

## Practices of the penta-helix approach in the European leading smart cities

DORA SZENDI<sup>1</sup>  
*University of Miskolc*  
Hungary

### Abstract

The enhancing globalisation raises new challenges for the cities, such as rapid population growth, growing environmental problems and overcrowding in some cities, to which smart cities can give adequate solutions. Nowadays, with the widespread adoption of smart technologies and Industry 4.0 solutions, more and more cities are preparing strategies to be more innovative. The penta-helix model besides the classical stakeholders and civic society also integrates the participation of the social entrepreneurs and activists in its proactive model. The aim of the research is to analyse the penta-helix initiatives in the European smart cities, how it is applied in the different best practices. The analyses underlie that the leading European smart cities regarding the penta-helix approach are Aarhus, Berlin, Copenhagen, Helsinki, London, Oslo, Stockholm and Zurich, which emphasize the citizens' participation in the smart solutions. The case studies verify this group of cities, where there is a strong people-centric approach along the project generation and implementation.

**Keywords:** smart city, penta-helix, European Union, case studies, comparison of rankings.

**JEL Classification:** R12

### 1. Introduction

In the global economy, rapidly changing conditions (globalisation, industry 4.0, artificial intelligence or the current pandemic situation) are setting new challenges for cities. Today, 55% of the world's population lives in cities, which is expected to increase to 65% by 2050 (Worldbank, 2018). The cities are the most important hubs of economic activity around the world (concentration of population, enterprises, trade, stock exchanges). As an example, „the ten most innovative cities in the United States account for 23% of the national population, but for 48% of its patents and 33% of its gross domestic product” (Balland et al. 2020, p. 248). The biggest cities are somehow the steering centres of the countries' economies. “By 2025, the 600 biggest cities in the world are projected to account for 60% of global GDP.” (Debnath et al. 2020, p. 5). These challenges require new and innovative solutions from cities. Smart cities may be the winners in the process, as the smart solutions they adopt can make a major contribution to their resilience and competitiveness (Arafah and Winarso, 2017).

The term "smart city" has appeared in the literature since the late 1980s and early 1990s, but nowadays, in these times of pandemic, it is becoming even more relevant with the use of IoT technologies, open data solutions, e-government tools or digital education methods. The development of a successful smart city strategy is a critical issue for most city governments, but

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<sup>1</sup> Dr. Dora Szendi; University of Miskolc, Faculty of Economics, Institute of World and Regional Economics, Miskolc-Egyetemváros, 3515, Miskolc, Hungary, [regszdor@uni-miskolc.hu](mailto:regszdor@uni-miskolc.hu)

the strategies for stakeholder engagement vary from city to city. Some use top-down approaches, while others emphasise bottom-up and co-creation methods. The aim of this research is to examine the success of smart cities from the perspective of penta-helix models, which, in addition to classical stakeholder involvement, also stress public participation (social entrepreneurs, civic society) in the design and implementation of smart strategies.

The main research question is whether cities that involve stakeholders more intensively in smart solutions can achieve better positions in the European ranking of smart cities? In the analysis, I will examine the ranking of the European smart cities, with a particular focus on factors that include stakeholder involvement, and then I will also overview/check some best practice solutions for the top performing cities.

## 2. Theoretical background

The term 'smart city' became popular in the early 1990s and has changed its interpretation several times since then. Today, there is no single agreed-on definition of smart cities in all parts of the world. Initially, the vast majority of the definitions focused on the technological aspect of smart city development. One of the most frequently cited concepts in technocratic approaches is that of Harrison et al. (2010), emphasising that smart and appropriate use of ICT technologies can lead to intelligent, institutionalised and interconnected cities. Related to this ICT-based approach, Caragliu et al. (2009) have argued also that dimension of cities. Later on, more and more researchers integrated soft elements such as knowledge, innovation, creativity and human capital into the definitions, creating complex concepts. An example is related to Komninos (2011), who argues that a smart city is an area with a very high share of knowledge and innovation. Based on the above-mentioned dimensions and other empirical studies, the synthesis can be the following: A smart city is an area that adopts innovative strategies and solutions to improve the quality of life of the citizens, while effectively using the citizens' creativity and knowledge base (Szendi, 2019).

