a focus on recommendations and methodologies provided by the Ministry of Regional Development. The concepts and strategies of selected cities are analysed and then compared, with a particular focus on transport in the context of recommendations and methodologies.

2. Theoretical Background

SUMP is a modern and very current topic. The term SUMP is found in scientific articles over the past 5 years [3, 4, 5, 6, 7]. The SUMP is a strategic plan proposed by the European Commission as a policy tool for a new planning paradigm in the Europe. SUMPs are local transport plans that should include a long-term and sustainable vision of cities, be based on extensive citizen and stakeholder participation processes, and serve as a means of coordinating cross-sectoral policies in order to respond effectively to people's mobility needs [8]. The SUMP concept considers a functional urban area and assumes that plans will be developed in collaboration across different policy areas and sectors across different levels of government and administration and in cooperation with citizens and other stakeholders [9]. Various options are available for urban mobility, including congestion charges, car sharing systems, eco-driving support, etc. [10]. There are currently many examples of the application of these measures in European cities; for a summary of the applications see [11]. According to the European Commission and the Green Paper on Urban Mobility [12], urban transport in the European Union is responsible for almost 40% of CO_2 emissions from the total transport sector and 70% of other pollutant emissions [13]. Cities are in charge of developing a SUMP, whose main objective is to provide and promote alternative means of transport for passenger cars [14]. Mobility is a factor

contributing to urban energy consumption. In terms of energy, mobility is a part of the transport sector, and therefore the characteristics of urban mobility need to be taken into account when planning transport issues [15]. Mobility is heavily dependent on the private car and its use has a significant impact on fossil fuel consumption [16]. The relationship between urban development and mobility is largely dependent on the modes of transport and the speed at which they move [17, 18].

The need for the active participation of all sectors of society in consultations and decisions on sustainable development and urban future planning was already formulated in the Brundtland Report in 1987 [19]. It was soon recognized that sustainable mobility planning had to be complemented by processes to address the impact of increasing urban traffic. In Europe, some countries have adopted, at an early stage, comprehensive transport planning policies that would lead cities to develop and implement these plans [20]. The term Smart City concept is a very important term in the context of SUMPs. Recently a new concept of urban management called Smart Cities or the Smart City concept has been found in scientific literature, as evidenced by numerous articles and conferences and various other activities taking place on this subject almost daily [21]. Smart City is a fuzzy concept that is not yet well defined and not fully understood [22, 23, 24]. There are many ways and directions that try to explain what a Smart City concept is and what it actually includes [25]. Popular descriptions of the Smart City concept include: sustainable development, intelligent and associated urban systems, innovative urban approaches, especially in spatial planning and urban planning [26]. In fact, the whole Smart City concept is designed and focused on finding smart ways of accessing and developing the interconnection of innovative and modern technology solutions that will enable everyone in the city to achieve better coexistence in an urban environment [27]. At a global level, different priorities in the development of Smart Cities: in North America the focus is on smart grids, in Europe for recovery and sustainability, in Asia more on urbanization and eGovernment issues, and most in Latin America to promote transport. The fact is that a Smart City is not a top-down concept, but a bottom-up concept, because the Smart City concept is based on the use of technology to solve urban problems [28].

3. Materials and Methods

In Europe, there still doesn't exist any unified methodology for the Smart City concept. Most of the cities go their own way in order to gain new experience following with their pros and cons sharing. The methodology of the Smart City concept is available on the website of the Ministry for Regional Development of the Czech Republic [29]. This methodology is intended as a guide on how to access to the Smart City solutions. It defines Smart City attributes that result in a unified table which consists of 16 components (see Table 1).

Table 1

The overview of the Smart City concept components

Higher unit	nr.	Component	Example of use
A: organizational	1	Political commitment	Smart city vision
	2	Organization and responsibility	City department and responsible person
	3	Strategy / action Plan	Strategic and action plan for vision implementation
	4	Cooperation and long-term partners	Working group (with minutes)
B: community	1	Activates and connects	Application / website for collecting ideas and comments
	2	Creates and manages communities, supports a self-development	Motivation and support programs for residents
	3	Shares (sharing economy)	Sharing concepts (housing, workplaces, means of transport, etc.)
	4	Cultivates a public space	Zoning plan visualization, street space categorization
C: infrastructural	1	Area coverage	Technology and fullarea regulation
	2	Multipurpose solution	One investment / technology to cover multiple purposes, a system synergy
	3	Integrated solution	One central administration subject
	4	Open solutions	Open data
D: final	1	Quality of life: a digital, open and cooperative city	Variety of services, space for business
	2	Quality of life: a healthy and clean city	Environmental impact on residents
	3	Quality of life: an economically interesting city	Financial impact on residents
	4	Brand with a great reputation	Media image of Smart city programs

Source: [29]

They also represent a unified step-by-step procedure leading to the real social change which the concept sets. These components are divided into 4 consecutive higher units (organizational, community, infrastructural and final). The Smart City concept presents a program change driven by the city management. It is a sequential process, not only an actual state.

