

SMART CITY INTERNATIONAL CONCEPTS AND CHALLENGES*

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1. Introduction

From the middle of the 20th century in the developed countries it is now a typical feature to see urbanization and cities growing: increasing population and areas of the cities, expending city life, improving infrastructure and public services, and the changing of the structure of economy. Urbanization and globalization both affect the development of cities by proposing new challenges. Dealing with the problems (such as health care, public transport, pollution etc.) require new innovative solutions, social innovation is needed on an urban level. Such innovative solutions could be the developing of smart cities which could also contribute to the development of the local information society. Today international competitiveness is directed by a city's innovative nature. In order to achieve this cities go thorough significant changes; implementing ICT infrastructures places them on a global level by providing new locations for businesses and clusters.

2. Smart City definitions and international concepts

The concept of smart cities gained a respectable attention in the second half of the 1990s thanks to the spreading of the information communication technologies (from now on ICT). In literature they refer to the smart city concept as the future's safe, environment friendly and effective city center which innervates high existence and sustainable economic growth with its developed infrastructures (such as sensors, electronic devices and networks). In the meantime, the smart city has yet to have a uniformly accepted definition, there are actually several definitions.¹ In the following, I m going to introduce the concepts published in international literatures after the turn of the century.

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¹ NAGY, Zoltán –SZENDI, Dóra – TÓTH, Géza: Opportunities for Adaptation of the Smart City Concept – A Regional Approach. *Theory, Methodology, Practice*, 2016/3, p. 87, DOI: 10.18096/ TMP.2016.02.08.

Robert Hall created the definition of smart city in 2000, according to which a smart city is a city that inspects and integrates the critical infrastructures (roads, bridges, ports, water supplies, tunnels, railways, airports, big buildings, communication systems, power supplies) optimizes power sources, plans and supervises preventive maintenance activities while maximizes public services.²

The most referred study on the concept of smart city in the international publications is Rudolf Giffinger's work³ in 2007 in which he came up with the definition of smart city and defined the indicator system of European middle sized cities. According to Griffinger the smart city is a city which provides outstanding performs in the areas of people, public transport, quality of life, governing, environment and the economy,⁴ furthermore, it provides a certain approach which considers awareness, flexibility, the ability to transform, consistency, cooperation and strategic behavior as abilities.⁵

According to Griffinger the term smart economy implies competitiveness, based on innovative business point of view, entrepreneur potentials, trademarks, costs spent on research-development, productivity and flexibility of the labour market, the city's national and international economic integration.⁶

Smart governing includes partaking in decision making, community and social services, transparent governing and political strategies as well as perspectives.⁷

Smart people are not characterized only by its citizens' level of qualification and their affinity towards lifelong learning, but their flexibility, creativity, open mindedness and their social activity.⁸

The elements of smart mobility are local and international accessibility, sustainable, safe and innovative transport system, furthermore, availability of ICT infrastructures. Smart mobility programs also support more effective transport systems (such as pedestrian, bicycle).⁹

Smart environment can be characterized by its auspicious environmental conditions (such as climate, green areas), efforts made to the betterment of pollution, energy source management as well as environmental protection.¹⁰ Smart environment promotes the necessity of sustainable environmental energy source-management and

² HALL, Robert E.: *The Vision of a Smart City. 2nd International Life Extension Technology Workshop*, 2000, Paris, p. 1.

³ GIFFINGER, Rudolf: *Smart Cities – Ranking of European Medium-sized Cities*. Centre of Regional Science, Vienna UT, 2007, pp. 1–28, http://www.smart-cities.eu/download/smart_cities_final_report.pdf.

⁴ NAGY, ZOLTÁN – SZENDI, DÓRA – TÓTH, Géza: op. cit. p. 88.

⁵ SZENDREI Zsolt: *Smart city, a jövő városa*. p. 4.
http://www.urb.bme.hu/segedlet/varos1/eloadasok_2014/07B_SMART%20CITY_SZENDEI%20ZSOLT_kivonat.pdf

⁶ GIFFINGER, Rudolf: op. cit. p. 11.

⁷ Ibid. p. 11.