The concepts have a common feature of aiming to improve the quality of life of residents and emphasise the role of sustainability, innovation and knowledge. The different concepts attempt to define smart city performance based on several components (e.g. Giffinger et al. (2007): economy, people, governance, mobility, environment and living conditions) and a number of indicators, using both qualitative and quantitative ones. The role of stakeholders in smart city processes is rarely reflected in the definitions, as different cities may adopt different approaches based on their initial conditions, capabilities and governance methods. Lim et al. (2018, p. 44) argue that citizen-participation is an important aspect of today's smart cities, as the citizens are the possible source of the complexities, they are beneficiaries of the values which smart cities can deliver and they are also responsible for the development of smart cities. In the model of Simonofski et al. (2017) citizen-participation can be realized in three different forms: citizens as democratic participants (participation in governance, decisions), citizens as co-creators (direct interaction, living labs, online platforms), or citizens as ICT users (infrastructure, open data). The closest to the topic of this recent research is the role of citizens as co-creators, hence the penta-helix approach (proactive) integrates the participation of social entrepreneurs and activists alongside classical stakeholders and civil society.

Until the end of the first decade in the 2000s, the main idea of partnerships relied mainly on the approach of the triple-helix framework. This builds on the cooperation of three different

stakeholder groups (public, private and academic fields - practically governments, enterprises and universities or research institutes). It is basically a top-down model where the role of civic engagement is relatively low (Calzada and Cowie, 2017).

Compared to this the quadruple-helix, coming from the 2010s, also integrates the participation of the civic society in the model, as “triple-helix is not really sensitive enough for democratic additionality” (European Union, 2016, p. 14). This model gives a reactive solution for the emerging problems, and can react more flexibly to the changes happening in the city’s environment. So it is an institutionalized bottom-up framework, where also the civic society can contribute to build smarter solutions (Szendi, 2021).

The penta-helix approach goes one step further, as it integrates the social entrepreneurs and the social activists in a proactive model, where the project ideas are generated in a bottom-up manner (Calzada, 2020). It is important to mention that two interpretations of the penta-helix approach are prevalent parallel in the literature. The approach described above interprets the model in terms of the number of stakeholders and their contribution, based more on the emerging needs of local communities. However, there is another interpretation, which includes besides the elements of triple helix (industry, government, academia) the society as a fourth helix pillar, and the environment as the fifth helix dimension (e.g. Cabrera-Flores et al. 2020). Regarding smart cities, I thought that the first version (which integrates citizen-participation and social entrepreneurs) is closer to the research topic, as smart cities have in the majority of concepts their own pillar dedicated to environmental issues, and the different types of project generation processes are more interesting.

Based on the above, my main focus area is on the examination of smart city solutions in Europe from the aspect of penta-helix approach. In most cases, the governance or people pillar includes information regarding citizen-engagement.

### 3. Methodology and data

The aim of the research is to examine the success of smart cities from the aspect of the penta-helix approach, which also emphasises the participation of residents in the design of smart strategies. The first step of the research was to compare different smart city rankings in order to see the best performing cities in different dimensions and find the common points of the rankings. The analysis covered the following six models:

1. Giffinger et al. (2007) ranking of European medium-sized cities;
2. Giffinger (smart-cities.eu) ranking of larger European cities (2015);
3. IMD Smart City Index (2020);
4. Eden Strategy Institute Top 50 Smart City Governments (2018);
5. IESE Cities in Motion Index (2020);
6. Szendi et al. (2020) smart index ranking of EU28 capitals.

In each model I examine the role of the citizen-participation component in the global smart city ranking mostly based on the governance and people pillars.

For each method, I have defined a threshold value which indicates the success of cities in each pillar. Table 1 below summarises these critical points of the analysis.