The aim of the article is to analyze and compare Smart City concepts of selected cities with a particular focus on transport in the context of the methodology. The concepts of cities Pardubice and Hradec Králové were monitored. Both are regional cities with over 90 thousand of inhabitants [30].

In Table 2 below there are listed fundamental characteristics of the two selected cities, as mentioned above.

Table 2

Fundamental characteristics of the selected cities

	Pardubice	**Hradec Králové**
Number of Inhabitants	90 335	92 917
Area [m^2]	83	106
Private/personal cars *	263 037	290 255
Motorcycles *	69 325	71 977
Buses*	1 171	752
Public City Transport (number of lines)	35	42

* The data is for Pardubický region, Královéhradecký region respectively

Source: [30, 31]

These two cities have been selected for the reason that the abovementioned methodology should be used, as recommended, primarily for implementation of Smart Cities programs in a more complex manner and such conditions can be expected mainly in large cities and agglomerations. The methodology, for this objective, creates own categorization of cities. This categorization of cities includes the size of cities in the CR (defined by the number of inhabitants) as well as functional typology of cities and municipalities under the overall structure of settlements (that means the functional category of municipalities/ranking of a municipality, administrative and territorial divisions and other functions that a municipality provides to its wider area according to its rank). Both of the selected cities are cities of Category B (from 40 th. to 150 th. inhabitants); these are larger cities with a more developed public transport system, statutory towns.

To meet the objectives of this article content analysis has been carried out. This analysis is based on publicly available documents and information that is available on web pages of both cities. The recommendations from the methodology were used to assess the level of fulfilling the individual components of the methodology for transport – points from a pre-defined points scale/rank were allocated. For the purposes of this article the evaluation scale 0 – 5 was applied, the higher the evaluation the higher the level of quality of the fulfilment of the individual criteria/component. The authors of this article did the evaluation independently. The total points evaluation represents the arithmetic average of the points allocated to the individual components of the concept by the individual evaluators.

This evaluation was realized with the knowledge that the concept of Smart City can be implemented only by using overall system approach to the individual city agendas that must be mutually interlinked. This is indeed a complex process that requires the achievement of synergy effects. In the framework of this article and with regard to the used methods the individual components of the concept were evaluated in an isolated manner and only based on publicly available information. For complex evaluation it was essential to execute more complex analyses.

4. Results and Discussion

Table 3 shows how the cities Pardubice and Hradec Králové meet individual components of the Smart City concept in the field of transport.

From the results of the analysis (see Tab. 3) it issues that both cities got the highest number of points in the Component A.1, that is Political Commitment and Visions that are included in the strategic plans of both these cities or alternatively their are included in political program statements. They give attention to building a well functioning transport system that would be environmentally friendly with a major role of public transport in these systems.

Promotion of knowledge of these issues as well as developing outstanding reputation is supported by component D.4. which is represented by various press statements and short information programs broadcasted in local televisions (EastBohemia broadcasting and Hradec internet television). Pardubice fulfils component A.2 by the act of establishing committee for strategy and Smart City; Hradec Králové has established commissions for transportation and for cycling promotion; both commission closely cooperate with city strategy development department. Both Pardubice and Hradec Králové have city strategy documents available, (strategy concepts respectively) of Smart City. Pardubice put focus on intelligent parking, electro mobility development, bike and car sharing and on having smart transport information available. In the strategy document the most advanced concept is the concept of the system for monitoring

available/free parking spaces. Hradec Králové divides the concept of Smart City in the transport area into 4 main areas. These are: Hradec Králové as the city of cyclists, transport organization (that includes: intelligent transport system and smart parking) smart public transport and electro mobility. When regarding the transport system as a whole unit both cities have the most developed strategy for cycling transport. In relation to this these cities have established special web portals www.pardubike.cz and www.cyklohradec.cz that serve the purpose of information exchange. The support to cycling transport takes the form of organization and implementation of various events (for instance events "Cycling to Your Work Place" and "Mobility Week"). Both cities have also week areas. These areas are: lack of e-portal for collection of comments and ideas from citizens. Citizens of both of these cities can only participate in public hearings; they can submit their comments/feedback only via the official filing/registry office or via the relevant officer. Regarding the development of strategic partnerships in the Smart City area Pardubice city cooperates with Smart City Point and Hradec Králové co-operates with s GIST, s.r.o.

