Beyond indicators, new methods in Smart city assessment

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Abstract
In the past years, cities are increasingly aware of the concept of "smart city" and actively developing strategies towards the goal of becoming "smart" and manage, more efficiently, city resources and addressing development and inclusion challenges. The growth of smart cities is helping the increase of government use of ICTs to improve political participation, implement public policies or provide public sector services.
There are also sharp critics of smart city concept, regarding it only a marketing tool applied by all the cities using some forms of ICT, as a label or brand of successfulness. That is why the elaboration of smart city assessment tools and performance measurement systems are needed in order to sort out real smart cities and effective smart city methods and solutions. Various evaluation methods, models for understanding and conceptualizing smart cities have been developed to explain smart city concepts, which aim to define their scope, objectives and architectures. The multidimensionality of smartness coupled with cities' complexity, calls for specific assessments able to distinguish between different dimensions of smartness. The usage of indicators is relatively simple, clear, easily interpretable, easy to understand, visualize, compare and reproducible in time and space. Still, from the review of different smart city rankings and indexes some limits and problems can be derived. A meaningful smart city assessment method should be able to measure individual well-being and satisfaction in the city in a comparable and dynamic way which is a very complex goal. Methodological limits, practical and economical obstacles of data collection at settlement level are also affecting the elaboration of better evaluation system. More specific, focusing on city's vision, strength and weaknesses, using bottom-up approach assessment methods are needed.

Keywords: evaluation, individual aspects, limits of indicators.

1. INTRODUCTION

The theoretical thinking on information society come to the fore at the beginning of the 1990s, although the concept of information society itself was controversial (Élő-Pintér 1999). In spite of it the notion was ubiquitously used not only in academic but in public life as well. Other concepts connected to the phenomena of information society were known earlier as post-industrial society (Bell 1973) or post-capitalist society (Drucker 1993).

In the European Union it was the Bangemann report in 1994 which made information and communication technologies and information society an official union policy. At the beginning of this new era mainly the economic and infrastructural aspects of information society were emphasised. As a consequence of the Bangemenn report new information society strategies were born affecting different spatial levels.The phrase of smart city is not new. It may have origins in the 80s and 90s, when a new way of thinking about examining the role of new technologies in the operation, structure and planning of cities emerged. The theory of information society was formed, with the availability, presence and quality of information and communication technologies (ICTs) in the centre of it.

At the beginning of the 21st century a new way of thinking emerged, where new technologies were not aims but tools, where municipalities, different communities, actors of business life, citizens of settlements cooperating on applying innovation based on participatory planning, aiming at establishing low energy consuming, liveable city. This is the "smart" city concept.

In the 2000s a new concept came to fore emphasizing not only the technology itself, but its role in human, social capital and the usage of these technologies. In recent years the concept of smart cities drew the attention of many researchers dealing with urban development and competitiveness, experts of urban planning and management and leaders of big multinational IT companies.

After the explanation of different layers of smart city concept, I would like to present why evaluation of smart city performance is needed, and how smartness is possible to assess from using indicators and indexes to the evaluation of the happiness of the inhabitants.

2. SMART CITY CONCEPT

Smart city concept appeared, not only in academic researches, but in public government choices and projects. In spite of the very broad usage of the notion of smart city, shared and sound definition of the concept is still lacks. Although there is no general consensus on the concept, the idea of smart cities is rooted in the creation and connection of human capital, social capital and ICT infrastructure to generate greater and more sustainable economic development, and a better quality of life ("Doing more with less."). The usage and content mainly depends on the context, background and interest of different stakeholders using the smart city definition.

According to the origin of elaboration, the smart city concept can be:

- academic
- industrial or corporate
- governmental
- term of the media (Mosannenzadeh,- Vettorato, 2014).

In academic research papers and documents we can find a very broad range of smart city definitions and concepts covering very different terms and phenomena. Despite of the variety of definitions, it is obvious that technological and social innovation are basic components of the smart city concept. One of the earliest explanations of what smart city means is coming from Hall (2000): "A city that monitors and integrates conditions of all of its critical infrastructures, including roads, bridges, tunnels, rail/subways, airports, seaports, communications, water, power, even major buildings, can better optimize its resources, plan its preventive maintenance activities, and monitor security aspects while maximizing services to its citizens". One of the most influencing term in this field can be found at Giffinger et al. (2007): "A Smart City is a city well

performing in a forward-looking way in six characteristics. It is built on the 'smart' combination of endowments and activities of self-decisive, independent and aware citizens." Others try to connect smart city to other notions and terms: "The Smart Cities concept is connected to notions of global competiveness, sustainability, empowerment and quality of life, enabled by broadband networks and modern ICTs (Komninos et al. 2011). Caragliu, Del Bo and Nijkamp (2011) give a holistic definition of smart cities: "when investments in human and social capital and traditional (transport) and modern (ICT) communication infrastructure fuel sustainable economic growth and a high quality of life, with a wise management of natural resources, through participatory government."