**Table 1 Selected methods and their threshold values**

Method	Threshold	Notes
Giffinger et al. 2007 for medium-sized European cities	both people and governance pillar top 10 position, complex index top 10 position	-
Giffinger et al. 2015 for larger European cities	both people and governance pillar top 10 position, complex index top 10 position	-
IMD Smart city index (2020)	minimum 2 significant components from the total 3	Components: 1. minimum 30% of respondents have thought the citizens engagement as the most important priority axis (from the analysed 15), 2. minimum 65% of respondents contributes in decision-making, 3. minimum 65% of respondents provides feedback on local government projects
Eden Strategy Institute Top 50 smart city governments	top 25 places in people-centricity pillar	people-centricity component means a “sincere, people-first design of the future city”
IESE Cities in Motion index	governance pillar top 25 places	-
Szendi et al. 2020. smart performance of EU28 capitals	top cities in governance pillar	-

Source: own compilation

The original model by Giffinger et al. (2007) analyses the best performing European medium-sized cities along six dimensions: economy, people, governance, mobility, environment and living conditions. The criteria for cities are: a population of between 100 000 and 500 000, at least 1 university in the area and a catchment area with a population of up to 1 500 000. The same components and indicators were subsequently used to assess the larger European cities (population between 300 000 and 1 million; included in the Urban Audit database). The IMD Smart city index was most recently published in 2020, and ranks the 109 smartest cities in the world. The list measures residents' opinions on the structures and technological applications available in their cities (IMD, 2020). The Eden Strategy Institute evaluates the Top 50 smart city governments based on 10 factors: vision, leadership, budget, financial incentives, support programs, talent-readiness, people-centricity, innovation ecosystems, smart policies and track record. The IESE Cities in Motion index is produced annually by the University of Navarra Business School and is also a well-known example of smart city ranking. The current (2020) version of the index ranks the 174 analysed cities on the basis of 9 dimensions and 101 indicators. The main dimensions are: human capital, social cohesion, economy, governance, environment, mobility and transport, urban planning, technology and international relations. Szendi et al. 2020 analysed the smart performance of the EU28 capitals based on the methodology of Giffinger et al. (2007) with an extended and modified indicator structure.

## 4. Results

The ranking of cities based on the penta-helix approach can be compiled from those cities that are indicated in a favourable position in the above-mentioned rankings. The different methods have resulted in the following number of cities (Table 2): Giffinger et al. (2007) model: 5 significant cities, Giffinger et al. (2015) model: 6, IMD smart city index: 3, Eden Strategy Institute: 7, IESE Cities in Motion index: 7 and Szendi et al. (2020): 5 cities.

**Table 2 Significant cities by the different components**

<b>Giffinger et al. 2007 medium-sized</b>	<b>Giffinger et al. 2015 larger</b>	<b>IMD Smart city index</b>	<b>Eden Strategy Institute</b>	<b>IESE Cities in Motion</b>	<b>Szendi et al. 2020.</b>
<i>both people and governance pillar top 10, complex top 10</i>	<i>both people and governance pillar top 10, complex top 10</i>	<i>minimum 2 significant components</i>	<i>top 25 people- centricity</i>	<i>governance top 25</i>	<i>top governance pillar</i>
Aarhus	Stockholm	Zurich	London	London	Copenhagen
Umeaa	Copenhagen	Oslo	Barcelona	Reykjavik	Stockholm
Eskilstuna	Göteborg	Geneva	Vienna	Copenhagen	Luxemburg
Odense	Helsinki		Amsterdam	Berlin	Helsinki
Jyväskylä	Aarhus		Tallinn	Zurich	Valletta
	Malmö		Berlin	Oslo	
			Dublin	Stockholm	

Source: own compilation

Two main clusters can be distinguished from the results: leading cities regarding the penta-helix approach, whose significant position is supported by 2 or 3 methods, and strong cities regarding the penta-helix approach, which are supported by 1 method. I have examined the cities' performance based on the different indices and have created clusters among them. The intersection of the created clusters has resulted in two groups of cities with different characters. The synthesis of the rankings can be transformed to the following hierarchy (Figure 1).