Table 3
Fulfilment of the Smart City concept in the field of transport in selected cities

Higher unit	nr.	Component	Pardubice	Hradec Králové
A: organizational	1	Political commitment	3.3	3.5
	2	Organization and responsibility	2.3	2.5
	3	Strategy / action Plan	2.8	2.5
	4	Cooperation and long-term partners	2.2	2.0
B: community	1	Activates and connects	0.8	1.0
	2	Creates and manages communities, supports a self-development	1.5	1.2
	3	Shares (sharing economy)	1.5	1.2
	4	Cultivates a public space	2.3	2.2
C: infrastructural	1	Area coverage	1.7	1.5
	2	Multipurpose solution	0.7	0.5
	3	Integrated solution	2.2	1.2
	4	Open solutions	0.8	0.7
D: final	1	Quality of life: a digital, open and cooperative city	2.2	2.8
	2	Quality of life: a healthy and clean city	1.7	2.2
	3	Quality of life: an economically interesting city	0.0	0.0
	4	Brand with a great reputation	3.0	2.8

Source: [authors based on 32, 33]

Transport research is done to find out more about the transportation behaviour of citizens under the infrastructure area. Pardubice, compared to Hradec Králové, uses more of cycling counters that are located in major transport points where large flows of cyclist are expected. Regarding public municipal transport both cities strive to provide better information to citizens by means of information boards that contribute to easier transport in the city. Pardubice operates Geoportal. On this Geoportal citizens can get information about parking and about transport situation (for instance about existing and planned road closures, about traffic accidents and similar). Hradec Králové currently focuses mainly on integrated parking system developed based on licence/concession agreement with company ISP Hradec Králové, a.s.. In the area of open data (C.4) Pardubice offers results of transport research and as well provides information via the abovementioned Geoportal where any citizen can obtain various information in order to improve the quality of life in the city. Hradec Králové established the portal Opendata that has a large potential. However currently it does not provide much useful information. Regarding communication via social networks Hradec Králové is more advanced since Hradec communicates also via Youtube, Instagram and via its own Internet television next to the already standard communication channels (Facebook and Twitter). In the quality of life area both cities show approximately same results and in both cities support to cycling transport and preservation of green areas in the city are the dominating activities. Currently there are no economic incentives for citizens not owning/using cars compared to citizens owning more that one car. The future will show whether those citizens, whose behaviour is more environmentally friendly, compared to conventional behaviour, receive any economic benefits for such behaviour.

Figure 1 shows summary results of evaluations for individual higher units for both cities. The resulting value of the higher unit is calculated as an arithmetic average/mean of evaluations and their individual components.