In the past years, cities are increasingly aware of the concept of "smart city" and actively developing strategies towards the goal of becoming "smart", managing city resources more efficiently and addressing development and inclusion challenges. The growth of smart cities is helping the increase of government use of ICTs to improve political participation, the implementation of public policies or the provision of public sector services. A smart city from the governmental aspect can be seen as an urban strategy aiming at improving quality of life in the city, safeguarding the environment and reaching economic development at the same time.

The industrial interpretation of smart cities supplements the term with several practical elements. Big multinational companies like IBM, CISCO, Siemens elaborated their own smart city concepts and smart city solutions and applications. The smart city concept for IT companies means the elaboration, installation and application of complex information systems aiming at integrated operation of cities' infrastructure and services. The blurred boundaries between a policy concept and a business model that is focused on profit maximization, can give rise to semantic confusion and, more relevantly, to ethical issues. Townsend (2014) argues against the corporate likes of Cisco and IBM, who think that smart city initiatives are scalable to any other city. Smart cities need to be efficient but also preserve opportunities for spontaneity, serendipity, and sociability. If we program all of the randomness out, we'll have turned them from rich, living organisms into dull mechanical automatons (Townsend 2014, 15).

According to the main topic of smart city articles and researches we can differentiate the following concepts:

- ICT oriented. With information and communication technologies in its center, enabling cities to fulfil their future objectives. (Joss 2013, Mitchell et al. 2013). Smart cities combine smart technologies with a new holistic way of thinking, leading to positive changes in cities' behavior, helping to overcome challenges of rapid urbanization (Hill-Watts-Buscher 2011).
- Sustainability oriented. Most of the smart city articles are focusing on sustainability as main topic. In this approach smart city is working in a built environment as an effective integration of physical, digital and human systems, helping to achieve a sustainable, prosperous and inclusive future for the inhabitants of the city (Cavada-Hunt-Rogers 2014).
- Mobility oriented.
- Innovation oriented.

In the numerous definitions of Smart City, which vary according to the origin of the concept, the point of view and the stakeholders the common aspects are the following:

- social and environmental sustainability as strategic priority,
- importance of network infrastructure,
- entrepreneurship as a crucial force of development that needs to be accompanied by other such forces,
- maximizing access of citizens to public services, improving social inclusion,
- crucial role of creative industries,
- the role of social and relational capital in smart city projects (Manitiu-Pedrini 2015).

3. SMART CITY EVALUATION

Various evaluation methods, models for understanding and conceptualizing smart cities have been developed to explain smart city concepts, which aim to define their scope, objectives and architectures. The multidimensionality of smartness coupled with cities' complexity, calls for specific assessments able to distinguish between different dimensions of smartness.

Evaluation helps:

- to explore the current status and position of settlements as smart cities,
- to present the relative position of cities to each other
- to explore the development or "movement" of cities towards becoming smart cities,
- to provide information and model future actions,
- to prepare, establish decisions and to determine development trends.

There are many different ways of assessing the smartness of settlements. The first way of evaluation of city smartness is the usage of indicators, elaboration of indexes and city rankings.

3.1. USING INDICATORS FOR SMART CITY ASSESSMENT

In the last 20 years city rankings become very important tools in evaluating competitiveness, development, attractiveness of city regions. In these comparative analysis cities are evaluated and ranked according to their different economic, social and geographical parameters, not least in order to determine "leaders" and those, lagging behind, performing better and least settlements. The city rankings and lists were used by the cities as well, to elaborate development priorities and to improve the prestige and image of the settlements.