⁸ Ibid. p. 11.

⁹ Ibid. p. 12.

¹⁰ Ibid. p. 12.

city planning, supports the decreasing of energy consumption and the integrating of new technological innovations, which result in increasing efficiency. Decreasing pollution and emission as well as the efforts made in environmental protection both contribute to the preservation of the city's environmental beauty.

Smart lifestyle includes the different elements of the quality of life such as: culture, health care, safety, housing, tourism etc. and those that improve the quality of life.¹¹

Griffinger groups the six areas of a smart city further into factors and indicators.¹²

Andrea Caragliu, Chiara Del Bo and Peter Nijkamp created a definition for smart city in 2009: a city is smart if the human and financial investments, the traditional transport and modern infrastructures – due to responsible utilization of natural resources and governing based on participation – support the sustainable economical growth and the higher quality of life.¹³ We can recognize a smart city by the following determining qualities:

- The utilization of the network infrastructure increases efficiency in economy and politics as well as contributes to the social, cultural and city development. By infrastructure we mean the business, housing, spare time and life leading services, furthermore the ICT services (such as phone, TV, internet).
- The primary emphasis is on the business based developments.
- In the public services the most important priority is the social integrating of the different city inhabitants.
- High tech and creative sectors have an important role in the city's long term development.
- Social and relation capital get highlighted attention in city development. A city can become in a smart city if its community learns to learn, adapt and renew. The people must be able to use technology in order to benefit from it. However, ignoring social and relation problems could lead to social polarization.
- One of the most important factors of strategy is the social and environmental sustainability. In a world where sources are scarce, and where the cities rely on tourism and natural sources in their development and well being, they need to make sure that while taking advantage on these sources they also maintain the safety and renewability of the natural heritage.¹⁴

Donato Toppeta explains in his study written in 2010 that since a smart city is part of a complex, multiple dimensional network system, and some of the cities have individual cultural, economical, social and geographical boundaries, the definition

¹¹ Ibid. p. 12.

¹² See in details in: GIFFINGER, Rudolf: op. cit.

¹³ CARAGLIU, Andrea –BO, Chiara Del –NIJKAMP, Peter: Smart Cities in Europe. *3rd Central European Conference in Regional Science – CERS*, 2009, p. 50.
https://inta-ai.vn.org/images/cc/Urbanism/background%20documents/01_03_Nijkamp.pdf

¹⁴ Ibid. pp. 47–48.

of smart city need an analytical and holistic approach.¹⁵ Smart cities connect ICT and Web 2.0 technology with other functional and projecting solutions in order to accelerate bureaucratic process, as well as in order to increase sustainability and livability they contribute to the complexity of the city governing with new, innovative solutions.¹⁶ Toppeta classifies the role of ICT for smart cities according to the following:

- “Infomobility” and intelligent transport systems: include the integrated, variable fare systems, more advanced travel information services (such as locating stops, nearest taxi/bus, restaurant etc. on smart phones), analysing traffic intensity, automatic acknowledging of traffic violations, automatic noticing of hazards in traffic (such as out of order traffic lights, flood, fog, etc.)¹⁷
- Smart people (the developing of human energy sources and social capital): includes for example life long learning, education involving computers, e-book rentals, telemedicine-services, providing local services for adds and touristic information, etc., virtual museums, digital art, ecotourism services, etc.¹⁸
- Economy 2.0.: the author includes for example individualized services for the citizens, virtual offices for universities, commercial chambers and incubators related to analytic and consulting companies, etc.¹⁹
- Life quality and sustainability: listed here by the author for example the geothermic heating systems, third generation central heating, micro horticulture, the CAD software and the WebGis applications, etc.²⁰
- Ecosystem: Sustainable environmental protection, renewable energy and other sources: here, he mentions the list of smart traffic control solutions, continues inspection of sewers and gutters for the protection of water, efficient lightings, the operation of systems controlling noise and electromagnetic pollution, the operation of the sustainable city drainage system and smart watering systems to prevent ground water contamination and floods.²¹
- E-Democracy, government 2.0, smart government: here the author lists for example the cloud based information sharing platforms, the direct and safely accessible internet systems operated for the good access to local information and public services, and the centralized smart appointment making systems for health care services, furthermore, the public safety and the decreasing of the time in responding to crime or emergency calls, etc.²²

¹⁵ TOPPETA, Donato: *The Smart City vision: How Innovation and ICT can build smart, “liveable”, sustainable cities*. The Innovation Knowledge Foundation, 2010, p. 1.