The penta-helix approach, involving social entrepreneurs and activists, helps to better respond to the challenges of a changing environment and can increase the resilience of cities. The vast majority of the world's leading smart cities are using this model to shape their smart vision; however, the geographical intensity of this model's application varies considerably. In Europe, it is mainly Scandinavia where the adoption is the highest. It is also remarkable that these citizen-centred components are not always a guarantee for overall success, but can be a major contributor to a good overall position (and a traditionally top-down driven city can be similarly successful, like Vienna). Europe's leading smart cities according to the penta-helix approach are Aarhus, Berlin, Copenhagen, Helsinki, London, Oslo, Stockholm and Zurich, where community participation plays a strong role in the creation of smart city projects.

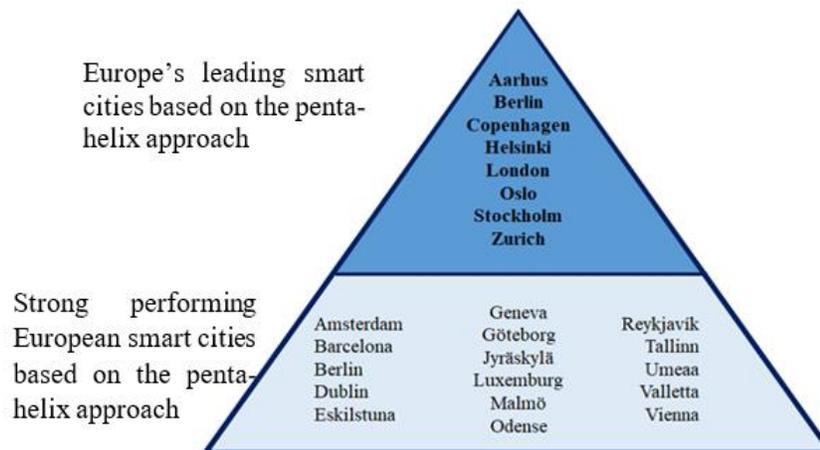


Figure 1 Hierarchy of smart cities regarding the penta-helix approach

Source: own edition

#### 4.1 Case studies

In the last part of the study, I have examined some examples of the above-mentioned leading smart cities to see what kind of co-creating projects exist in the practice which support their good position.

##### Aarhus

In the case of the Danish Aarhus, the smart city idea is based on the Smart Aarhus project, which uses digital solutions to make Aarhus greener, better and generally smarter. The project is implemented by the collaboration between the municipality, companies, citizens and knowledge institutions ([smartaarhus.eu.aarhus.dk](http://smartaarhus.eu.aarhus.dk), 2021). So it is a working penta-helix. Regarding the projects, there are a lot of different solutions in the city, like the center for telehealthcare, LED street lights, IoT Forum, traffic control center, or open data portal. The mostly participation-centered solution may be probably the Aarhus City lab (a digital test center for smart city solutions and a showroom for smart initiatives), where the citizens can actively contribute to project generation ([smartaarhus.eu.aarhus.dk](http://smartaarhus.eu.aarhus.dk), 2021).

##### Berlin

The main aim of the Smart Berlin project is threefold: 1. expanding the international competitiveness of the Berlin-Brandenburg metropolitan region, 2. increasing the resource efficiency and climate neutrality of Berlin by 2050, and 3. creating a pilot market for innovative applications (Senate Department for Urban Development and the Environment, 2015). The implementation model follows basically rather a quadruple-helix framework, and involves the following stakeholders: economic actors, alliances, science field, NGOs, representatives, government. But the city also has a CityLAB where the different stakeholders can participate in the project generation processes. Here also the social activists, NGOs can suggest new solutions, but the participation of inhabitants is weaker. The main ways of creating projects are various co-working, discussion events, hackathons, think tanks, experimental laboratories and exhibition areas ([smart-city-berlin](http://smart-city-berlin), 2021).