The Central-European – and the Hungarian in it – settlement network is significantly different than the West-European. The extent of urbanisation lags behind the average of Western areas, the number of settlements with city rank is rather high; the population of cities is quite low. Another characteristic is that the European level cities with population over 500000 or million, and with the exception of Poland the bigger city districts with

regional economic role are missing. Hungary is in a particularly unfavorable position, as it is one of the most monocentric countries in Europe (Schneider 2008). According to the European Union typing, areas with more than 500000 inhabitants are called metropolis regions, settlements with inhabitants less than 500000 inhabitants are city areas. There are significant difference between functions and performance of different areas. Due to the peculiarities of the Hungarian settlement structure only Budapest and its agglomeration belongs to the metropolitan areas, the cities with county status and their neighbourhoods are city areas. Thus, the Hungarian cities of magnitude smaller than the Europeans essentially correspond to the European third city level (Hegedüs, 2008).

The integrated thinking, local independence, local cooperation are new notions in urban development in Eastern European, in former socialist countries. It is difficult to understand and accept for local governments and inhabitants of the settlements that their life improvement is depends on their local cooperation, foresight, not on outside forces. That is how - with the help of outside resources - the jointly formulated goals can be implemented successfully (Barta, 2009).

The Central-European urban network suffers from accumulated serious problems:

- forced industrialization during socialist era;
- confusing land use conditions (lack of real estate market, then non-transparent privatization);
- too slow dissolution of indifference against environment pollution;
- increasing social differences and segregation;
- problems requiring urgent solutions because of previously lacked development actions;
- the direct, local resources are playing relative small role in management and development of settlements (Barta, 2009)
- with the exception of today's Czech Republic the proportion of urban population is much below the West European level, moreover many of the cities have been created under the socialist political period;
- the older towns were mostly country towns, so appropriate service functions are missing;
- lack of citizens in the society of cities;
- the urban built environment is neglected, infrastructural investments are missing, housing estates (block of flats) are very serious problems (Enyedi, 2009);
- The special paradox of the Hungarian local governmental system is that while broad rights were given for local governments in property management, borrowing and organizing services, financing basically remained function of central controllers (support and transferred taxes). Development possibilities are determined by – besides the general financial conditions of local governments – sectoral programmes proposed by central government (Hegedűs, 2008).

Besides problems evolved and accumulated during socialist period and due to the features of transition, Central-European cities as members of the European and global urban system are facing global challenges as well:

- urbanisation;
- ageing population;
- increasing unemployment;
- inadequate urban housing stock;
- climate change, environment pollution, unhealthy environment;
- traffic jams, inadequate public transport services (long travelling time, parking problems, problems of radial transport system);
- problems of waste management;
- inadequate support of regional and governmental authorities on sustainable urban development (need for more autonomy) (Smarter…2010).

The challenges can be answered by not only modernizing urban infrastructure but by better usage and adaptation of already available, existing possibilities of information and communication technologies. Smart and livable city creates the following conditions to be able to respond to new challenges:

- City administration putting inhabitants not services in to the centre (less bureaucracy, more electronic spread of information and data, better capability to share with other institutions, better transparency).
- "Greener" and more efficient utility management. (Technology creates huge possibility to monitor every point of the process – especially useful in water and waste management – e.g. intelligent water meters helping to explore wasting points for inhabitants, more efficient management of public buildings.)
- Environment friendly and safe transport (intelligent transport systems).
- Better public safety (elaboration and usage of predictive models through previously available data, usage of special cameras to predict accidental incidents).
- Quality education (cloud based sharing of universities' computer capacity with other educational institutions dynamically adapted to the changing needs; distance learning, e-learning in higher educations and adult education, intelligent boards).
- Cost efficient social and health supply system (data integration, more easy access to information on one patient).
- More "convenient" and attractive tourism (adequate information and navigation systems combined with online booking possibilities) (Smarter…2010).

Smart or liveable city is using available technological possibilities (mainly information and communication technologies innovatively, to develop a more diversificated and sustainable urban environment. A smarter city is one where investments into human capital, to traditional (e.g. transport) and into modern information and communication infrastructure drives and inspires sustainable development and increase quality of life while largely finite natural resources are used prudently through participatory governance (Smarter 2010..) Smart city uses technology that city services and systems are connected in a more intelligent and effective way.

New technology creates great, so far not used opportunities in city development. In spite of it - while accessibility of technology and infrastructure developed outstandingly – the processing and usage of data is not kept pace with technology development. It is especially visible in public sector, where the usage of opportunities given by ICT is disappointingly low (Selhofer et al., 2010).