¹⁶ Ibid. p. 4.

¹⁷ Ibid. p. 5.

¹⁸ Ibid. p. 6.

¹⁹ Ibid. p. 6.

²⁰ Ibid. p. 6.

²¹ Ibid. p. 7.

²² Ibid. p. 7.

In his 2010 written study, Harrison explains that a smart city is lead by electronic devices, connected and intelligent city, which has an impact on the city's collective intelligence by the combination of its physical, IT, social and business infrastructure.²³ Lead by electronic devices means that applying sensors, kiosks, devices, cameras, smart phones, inbuilt medical equipment, web and similar data gathering systems makes it possible to record and integrate actual concrete data. The author means by connecting that these data are integrated in a company computer platform and then made accessible to the different city services. Intelligence refers to the complex analysis, modelling, optimizing and visualizing in the operative business process- and decision management.²⁴

In their study, published in 2010, Dough Washburn and Usman Sindhu explains that smart a city uses "smart computing" technologies in order to make the city's critical infrastructure (such as local government, education, healthcare, public safety, traffic and public services) more intelligent, connected and efficient. "Smart computing" is the new generations of integrated hardware, software and web technologies, which help people make more intelligent decisions in the possession of the real world and real time observing IT system and improved analysing and also optimises business processes and business balance outcomes.²⁵

Thomas Chen published his standpoint in 2010, according to which smart cities take advantage of the communication and sensor possibilities built in the city's infrastructure in order to optimize the necessary electronic, transport/traffic and other logistic operations and by doing so can they improve everybody's quality of life.²⁶

Taewoo Nam and Theresa A. Pardo in 2011 created a relatively new concept for smart city. They simplified and regrouped a city's most important defining elements into three categories: technological (hardware, software infrastructures), human (creativity, diversity, education) and institutional (governmental, political) factors.²⁷

²³ HARRISON, C. – ECKMAN, B. – HAMILTON R. – HARTSWICK, P. – KALAGNANAM, J. – PARASZCZAK, J. – WILLIAMS, P.: Foundations for Smarter Cities. *IBM Journal of Research and Development*, 2010/4, p. 7, DOI: 10.1147/JRD.2010.2048257.

²⁴ CHOURABI, Hafedh – NAM, Taewoo – WALKER, Shawn – GIL-GARCIA J. Ramon – MELLOULI, Sehl – NAHON, Karine – PARDO, Theresa A – SCHOLL, Hans Jochen: Understanding Smart Cities: An Integrative Framework. 2012, *45th Hawaii International Conference on System Sciences*. 1st ed. Washington, DC: IEEE Computer Society, p. 2290, DOI: 10.1109/HICSS.2012.615.

²⁵ WASHBURN, Doug – SINDHU, Usman: *Helping CIOs Understand "Smart City" Initiatives. Defining The Smart City, Its Drivers, And The Role Of The CIO*. Forrester Research, Inc., 2010, p. 3.

²⁶ CHEN, Thomas: Smart Grids, Smart Cities Need Better Networks. *IEEE Network*, 2010/2, p. 3, DOI: 10.1109/MNET.2010.5430136.

²⁷ NAM Taewoo – PARDO, Theresa A.: Conceptualizing Smart City with Dimensions of Technology, People, and Institutions. *Proceedings of the 12th Annual International Conference on Digital Government Research*, DG.O 2011, College Park, MD, USA, June 12–15, 2011, p. 286, DOI: 10.1145/2037556.2037602.