## **Copenhagen**

In the smart strategy of the Danish capital there is a clearly declared citizens-come-first mindset, which means that regarding a lot of projects there is a strong co-creating process with the inhabitants. There are IoT living labs and voting platforms where “developers can submit a request for testing their smart city solution to the city’s Street Lab. Once accepted, Copenhagen Street Lab offers full assistance to install and connect the solution to the existing infrastructure” (cities-today.com, 2021). There is also a Smart City Academy in the city, where there is an active cooperation among Anchor Cities, Corporate Partners, National Partners, and Academic Partners (stateofgreen.com, 2021).

## **Helsinki**

The Finnish capital creates a regional smart specialisation strategy together with its broader region Helsinki-Uusimaa as they think that the whole region is considered together as a knowledge and innovation hub. Here the citizens are also “active, creating together with companies and cities agile, user-focused services and solutions” (helsinkismart.fi, 2021). Besides that the whole city is an entire city-lab, to test the operability of creative businesses (myhelsinki.fi, 2021). Here the citizen-engagement is very strong, which can be verified by the fact that over 800 of Kalasatama’s 3000 residents (a district of Helsinki) have already participated in developing new smart solutions (myhelsinki.fi, 2021).

## **London**

The city has launched the Smarter London Together project in 2018, and aims to transform the city into the most innovative/smart in the world. There are numerous priority axes connected to the idea of penta-helix, like the “more user-designed services” axis (they seek to realize Civic Innovation Challenges, or new civic platforms to engage citizens and communities), or the “improve city-wide collaboration” axis (collaboration of different systems). The innovation challenge for example creates good opportunities to test solutions together with the business leaders, science sphere, and government (Greater London Authority, 2018).

## **Oslo**

The Smart Oslo Strategy aims to create a smarter, greener, more inclusive, and creative city for all citizens and besides that a living-lab is working in the city. Oslo has created a framework for innovation, tech and knowledge hubs. The citizen-participation appears in almost all projects generated in the city (grafill.no, 2018).

## **Stockholm**

Stockholm would like to be a smart and connected city, and that is why the common goal is to achieve “A Stockholm for all”. The smart city strategy is developed together with residents, academia, business through direct dialogues, social media, and work meetings (City of Stockholm, 2020). A good example of citizen-engagement projects can be the Maptionnaire online platform of urban planning which gives an opportunity for presenting the residents’ ideas and opinions about public place designs (maptionnaire.com, 2021).

## Zurich

The grounding principles of Smart Zurich are the people-centric approach, connectedness and collaboration, openness and sovereignty, agility (Stadtentwicklung Zurich, 2018). There is a working city lab in Zurich, which means a smart participation among the stakeholders; the specific urban projects are used to test innovative forms of participation and the involvement of various stakeholders. The main focus area is to connect people, organisations or infrastructures in such a way as to create social, ecological or economic added value (stadt-zurich.ch, 2021).

## 5. Conclusion

This recent article analyzed the role of penta-helix approach in the case of the top performing smart cities in Europe. I have checked the role of citizen-engagement in the smart cities with the help of six ranking methods and have created homogenous clusters from the leading ones. As a synthesis of the results, I can conclude that the vast majority of top smart cities in Europe apply the penta-helix approach to some extent. Usually the Scandinavian cities use this approach more often, but there are also other regions among the best performing ones. The Top cities in Europe are the following (leading cities based on the penta-helix approach): Aarhus, Berlin, Copenhagen, Helsinki, London, Oslo, Stockholm and Zurich. However, these elements are not always a guarantee of success (top-down models can be also successful, e.g. Vienna), but can contribute strongly to a good overall position. It is also important to mention that this model of analysis has some limitations, and the list of ranking methods can be extended further, as for example Amsterdam or Barcelona are well-known practices of people-first thinking, living labs or innovation, but these 6 models don't verify their leading role. The analysed case studies of the best performing smart cities underlie the strong role of penta-helix approach by these entities, and the importance of people-centric thinking by the project generation of intelligent solutions.