Using indicators is a comparative analysis, where cities are evaluated and ranked according to their different economic, social and geographical parameters, not least in order to determine "leaders" and those, lagging behind, performing better and least settlements. The city rankings and lists were used by the cities as well, to elaborate development priorities and to improve the prestige and image of the settlements. Indicators and indexes are useful tools of preparation of location choices for enterprises or investments. They are also aiming at positioning cities according to their competitiveness, strength and weaknesses. Indicators are helping to elaborate strategic priorities and development possibilities. There are many advantages of using indicators and indexes for the evaluation of city smartness. City rankings attract lot of attention in both scientific and public life. They generate discussion and debate on smartness, competitiveness, quality of life, helping to rethink formerly elaborated strategies and development priorities. They also allow to position cities, can be marketing tools in city promotion and contribute to the success of city leaders (Giffinger-Gudrun 2010). The usage of indicators is relatively simple, clear, easily interpretable, easy to understand, visualize, compare and reproducible in time and space.

Still, from the review of different smart city rankings and indexes some limits and problems can be derived:

- The problems of data collection. To conduct a successful smart city ranking, very well defined and available settlement level indicators are needed. The settlement level data are missing in most cases or not updated year by year. Using regional or national data is blurring the differences among cities. Most of the data arisen at city level are not collected and processed as there is no interest in them. Huge data sources owned by private enterprises are not available for research or analysis. To conduct a successful smart city assessment not only "big data", but "right data" is needed.
- The weighing and aggregation of indicators will greatly influence the final results.
- The problems of transparency. Although the methods behind the indexes and rankings are complex, the used methods and the selected indicators are greatly influencing the results, the methodology of data collection and processing are usually not transparent.
- The correlation among indicators and different fields of analysis are quite strong.
- The problems of comparison. As the content of the indicators and the methods of data processing are not transparent and heterogeneous, there is a huge obstacle to enhance comparison. There are several studies based on indexes related to smart cities that are repeated annually (e.g. Smart cities in the world by Boyd Cohen), but even these cannot be compared to each other, as the indicators and methodology used to conduct them are changed every year.

- The lack of dynamic analysis. Indexes reflect the static state of a settlement's "smartness" and livability at a specific time. Little knowledge can be obtained about how the development or behavior of a city is changing, how it reacts to certain situations or critical events. However this might be the true essence of smartness (reduced reaction time, rapid adaptation to abrupt changes). A city cannot be studied separately from its surrounding environment; its operation influences the neighboring areas and settlements that are also asserting a dynamic influence on each other. Using dynamic approach also allows you to provide a more appropriate definition of smartness. As well known, the physical space and the "place" are not equivalent (Giovanella 2013)
- The lack of individual aspects. There are people living in the city who are striving to utilize the resources of their city in an optimal way to achieve a higher quality of life. They have their own motivations, expectations, needs, their own lifestyles. When we only consider indexes, the study will lack this bottom up dimension. Several studies have experimented with including the individual dimensions into the analyses of smart cities. For example there are studies that try to research and present the emotional state of a given settlement from the quality and quantity of posts related to city. Utilizing text processor and analyzer software solutions, these studies measure the emotional state of the people living in or talking about the city. Emotions can be studied in the temporal dimension helping researchers to clarify how the emotional state of the city follows the emotional state of its individual citizens.
- Last but not least there is a problem related to how much effort it presents to build qualitative factors into the indicator system (e.g. quality of services).

Table 1.
Examples for researches using indicators

	European Smart City Research (Giffinger, 2007)	**IBM Smarter City Assessment (2009)**	**Hungarian Smarter City Assessment (2011)**	**Siemens, Green City index (2012) (formerly only for European cities)**	**Between Smart City Index (Italy, 2013)**	**Boyd Cohen: Smart cities in the world (yearly since 2012)**	**Ericsson Network Society index 2013, 2014**
Type of settlements	European cities with universities	Cities from all over the world	Hungarian cities	cities	Italian cities	Cities from all over the world	cities
Size of examined settlements	70 medium size cities (100.000 – 500.000 inhabitants)	Large and medium size cities	8 medium size cities (+ Kőszeg)	more than 120 cities, accorfing to their size and importance (mainly capital cities and business centres)	116 countyseats	From 120 potential cities 10 European and 10 North American cities	More than 40 cities from all over the world