A smart city's essential technological elements are the wireless infrastructure as well as the everywhere present computer infrastructure. Also essential to a smart city's technological requirements the network devices (optical and wireless networks) public hotspots (wireless hotspots, kiosks) and the service oriented information systems. Technology is indispensable for a city to become smart because the use of ICT basically changes life and labour conditions in the city. Well working infrastructure is necessary; however, this alone is not enough: information infrastructure and applications are both preconditions for a smart city, but unless the cooperation of the public institutes, private sphere, civil organizations, schools and the public are not present, we cannot possibly talk about a smart city.²⁸

In addition to the accessible and qualitative IT infrastructure, in urban development the role of human infrastructure, creativity and education are determining. By human factors we mean the citizens social integration to public services, city diversity, social, human and relation capital as well as education based educational institutes.²⁹

Governmental and political support has a key role in establishing a smart city.³⁰ Providing an administrative environment, transparent, integrated management, strategic and promotional activities, building relationships as well as taking care of partnerships are necessary. Governing include cooperation, partnership, partaking and role of the citizens. The specifics of a successful city rely in the cooperation of the government, business, scientific, non-profit, civil sectors and the political parties. The local government must share its smart city plans, visions, priorities, and strategies with the citizens and other parties concerned. Management has a cardinal role in a smart city's success.³¹

John V. Winters in 2011 described his smart city concept focusing on education. In his opinion a smart city is the centre of higher education, highly qualified individuals and professional labour. He owes the development of a smart city partly to the fact that the candidates of higher education typically stay in the city after graduating, therefore the city area becomes bigger with most of the inhabitants owning a diploma from a higher educational institute. According to him the city can even become smarter by attracting creative people and labour like a magnet. A smart city is a human friendly environment which has multiple possibilities to utilize human potentials and establish a creative lifestyle.³²

In 2011, Moe Thuzar explains that future smart cities will need a sustainable city development policy that would provide good livelihood for the citizens including the poor, and also maintain the cities' appealing feature. Smart cities are cities that provide high living standards by realizing sustainable economic growth, human and social capital input and also traditional and modern infrastructure as well as provide

²⁸ Ibid. pp. 286–287.

²⁹ Ibid. p. 287.

³⁰ Ibid. p. 288.

³¹ Ibid. p. 288.

³² Ibid. p. 288.

social partaking in natural resource-management. Smart cities need to realize sustainable, converged economic, social and environment protecting visions.³³

According to Juan M. Barrionuevo Pascual Barrone and Joan E. Ricart a smart city utilizes technology and sources in its possession in unison in order to establish integrated, liveable and sustainable city centres. For a city to become smart there are five components: economic capital (GDP, international transactions, international investments), human capital (talent, innovations, creativity, education), social capital (traditions, customs, religion, family), environmental capital (energy policy, waste- and water management), and finally institutional capital (civil obligations, administrative authorities, elections).³⁴

Karima Kourtit and Peter Nijkamp published in 2012 that smart cities are the result of such knowledge intensive and creative strategies that aim to emphasize the cities' social-economical, ecologic, logistic and competitive activities. A smart city's basic elements include human capital (such as professional labour), infrastructural capital (high-tech communication devices), social capital and entrepreneur capital (creative and risk-taking business activities).³⁵

Sotiris Zygiaris explains in his 2012 publication that the term smart city is interpreted as a certain intelligent ability, which deals with several innovative, socio-technical and social-economic related issues for development. These aspects lead to such smart city concepts like "green", connected, intelligent, innovative cities.³⁶

Renata Paola Dameri in her publication in 2013 defined the definition of smart city according to which on the one hand a smart city is a particular area in which developed technologies (like ICT, logistics, power generation, etc.) contribute to producing advantages in the aspect of the citizens' wealth, partaking, quality of environment and intelligent development. On the other hand, it is a city managed by a personal team that is capable of specifying the regulations and policies of the city management and development.³⁷

According to Tuba Yesim Bakici, Esteve Almirall and Jonathan Wareham a smart city is a developed city that uses high technology, which connects people, information and city elements by applying the new technologies in order to estab-

³³ THUZAR, Moe: *Urbanization in SouthEast Asia: developing smart cities for the future?* Regional Outlook, 2011, p. 96, DOI: 10.1355/9789814311694-022.