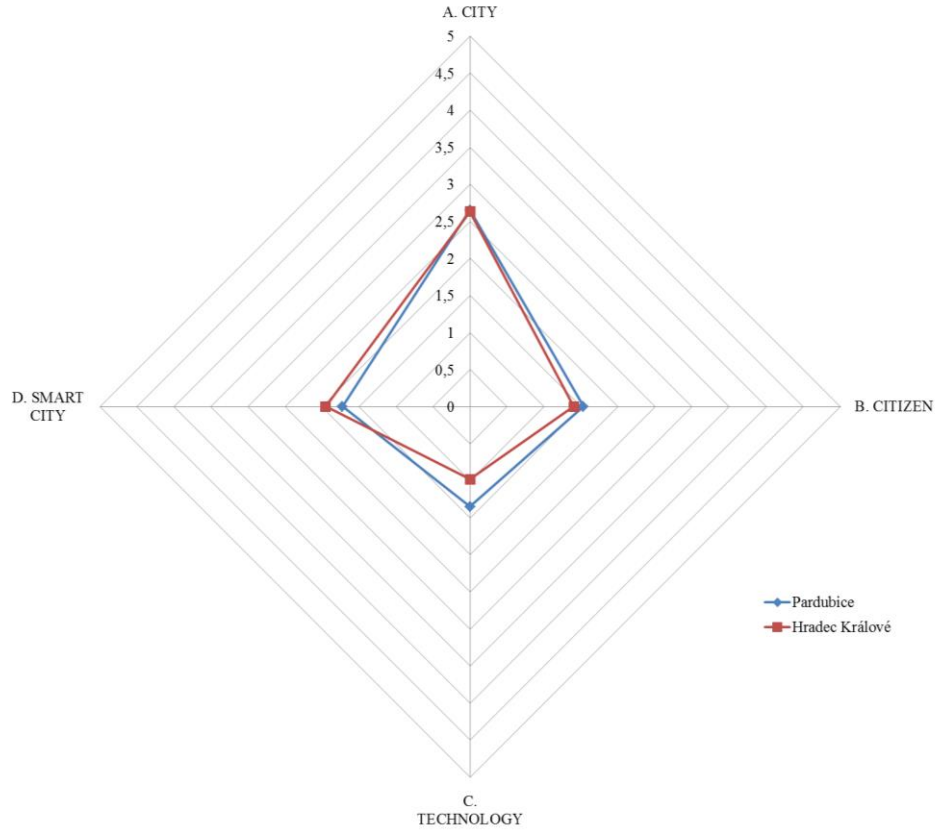

Fig. 1 Smart City Framework with 16 hierarchically organized components [source: authors]

5. Conclusions

The objective of this article was to analyse and consequently compare Smart City concepts in the area of transport in selected cities with the methodology recommended by the Ministry for Local Development of the Czech Republic. Cities Pardubice and Hradec Kralove are currently in the initial, preparatory phase respectively in the area of smart solutions in transport. The Smart City concept has political commitment, which is obvious from strategy plans of both cities and from various media presentations that promote the Smart City idea. In the area of transport both of the analysed cities are most developed in the area of cycling transport. In this area they have already developed and designed strategy and action plans that are step-by-step implemented. From the analysed documents it is clear that both cities have already defined the key issues in the transport area, which have to be dealt with. Among such issues are the growing number of transport vehicles and the related parking issues and the transport density and intensity within the city issues. Both cities have available solutions in place that shall be step-by-step implemented while they strive to utilize synergy effects (for instance building an intelligent transport system within the Hradec-Pardubice agglomeration).

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References

1. **Przybylowski, A.** 2018. Sustainable Urban Mobility Planning: Gdynia City Case Study, Ekonomia I Prawo-Economics and Law 17(2): 195-209.
2. **Ducruet, C.** 2011. Economic Development Paths of Port-Cities: Specialization vs. Diversification, Global Ports and Urban Development: Challenges and Opportunities.
3. **Foltynova, H. B.; Attard, M.; Melo, S.** 2018. Topical Collection on the Role of Planning Towards Sustainable Urban Mobility, European Transport Research Review 10(2): 1-3.
4. **Cirianni, F.; Monterosso, C.; Panuccio, P.; Rindone, C.** 2018. A Review Methodology of Sustainable Urban Mobility Plans: Objectives and Actions to Promote Cycling and Pedestrian Mobility, Smart and Sustainable Planning