Used indicators	74 indicators mostly from Eurostat	More than 200 hard and soft indicators, weighting depends on the priorities of the given city, so the wrihting of the same indicator can be different in different cities	80, mostly hard indicators (KSH, GKIenet, MTA RKK NYUTI), same weighting in the different cities	Almost 30 indicators from 8-9 fields, quantitative indicators from public data basis and qualitative indicators from the analysis of environ-ment policy of the city	153 indicators (Italian Statistical Office and own data of Betweeni)	62 indicators from 400 potential indicators (Brookings Institute, Siemens, Mercer, Eurotest, The Economist, indicators from cities)	41 indicators
Level of indicators	35 local, and 39 regional and national indicators	Local indicators	Local indicators	Local and regional	Local, regional and national indicators	Local indicators	
Type of examination	ranking	scoring	Scoring and principal component analysis	Elaboration of and index measuring the performanc e in five categories	ranking	Scoring and ranking	Scoring (scale: 0-100)
Aim of the examination	Smart portfolio of cities, benchmarking	benchmarking	Benchmarking, exploring smart development objectives		Ranking, benchmar king, digital roadmap in local and regional level, market possibiliti es for ICT companies	ranking	Examinati on of ICT maturity of cities, elaboration of vision, formulatio n of trends
Other resources	-	Extensive experiences in evaluation of facors of Global Location Strategies, especially of non visible factors	Document analyses, face to face meetings, consultations		-		Consultati ons with local leaders and experts

Source: Own collection

3.2. BEYOND INDICATORS, OTHER FORMS OF EVALUATION

Cluster analysis

As indicators and city rankings have their own limitations and problems, other possible evaluation methods were developed. One of them is the factor analysis followed by clustering. With factor analysis we can eliminate the problem of having strong correlations between indicators and find the factors that have the closest relation to the "smartness" of the city.

With the help of clustering the data arrays available can be categorized into homogenous groups. These can help us to discover and analyze the spatial structure of cities. Clustering can help us visualize the complex information behind the operation of a cities in a simplified way. It can also help us to eliminate the need for comparison from establishing a ranking of such information. There are many existing methods of clustering. The most well known and most used one to study the spatial organizational patterns of cities is the K-means cluster. During K-means clustering we assign all elements to the cluster with closest center point to that specific element.

An emerging method that has not seen much use in social studies yet is the Self organizing map (SOM). The SOM algorithm grew out of early neural network models, especially models of associative memory and adaptive learning (Kohonen 1984). A new incentive was to explain the spatial organization of the brain's functions, as observed especially in the cerebral cortex. With the help of SOM a problem space with many dimensions can be reduced to a space with less dimensions, mostly to a two-dimensional discrete space. Meanwhile we can visualize the most important aspects of the vector space of many dimensions in the topology of a two-dimensional space. This way we can simultaneously reduce the dimension of the inputs used and sort the elements into groups.

Models and modeling techniques

Different models and modeling techniques that enable us to predict future events from existing information and allow us to run a better simulation of complex city systems. One such model is a modified version of the triple helix model, relating the multiple and reciprocal relationships between the three main agencies in the process of knowledge creation and capitalization: universities, industry and government. To the previous three main agencies of knowledge creation, the authors added the civil society (determining a "four helices model"), and for each of the four different drivers of innovations, they indicated the possible indicators of a smart city (Lombardi et al., 2012). Another possible modeling approach can be the analytic network process. The ANP model consists of clusters (i.e. groups of homogeneous elements of a decision problem), elements (i.e. nodes of the network), interrelationship between clusters, and interrelationship between elements. It allows interactions and feedback within and between clusters and provides a process to derive ratio scales priorities from the elements (Lombardi et al, 2012) The spatial autoregressive models are also possible modelling methods for evaluating smartness of cities.

Analysis of smart city initiatives and projects

The analysis of smart city projects and initiatives is an other possible way of evaluation of smart city performance. Manitiu and Pedrini (2015) in their research defined a set of smartness and sustainability indicators applicable to European cities and to assess their outcome in an ex-ante perspective with regard to the implementation of Europe 2020 strategy. An other European research examined 240 cities with more than 100.000 inhabitants, where they had some kind of smart city initiatives. Cities were chosen and evaluated how much they fulfil Europe 2020 objectives. Four maturity levels were elaborated:

- maturity level 1: a Smart City strategy or policy only
- maturity level 2: in addition to level 1, a project plan or project vision, but no piloting or implementation
- maturity level 3: in addition to level 2, pilot testing Smart City initiatives
- maturity level 4: a Smart City with at least one fully launched or implemented Smart City initiative.