³⁴ BARRIONUEVO, Juan M. – BERRONE, Pascual – RICART, Joan E.: Smart Cities, Sustainable Progress: Opportunities of urban Development. *IESE Insight*, 2012/14, pp. 50–51, DOI: 10.15581/002.ART-2152.

³⁵ KOURTIT, Karima – NIJKAMP, Peter: Smart cities in the innovation age. *Innovation: The European Journal of Social Sciences*, 2012/2, p. 93, DOI: 10.1080/13511610.2012.660331.

³⁶ ZYGIARIS, Sotiris: Smart City Reference Model: Assisting Planners to Conceptualize the Building of Smart City Innovation Ecosystems. *Journal of the Knowledge Economy*, 2012/2, p. 218, DOI: 10.1007/s13132-012-0089-4

³⁷ DAMERI, Renata Paola: Searching for Smart City definition: a comprehensive proposal. *International Journal of Computers & Technology*, 2013/5, p. 2549, DOI: 10.24297/ijct.v11i5.1142.

lish sustainable, environment friendly city, competitive and innovative trade and also improve the quality of life.³⁸

M. L. Marsal-Llacuna, Joan Colomer-Llinàs and Joaquim Melendéz-Frigola explain in their study published in 2015 that smart cities try to improve the operation by utilizing data, they also provide more efficient services to the citizens with the use of the ICT, inspect and optimize the existing infrastructure, increase cooperation between the different economic individuals and support the innovative models both in public and in private sector.³⁹

Saraju P. Mohanty, Uma Choppali and Elias Kougianos defined the elements, attributes, objects and infrastructures of a smart city.⁴⁰

The elements of a smart city are the smart infrastructure, smart buildings, smart traffic, smart energy consumption, smart healthcare, smart technology, smart governing, smart education and smart citizens.⁴¹

The authors list sustainability, quality of life, smartness, and urbanization to the city's attributes.⁴²

The subject matters of a smart city include society, economy, environment and governing. In regards of society a smart city is for its locals or citizen. Economically a smart city produces continuous employment and economical growth. In the environmental aspect the city is able to maintain its functions and will work for the existing and future generations. As for governing, the smart city is able to apply the policies and connect it with other elements.⁴³

To the infrastructure of smart cities the authors include the physical infrastructure, the ICT-s and the services. Physical infrastructures are the smart cities' actual physical or structural elements such as buildings, roads, railroads, water supply systems, etc. Physical infrastructure is typically not the smart element of a smart city. ICT infrastructure is the smart city's most important smart element. Service infrastructure is based on physical infrastructure and includes some ICT elements (such as smart grid).⁴⁴

³⁸ BAKICI, Tuba Yesim – ALMIRALL, Esteve – WAREHAM, Jonathan: A Smart City Initiative: The Case of Barcelona. *Journal of the Knowledge Economy*, 2013/2, pp. 135–148, DOI: 10.1007/s13132-012-0084-9.

³⁹ MARSAL-LLACUNA, Maria-Lluïsa – COLOMER-LLINÀS, Joan – MELÉNDEZ-FRIGOLA, Joaquim: Lessons in Urban Monitoring Taken From Sustainable And Livable Cities to Better Address the Smart Cities Initiative. *Technological Forecasting and Social Change*, 2015/90, pp. 611–622, DOI: 10.1016/j.techfore.2014.01.012.

⁴⁰ MOHANTY, Saraju P. – CHOPPALI, Saraju P. – KOUGIANOS, Elias: Everything You wanted to Know about Smart Cities. The Internet of Things is the backbone. *IEEE Consumer Electronics Magazine*, 2016/3, pp. 61–62, DOI: 10.1109/MCE.2016.2556879.

⁴¹ Ibid. p. 61.

⁴² Ibid. p. 61.

⁴³ Ibid. p. 62.

⁴⁴ Ibid. p. 62.