## References

- Arafah, Y., Winarso, H. (2017). Redefining smart city concept with resilience approach. *IOP Conf. Ser.: Earth Environ. Sci.* 70 012065
- Balland, P. A., Jara-Figueroa, C., Petralia, S. G., Steijn, M. P. A., Rigby, D. L., Hidalgo, C. A. (2020). Complex economic activities concentrate in large cities. *Nature Human Behaviour*, Vol 4, March 2020, pp. 248–254.
- Cabrera-Flores, M., López-Leyva, J., Peris-Ortiz, M., Orozco-Moreno, A., Francisco-Sánchez, J., Meza-Arballo, O. (2020). A framework of penta-helix model to improve the sustainable competitiveness of the wine industry in Baja California based on innovative natural resource management. *E3S Web of Conferences* 167, 06005.
- Calzada, I., Cowie, P. (2017). Beyond Smart and Data-driven City-regions? Rethinking Stakeholder-helices Strategies. *Regions*, 308, 4, pp. 25–28.  
<https://doi.org/10.1080/13673882.2017.11958675>
- Calzada, I. (2020). Democratising Smart Cities? Penta-Helix Multistakeholder Social Innovation Framework. *Smart Cities* 2020, 3, pp. 1145–1173. <https://doi.org/10.3390/smartcities3040057>
- Caragliu, A., Del Bo, Ch., Nijkamp, P. (2009). Smart Cities in Europe. *Journal of Urban Technology*, 18, 0048, pp. 45–59.
- cities-today.com (2021)