for Cities and Regions 685-697.
5. **May, A.; Boehler-Baedeker, S.; Delgado, L.; Durlin, T.; Enache, M.; van der Pas, J. W.** 2017. Appropriate National Policy Frameworks for Sustainable Urban Mobility Plans, European Transport Research Review 9(1): 1-16.
6. **Michnej, M.; Zwolinski, T.** 2016. Objectives and Strategies of Sustainable Urban Mobility Planning in the City of Krakow, Transport Development Challenges in the Twenty-First Century 77-84.
7. **May, A.** 2015. Encouraging Good Practice in the Development of Sustainable Urban Mobility Plans, Case Studies on Transport Policy 3(1): 3-11.
8. **Arsenio, E.; Martens, K.; Di Ciommo, F.** 2016. Sustainable Urban Mobility Plans: Bridging Climate Change and Equity Targets?, Research in Transportation Economics 55: 30-39.
9. **Wefering, F.; Rupprecht, S.; Bührmann, S.; Böhler-Baedeker, S.** 2014. Guidelines Developing and Implementing a Sustainable Urban Mobility Plan. Brussels: European Commission, Directorate-General for Mobility and Transport.
10. **Pisoni, E.; Christidis, P.; Thunis, P.; Trombetti, M.** 2019. Evaluating the Impact of "Sustainable Urban Mobility Plans" on Urban Background Air Quality, Journal of Environmental Management 231: 249-255.
11. **Holman, C.; Harrison, R.; Querol, X.** 2015. Review of the Efficacy of Low Emission Zones to Improve Urban Air Quality in European Cities, Atmospheric Environment 111: 161-169.
12. **European Commission.** 2007. Green Paper: Towards a New Culture for Urban Mobility. COM 2007. 25. 09. 2007.
13. **Maria D. J.; Lopez-Lambas, M. E.; Gonzalo, H.; Rojo, M.; Garcia-Martinez, A.** 2018. Methodology for Assessing the Cost Effectiveness of Sustainable Urban Mobility Plans (SUMPs). The Case of the City of Burgos, Journal of Transport Geography 68: 22-30.
14. **Monzon, A.; Cascajo, R.; Madrigal, E.** 2006. SUMPS: Practical Guide for the Development and Implementation of Sustainable Urban Mobility Plans. Madrid: IDAE, Instituto para la Diversificación y Ahorro de Energía.
15. **Miranda, H. F.; Rodrigues da Silva, A. N.** 2012. Benchmarking Sustainable Urban Mobility: The Case of Curitiba, Brazil, Transport Policy 21(2004): 141-151.
16. **Valero-Gil, J.; Allue-Poc, A.; Ortego, A.; Tomasi, F.; Scarpellini, S.** 2018. What are the Preferences in the Development Process of a Sustainable Urban Mobility Plan? New Methodology for Experts Involvement, International Journal of Innovation and Sustainable Development 12(1-2): 135-155.
17. **Pozueta, J.** 2000. Movilidad y Planeamiento Sostenible. Hacia una Consideración Inteligente del Transporte y la Movilidad en el Planeamiento y en el Diseño Urbano, Madrid: Escuela Técnica Superior de Arquitectura de Madrid, Universidad Politecnia de Madrid. (in Spanish).
18. **Sanz, A.; Molina, E.** 1980. Transporte en Modos no Motorizados, Ciudad y Territorio 2. (in Spanish).
19. **World Commission on Environment and Development.** 1987. From one Earth to one World: An Overview. United Kingdom, 300 p.
20. **Decker, B.; Hecimovic, H.; Wolek, M.** 2012. Sustainable Urban Mobility Planning in Central Eastern Europe: Case Examples from Poland and Croatia, Transport Research Arena 48: 2748-2757.
21. **Sikora-Fernandez, D.; Stawasz, D.** 2016. The Concept of Smart City in the Theory and Practice of Urban Development ManagemenT, Romanian Journal of Regional Science 10(1): 81-99.
22. **Anthopoulos, L. G.; Vakali, A.** 2012. Urban Planning and Smart Cities: Interrelations and Reciprocities Urban Planning, The Future Internet, Future Internet Assembly, Future Internet Assembly 2012: From Promises to Reality 178-189.
23. **Lazaroiu, G. C.; Roscia, M.** 2012. Definition Methodology for the Smart Cities Model, Energy 47(1): 326-332.
24. **Desdemoustier, J.; Crutzen, N.; Giffinger, R.** 2019. Municipalities' Understanding of the Smart City Concept: An Exploratory Analysis in Belgium, Technological Forecasting and Social Change 142: 129-141.
25. **Eremia, M.; Toma, L.; Sanduleac, M.** 2017. The Smart City Concept in the 21st Century, 10th International Conference Interdisciplinarity in Engineering, Procedia Engineering 181: 12-19.
26. What is the Concept of Smart City? [online cit.: 2019-05-15]. Available from: https://www.quora.com/What-is-the-concept-of-a-smart-city
27. **Paliaga, M.; Oliva, E.** 2018. Trends in Applying the Smart City Concept, Ekonomska Misao I Praksa-Economic Thought and Practice 27(2): 565-583.
28. **Dameri, R. P.** 2013. Searching for Smart City Definition: A Comprehensive Proposal, International Journal of Computers & Technology, Council for Innovative Research 11(5): 2544-2551.
29. **Methodology of the Concept of Smart Cities** [online cit.: 2019-05-10]. Available from: https://www.mmr.cz/getmedia/b6b19c98-5b08-48bd-bb99-756194f6531d/TB930MMR001_Metodika-konceptu-Inteligentnich-mest-2015.pdf
30. **Czech statistical office** [online cit.: 2019-05-13]. Available from: https://www.czso.cz/csu/czso/home
31. **Yearbook of Transport** [online cit.: 2019-05-14]. Available from: https://www.sydos.cz/cs/rocenka-2017/rocenka/htm_cz/obsah4.html
32. **Hradec Králové – official website** [online cit.: 2019-05-09]. Available from: https://www.hradeckralove.org
33. **Pardubice – official website** [online cit.: 2019-05-09]. Available from: https://www.pardubice.eu/