Bhagya Nathali Silva, Murad Khan, Kijun Han specified a smart city's attributes and pillars in their study published in 2018.⁴⁵

According to their standpoint – similarly to that of Mohanty, Choppali and Kougianos – most suggestions regarding smart cities include four main attributes: sustainability, quality of life, urbanization and smartness. Sustainability is an essential paradigm of the city's development from the 1980s and also plays an important role in the establishing of smart cities. In the category of sustainability in addition to infrastructure and governing they include issues concerning pollution and waste, energy and climate change, society, economy and healthcare. Urbanization focuses on technological, infrastructural and city management aspects in regards of developing from rural to city environment. The improvement of the quality of life is present in the citizens' emotional and financial prosperity. In smartness the authors mean the need for improving the city's social, economical and environmental conditions.⁴⁶

The pillars of a smart city are the following: institutional, physical, human, and economical infrastructure. Institutional infrastructure includes city management, which involve partaking in decision making, public- and social services, transparent governing, political strategies and perspectives. Institutional infrastructure includes furthermore national and civil organizations necessary for the cooperation of services, and also keeps contact with the central government.⁴⁷

The pillar of physical infrastructure ensures the sustainability of energy sources for the operation of the city. In the realization of a smart city in addition to the quality of ICT infrastructure the quality and accessibility of smart material networks also receives similar importance. Green institutes, green urban constructions and smart energy consumption also belong in this category. Most initiatives concerning smart cities focus on preserving natural resources, in another word a smart city utilizes technology for the purpose of better city management in the meantime increases the sustainability of natural resources.⁴⁸

Human infrastructure includes intellectual and human capital as well as the quality of life. In the popularization of the smart city concept the people's consciousness, responsibility and commitment play an essential role, therefore human infrastructure is necessary regarding the development and sustainability of smart cities. Despite the fact that smart cities are well organized and use developed technology, sustainability is not guaranteed without social consciousness. Smart cities usually attract competent, well qualified (professional) citizens; therefore in smart cities knowledge based urban development is a basic factor. According to the au-

⁴⁵ SILVA, Bhagya Nathali – KHAN, Murad – HAN, Kijun: Towards sustainable smart cities: A review of trends, architectures, components, and open challenges in smart cities. *Sustainable Cities and Society*, 2018/38, pp. 698–700, DOI: 10.1016/j.scs.2018.01.053.

⁴⁶ Ibid. pp. 698–699.

⁴⁷ Ibid. pp. 699–700.

⁴⁸ Ibid. p. 700.

thors human infrastructure affects people and their relationships, so this pillar is one of the basic elements of smart cities.⁴⁹

Economic infrastructure of smart cities has several definitions in literature. The authors in a general sense by smart economy mean the use of e-trade and e-business applications and good practice for the increasing of productivity. Furthermore smart economy includes the new innovations of ICT and services relating to ICT.⁵⁰

Literature groups smart cities into three generations. In the first generation we list the smart cities that are lead by technology and its most significant feature is that the city management systems are developed by concerned companies specializing in technology and they offer the smart services to the cities. The main problem concerning these cities on the one hand is that there is no interrelationship between the city and its citizens,⁵¹ on the other hand technology lead city management systems do not accommodate to the city's nature.⁵²

The second generation includes the smart cities that are lead by the cities themselves. In this phase city management utilizes the smart services offered by the developers and pursues technological solutions that improve the inhabitants' quality of life.⁵³ The third generation's typical feature is the cooperation and joint value creating between the city and its inhabitants.⁵⁴

3. Challenges for the Smart Cities

Reviewing the challenges that smart cities face receives particular attention on an international level. Due to the limited volume of this paper I am introducing a few viewpoints. Mostafa Bahzadfar, Mahmoud Ghalenhoee, Mohsen Dadkhah and Nasrin Mehsen Haghighi divide the challenges facing smart cities into two basic groups: one group has the challenges before establishing a smart city, the other one has the ones after.⁵⁵

3.1. Challenges before a smart city is being established

Challenges before a smart city is established can be economic, technologic, managing related, administrative, infrastructural as well as functional, educational, urban development related or interdisciplinary.

⁴⁹ Ibid. p. 700.

⁵⁰ Ibid. p. 700.