- City of Stockholm (2020). *Smart&Connected*. Brochure. <https://international.stockholm.se/globalassets/ovriga-bilder-och-filer/smart-city/brochure-smart-and-connected.pdf> downloaded: 20. 10. 2021.
- Debnath, A., Isaksen, S. A., Mynster, A. S., Nielsen, J. U. (2020). *Smart Cities and Communities Infrastructure*. Whitepaper. <https://forcetechnology.com/en/articles/smart-cities-communities-infrastructure-whitepaper> downloaded: 05. 10. 2021.
- Eden Strategy Institute (2018). *Top 50 Smart City Governments*. [https://static1.squarespace.com/static/5b3c517fec4eb767a04e73ff/t/5b513c57aa4a99f62d168e60/1532050650562/Eden-OXD\\_Top+50+Smart+City+Governments.pdf](https://static1.squarespace.com/static/5b3c517fec4eb767a04e73ff/t/5b513c57aa4a99f62d168e60/1532050650562/Eden-OXD_Top+50+Smart+City+Governments.pdf) downloaded: 22. 03. 2021.
- European Union (2016). *Using the Quadruple Helix Approach to Accelerate the Transfer of Research and Innovation Results to Regional Growth*. ISBN: 978-92-895-0890-2
- Giffinger, R., Fertner, C., Kramar, H., Kalasek, R., Pichler-Milanovic, N., Meijers, E. (2007). *Smart Cities: Ranking of European Medium-Sized Cities*. Vienna University of Technology, University of Ljubljana and Delft University of Technology.
- Giffinger, R., Kramar, H., Haindlmaier, G., Strohmayer, F. (2015). Ranking of larger European cities. <http://www.smart-cities.eu/?cid=7&ver=4> downloaded: 20. 10. 2021.
- grafill.no (2018)
- Greater London Authority (2018). *Smarter London Together*. The Mayor's roadmap to transform London into the smartest city in the world. [https://www.london.gov.uk/sites/default/files/smarter\\_london\\_together\\_v1.66\\_-\\_published.pdf](https://www.london.gov.uk/sites/default/files/smarter_london_together_v1.66_-_published.pdf) downloaded: 20. 10. 2021.
- Harrison, C., Eckman, B., Hamilton, R., Hartswick, P., Kalagnanam, J., Paraszczak, J., Williams, P. (2010). Foundations for Smarter Cities. *IBM Journal of Research and Development*, 54, 4, pp. 350–365.
- helsinki.fi (2021)
- IESE (2020). *IESE Cities in Motion Index*. <https://media.iese.edu/research/pdfs/ST-0542-E.pdf> downloaded: 21. 03. 2021.
- IMD (2020). *Smart City Index 2020. A tool for action, an instrument for better lives for all citizens*. [https://www.imd.org/globalassets/wcc/docs/smart\\_city/smartcityindex\\_2020.pdf](https://www.imd.org/globalassets/wcc/docs/smart_city/smartcityindex_2020.pdf) downloaded: 21. 03. 2021.
- Komninos, N. (2011). Intelligent Cities: Variable Geometries of Spatial Intelligence. *Intelligent Buildings International*, 3, 3, pp. 172–188.
- Lim, S., Malek, J. A., Hussain, M. Y., Tahir, Z. (2018). Citizen participation in building citizen-centric smart cities. *Geografia, Malaysian Journal of Society and Space* 14, 4, pp. 42-53.
- mationnaire.com (2021)
- myhelsinki.fi (2021)
- Senate Department for Urban Development and the Environment (2015). *Smart City Strategy Berlin*. [https://www.berlin-partner.de/fileadmin/user\\_upload/01\\_chefredaktion/02\\_pdf/02\\_navi/21/Strategie\\_Smart\\_City\\_Berlin\\_en.pdf](https://www.berlin-partner.de/fileadmin/user_upload/01_chefredaktion/02_pdf/02_navi/21/Strategie_Smart_City_Berlin_en.pdf) downloaded: 20. 10. 2021.
- Simonofski, A., Asensio, E. S., De Smedt, J., Snoeck, M. (2017). *Citizen Participation in Smart Cities, Evaluation Framework Proposal*. 19th IEEE Conference on Business Informatics. Conference Paper. [https://www.researchgate.net/publication/318744709\\_Citizen\\_Participation\\_in\\_Smart\\_Cities\\_Evaluation\\_Framework\\_Proposal](https://www.researchgate.net/publication/318744709_Citizen_Participation_in_Smart_Cities_Evaluation_Framework_Proposal) downloaded: 05. 10. 2021.
- smartaarhus.eu.aarhus.dk (2021)

smart-city-berlin.de (2021)

Stadtentwicklung Zurich (2018). *Smart City Zurich*. [https://oascities.org/wp-content/uploads/2018/06/Seiler\\_Bilbao\\_ioTWeek\\_june18.pdf](https://oascities.org/wp-content/uploads/2018/06/Seiler_Bilbao_ioTWeek_june18.pdf) downloaded: 20. 10. 2021.

stadt-zurich.ch (2021)

stateofgreen.com (2021)

Szendi, D. (2019). Measuring the smart cities' performance in the capital cities of the EU. In: University, of Ho Chi Minh City (ed.) *Proceedings of the International Conference - Special mechanism and policy for the development of Ho Chi Minh City from the legal perspective*; Ho Chi Minh City, Vietnam, pp. 87–120.

Szendi D. (2021). The Connection of Smart Cities Approach and Social Innovation. *MULTIDISZCIPLINÁRIS TUDOMÁNYOK: A Miskolci Egyetem Közleménye*, 11, 2, pp. 241–246. <https://doi.org/10.35925/j.multi.2021.2.31>

Szendi, D., Sebestyén Szép, T., Erős, A., Bokland, H., Nagy, Z. (2020). Copenhagen, as the Smartest Capital in the European Union? In: *BOOK OF PROCEEDINGS: ICSS XXII.: 22nd International Conference on Social Sciences* Amsterdam, pp. 43–54.

Worldbank (2018). <http://www.worldbank.org/en/topic/urbandevelopment/overview> downloaded: 13. 11. 2018.