Cities that do not attain maturity level 1 did not qualify as 'Smart': clearly there would also be no evidence of them having any of the six characteristics (Mapping...2014).

Quality of life surveys, measurement of "happiness"

The surveys on quality of life and different attempts to measure "happiness" of cities are other possible ways of measuring smart city performance. These are qualitative researches surveying citizens of different settlements. In this case smartness is interpreted as a kind of well-being, satisfaction, happiness. They measure the effect of habitat on quality of life. In previous works the research was conducted by quantifying objective factors (Mercer Quality of Living ranking, CSR Hungary Livable City ranking). There are a number of urban surveys and happiness indexes. Seoul (S. Korea) tops the People sub-index of the Arcadis list, because its citizens see proof that their city cares. Oslo (Norway) and Zurich (Switzerland) top the poll in Europe in the most recent Eurobarometer survey. And the Gallup-Healthways Well-Being Index ranks Naples, Florida as the happiest US city. Meanwhile, some cities are conducting surveys of their own urban happiness. For instance, in 2013 Santa Monica, CA (USA) won a major award for its plans to create a "Local Well-Being Index". And all over the place, local experiments are testing methods to redesign cities, to make residents happier.

But there is an increasing demand for including subjective factors into the evaluation. For this reason citizens are asked to fill questionnaires where they have to evaluate their medical status, well-being, satisfaction and happiness. The cities that excel in objective studies are not necessarily the ones where people are most satisfied with their lives (Ballas 2013). This kind of approach is strongly connected to the "science of happiness" and draws attention that adding geographical dimension to happiness analysis is strongly needed. Not only efficiency but quality of life as well as matters. Being more efficient does not necessarily makes us happier. The citizen's vision and sense of scale is a perspective that is largely absent from the literature of smart cities. Questions relating to who gets left out and what people living in smart cities feel about this new environment are vital, but as yet are not being thoroughly addressed by academia or large IT companies.

The pursuit of happiness may be an unalienable right, but are the technologies we are designing really helping its users to be happy? Take the simple example of a web map. It usually gives us the shortest walking direction to destination. But what if it would give us the small street, full of trees, parallel to the shortest path, which would make us happier? As more and more of us share these city streets, what will keep us happy as they become more crowded?

But other concepts of happiness – and even beauty – are often fuzzy. Researcher of University of Cambridge worked on a web game called urbangems.org. In it, you are shown 10 pairs of urban scenes of London, and for each pair you need to choose which one you consider to be more beautiful, quiet and happy. Based on user votes, one is able to rank all urban scenes by beauty, quiet and happiness. Those scenes have been studied at Yahoo Labs, image processing tools that extract colour histograms. The amount of greenery is associated with all three peaceful qualities: green is often found in scenes considered to be beautiful, quiet and happy. Then they ran more sophisticated image analysis tools that extracted patches from the urban scenes and found that red-brick houses and public gardens also make people happy (Quercia-Schifanella-Aiello 2014).

A key issue that was identified when considering happiness of the cities, is the potential for inter-disciplinary research aimed at a better understanding of what makes a 'happy' city. In particular, there is great potential to build on the very successful urban and regional research of QoL indicators by complementing them and/or combining them with subjective measures of happiness and well-being. However, in order to fulfill this potential there is a need to conduct research drawing on a wide range of disciplines including geography, economics, sociology, urban and regional planning and psychology (Ballas 2013, 547).

4. CONCLUSION

This paper attempted to clarify the meaning of a concept that is getting increasingly popular—that of the smart city, and to explore the possible evaluation methods of cities' smartness. The overview is systematic but can not be complete. The definition of smart city is multi-faced. The usage of ICT, sustainability and better quality of life for people are common elements in the concept.

The paper showed that the assessment of smart city performance is complicated. The aim of this paper was not to define one exclusive way of measurement. The evaluated cities are greatly differing in infrastructural, cultural and governmental terms, so there is no one, universal evaluation model for smart cities. The local facilities, capabilities and limits are determining the road to becoming smart city. A meaningful smart city assessment method should be able to measure individual well-being and satisfaction in the city in a comparable and dynamic way which is a very complex goal. Methodological limits, practical and economical obstacles of data collection at settlement level are also affecting the elaboration of better evaluation system. More specific, focusing on city's vision, strength and weaknesses, using bottom-up approach assessment methods are needed.

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