⁵¹ EGEDY Tamás: Városfejlesztési paradigmák az új évezredben – a kreatív város és az okos város. *Földrajzi Közlemények*, 2017/3, p. 257.

⁵² ROZSNYAI Gábor: Az okos város nem egy applikáció. *Mérnök Újság*, 2017/7, p. 30.

⁵³ EGEDY: op. cit. p. 257.

⁵⁴ Ibid. p. 257.

⁵⁵ BEHZADFAR, Mostafa – GHALEHNOEE, Mahmoud – DADKHAH, Mohsen – HAGHIGHI, Nasrin Mohsen: International Challenges of Smart Cities. *Armanshahr Architecture & Urban Development*, 2017/10, p. 82.

Establishing a smart city requires national and international subservience as well as strict budget: it is necessary to have technology, ICT bases which are extensive, energy saving, decrease pollution and travel expenses, makes cities competitive, increase GDP, tourism as well as lead to further development.⁵⁶

Establishing smart cities also requires smart technology; however, in many countries the appliances and/or solutions are either only few or not available at all. Furthermore, a smart city has to face technical nature and security-based ICT challenges such as data-security, target-user interface, service search, etc. As a result the global establishment of smart cities requires technologies which can only be realized by the involvement and cooperation of international research centres and multinational corporations.⁵⁷

In some countries the involvement of public and the political decentralization are either not at all or only little provided, however, to establish a smart city these are necessary principals: the public fully takes part in solving problems on different levels, and the government provides the necessary special infrastructure to carry this out.⁵⁸

Even though several countries have the necessary area to establish a smart city, the ICT infrastructure is relatively weak which also presents a challenge to the countries.⁵⁹

The citizens of a smart city need to be trained and educated: they need to utilize smart technologies otherwise they won't be able to live in the smart city, they will encounter problems. In many countries indicators of education are given, including the paradigm of lifelong learning and the essential role of computers. The question is how knowledge, knowledge management and digital library can be placed in smart city platforms, furthermore how it can be available for the public on the internet.⁶⁰

Further challenge is that in order to establish and operate a smart city the experts of different sciences need to cooperate and the smart city needs to manage and organize in all fields of sciences. Existing needs can only be identified this way and the proper suggestions of a solution elaborated.⁶¹

3.2. Challenges after establishing a smart city

After a smart city is being established the city is faced with challenges presented by the hackers, changed city area utilization, challenges created by the older generation's inability of learning, as well as execution, human, technological and cultural challenges.

The most notable challenge smart cities face is dealing with the hackers. If the security of computer networks is not guaranteed then the hackers can easily have

⁵⁶ Ibid. p. 82–83.

⁵⁷ Ibid. p. 83.

⁵⁸ Ibid. p. 83

⁵⁹ Ibid. p. 84.

⁶⁰ Ibid. p. 84.

⁶¹ Ibid. p. 84.

access and control bank, statistical, purchase, transport, registration, notification, etc systems and by doing so they interrupt the city operation. In order to eliminate this, proper setting – online and offline – for the networks is necessary, for the employees a confidential password access, users can only get access to verified programs, or another possibility could be establishing so called ethical hacker groups.⁶²

According to reports written by the World Bank the ICT creates new workplaces and labour market is becoming more innovative and global.⁶³

Further challenges after a smart city is established are presented by the fact that the elderly has limited media and computer knowledge; they don't have or have very little experience which is not enough to use ICT. Learning the use of the different programs and applications is much more difficult for the older generation than the young.⁶⁴

Another challenging factor is to provide the Big Data as there is immense volume of data generated in the operation of a smart city; therefore future smart cities need to have priority attention to work out and provide Big Data concepts and techniques.⁶⁵

The theories of smart cities have problems that people cannot accept or solve, and which perhaps oppose to all positive and negative effects of smart cities.⁶⁶

Another challenge can occur following the establishment of a smart city, and that is that the city focuses on technology more than on the citizens' well being and providing a liveable environment. People need the face to face, personal relationships and if these are ignored due to the use of technology then this could lead to problems in the future.⁶⁷

Smart cities must also face cultural challenges. Smart cities could have an important role in establishing, propagating, transforming or even ruining culture. The wrongful use of technologies can have negative consequences in family structure and family relationships in some cultures.

According to Narmeen Zakaria Bawany és Jawwad A. Shamsi smart cities must facet the challenges presented by IT infrastructure, security and privacy, big data management, costs, efficiency, availability and social adaptability. The lack of IT infrastructure can cause a significant difficulty for a smart city to achieve its goals. Reliable, high efficiency networks and infrastructure are the bases for integrating informatics systems into city environment. Besides efficient and reliable infrastructure, accomplishing security and data protection requirements is also a basic challenge for a smart city, where there is high volume of sensitive data collection, pro-

⁶² Ibid. p. 84–85.

⁶³ Ibid. p. 85.

⁶⁴ Ibid. p. 85.

⁶⁵ BAJI Péter: Okos városok és alrendszereik – Kihívások a jövő városkutatói számára? *Tér és társadalom*, 2017/1, pp. 102–103, DOI: 10.17649/TET.31.1.2807.

⁶⁶ BEHZADFAR, Mostafa – GHALEHNOEE, Mahmoud – DADKHAH, Mohsen – HAGHIGHI, Nasrin Mohsen: op. cit. 85.

⁶⁷ Ibid. p. 85.

cessing, storing and data distribution in progress. Smart cities demand large information infrastructure: millions of sensors, thousands of network and information technology devices, in addition the needs of information technology experts and advisers also presents significant costs. The investment is not limited to only one occasion, the cost of the operation and maintenance of a real time system is high. The reliance and efficiency requirements demand several sources which result in higher costs as well. For example in an intelligent traffic control system all cars need to be equipped with sensors and each intersection needs to have an intelligent traffic controlling device. Such system cannot afford to break down; it needs to be reliable and efficient. The cost of a project like this is significant.⁶⁸

Pinaki Ghosh and T. R. Mahesh list the challenges facing a smart city into the following categories:

- a) privacy and security: personal identification of the involved needs to be separated from other collected data as when data of an individual is collected by smart devices privacy protection is essential. Personal data and identification of a person is not only important from a technical point of view, but legal and communication aspect as well.⁶⁹
- b) traffic systems: new technologies need to be developed to decrease mobility needs of individuals as well as cargo. Another challenge is the availability of determining the exact location therefore, new technologies need to be developed which are able to determine location even when there is no GPS signal.⁷⁰
- c) energy and environment protection: the increasing need for energy sources present a significant challenge for smart cities. The new technologies increase electromagnetic noise and network efficiency. Intelligent energy networks are the backbone of smart cities. Paring smart processes with technologies allows for energy efficiency and savings.⁷¹

4. Final Thoughts

Cities attract more and more people from the countryside. This phenomenon presents new challenges for the city inhabitants, infrastructure, environment and city management. For the sustainability of cities there is a need for innovative solutions and developments. For all these to be accomplished the involvement and cooperation of the public, local and central bodies as well as European institutions are necessary.

In the past few years smart cities – due to the research-development projects by the governments – received a special attention. Although there is no clear defini-

⁶⁸ BAWANY, Narmeen Zakaria – SHAMSI, Jawwad A.: Smart City Architecture: Vision and Challenges. *International Journal of Advanced Computer Science and Applications*, 2015/11, pp. 247–248, DOI: 10.14569/IJACSA.2015.061132.

⁶⁹ GHOSH, Pinaki – MAHESH, T. R.: Smart City, Concept and Challenges. *International Journal on Advances in Engineering, Technology and Science*, 2015/1, p. 26.

⁷⁰ Ibid. 26.

⁷¹ Ibid. 27.

tion to what we mean by smart cities, it could still be stated that smart cities are for the people's welfare; technology is only a resource which (can) realize the fulfillment of the inhabitants' life, makes it possible for them to be involved, and ensures sustainability and the high quality of the services. The new means and their applications can be considered useful if operating them is simple, transparent and easy and also has advantages. The involvements of ICT in local services help cities become more intelligent in the aspect of managing sources. Furthermore, cities with the new technological means could create new business opportunities and become the center of research.

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