



## DIVERSITY OF THEORETICAL APPROACHES TO THE CONCEPT OF SMART CITY

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**Abstract.** Recently the term “smart” has become an increasingly popular concept used in many different situations, in urban development context in particular. Often the term “smart city” is used in association with other categories, such as “knowledge city”, “innovative city”, “intelligent city”, “digital city”, “sustainable city” etc. The idea of smart specialization of cities and regions is spreading fast and has successfully become a platform for economic and social development of local communities. However, there is still a lack of clear scientific interpretation and conceptualization of this phenomenon. Therefore the aim of the paper is to identify the most popular general characteristics used to define the concept of smart city. Authors of the paper explain the theoretical basis of the concept “smartness” emphasizing its specifics in social sciences, compare different “smart city” definitions highlighting main similarities and differences of their content and identify the most common elements of the “smart city” concept. The results of the paper suggest key characteristics for a city aiming to become a “smart city”.

**Keywords:** smartness, smart city, smart city characteristics.

**JEL classification:** O1, O3, P00, Q00.

### 1. Introduction

Today’s society is in non-precedential situation – for the first time in human history more than a half of world’s population live in cities (Nam, Pardo 2011b). Rapid urbanization processes strengthen the need for sustainable development of cities and creation of better quality of life for urban communities around the world. Contemporary cities also meet difficulties of declining population, loss of economic base, high level of emigration, structural social problems, etc. Both growth and decline of cities bring serious challenges that require special attention and innovative policy solutions from national and local governments. The problems faced by cities in developed and developing countries are complex and difficult to solve due to the unique structures of cities, comprised of various interest groups with high level of interrelationships, competing values, social and economic complexity. Therefore there is a high demand for strategic and sustainable solutions to these problems. One of the increasingly popular solutions in this situation is a concept of “smart city”, representing a new model of a city that explains a de-

velopment and functioning of smart cities (e.g., AlAwadhi, Scholl 2013; Carabias *et al.* 2013).

However, despite a wide usage of the concept and numerous efforts to explain it, there is still a lack of consensus on its meaning, i.e. what qualities, characteristics or elements it embraces. Results of literature analysis on the subject show that researchers representing different fields of science propose different content of the concept. Even in the literature of social sciences there is no agreement on the content of a smart city. Without this consensus, the usage of the concept in practice, especially in the formation and implementation of city development strategies can lead to an ineffective usage of limited resources and a wrong direction of actions. Mistakes in public (urban) policies are especially costly with long-term consequences. Therefore the *aim* of this paper is to try to contribute to the solution of the problem by discussing the content of smart city concept and providing a complex perspective towards its elements and their interrelations.

Method of theoretical analysis of literature (scientific papers, policy documents, other) was used to identify and analyse various views to smart city.

## 2. Concept of Smart and Smartness in the Context of Social Science Research

The concept of smartness in the field of social sciences has been transferred from *technological sciences*. However due to the nature of social systems it is quite different and more complex, compared to technological sciences. The concept of smartness in technological sciences deals, for example, with smart knowledge-sharing platforms (Mancilla-Amaya *et al.* 2010), smart cloud computing (Kim *et al.* 2011), smart grid technology for efficient power management for existing power systems (Arulmurugan, Vijayan 2012; Graab 2011), integration of sensors into smart cities (Hancke, Hancke Jr. 2013), etc.

In social sciences smartness has been largely analyzed in the field of *educational studies* interpreting it as an individual trait (e.g., Hatt 2007; Anderson *et al.* 2003). As results of analysis of “smart” definitions provided in different dictionaries show, the quality of smartness usually is assigned to a person, who is insightful, responsive to the environment, clever, inventive, responsive to the environment, able to adapt to it by adequate solutions. It also can be assigned to material and virtual structures as well. Due to its complexity smartness is purposefully distinguished from human intelligence conceptualized as inherent and from knowledge conceptualized as attained (Hatt, Otto 2011). Therefore smartness is more than only intelligence and knowledgeable; it is a social construction comprising of one’s cultural capital, social capital, innate intelligence, and creativity or resourcefulness in US society often associated with power (Ibid.).

In the studies of marketing the concept of smartness is concerned with the customer which means being more attentive to customer. In the case of social systems (including the city) it should be treated as a better understanding of citizens’ needs and proposing respective services (e.g., Schaffers *et al.* 2012).

The concept of smartness is more widely met in the scientific literature of various social systems, such as cities, regions, states and communities. Various *public documents* also highlight the importance of smartness. For example, in the strategy “Europe 2020” an emphasis on smartness and smart development is also placed; several dimensions of smart development also have been distinguished in the national development strategy “Lithuania 2030”, such as a smart state, smart society, smart economy, and smart governance.

Yet, despite numerous scientific and popular publications on this topic, it remains unclear what qualities a social system should be characterized

by in order to call it “smart”? In the search for this answer, the research group “National competitiveness and innovation” of Kaunas University of Technology (Lithuania) in 2013 launched a research project “Smart development of social systems”, aimed to provide the theoretically and empirically justified concept of smart development and the methodology for its assessment, based on the good international practices in development of social systems, such as the state, city, region, society and economy.

The concept of smartness of a particular social system (city, region, state, and community) may be understood as an integral construct composed of different theoretical concepts and approaches (Fig. 1).

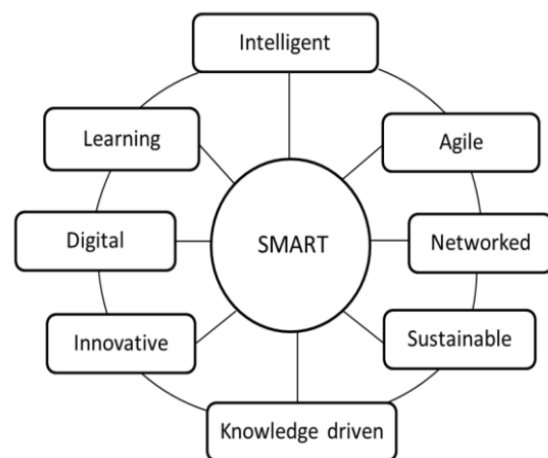


Fig. 1. Theoretical framework of the concept of smart development (source: Jucevicius, Liugailaite-Radzvickiene 2013)

In the frame of the above-mentioned project, smartness of a social system is being characterized as having qualities of intelligence, learning, digitality, innovativeness, knowledge management, sustainability, networking and agility.

*Intelligence* empowers a social system to choose its position among other social systems and to behave accordingly. Only by possessing the ability to scan external environment and gather useful information from it, a smart system becomes capable to compare itself with other social systems and to take proper actions by seeking its goals. *Learning* is about empowering individuals, groups and networks to learn for lifelong. Enabling *knowledge management* is also a fundamental aspect in a smart system. By seeking to be smart a social system should acclaim that knowledge is the key source for successful actions and continuous development. *Innovativeness* concerns about creating new products. As a quality of smart system, it enables to search for new approaches to problem solving and to make that in its own way, which is the

main aspect of smart specialization. *Digitalization* of smart system emphasizes information communication technologies (ICT) as a tool for socioeconomic development. It helps to connect individuals and groups and to reach the goals faster. Nowadays a social system cannot be successful without acting in *networks*. Being *agile* enables the smart system to respond quickly to changing circumstances. *Sustainability* is the basis for continuous successful development.

It should be highlighted that all of those characteristics, while interacting with each other, create favorable conditions for smart development of the city, region or state. However, are these characteristics, generated by the members of research project “Smart development of social systems”, also emphasized by other authors in the analysis of smart cities – the object of our article? What qualities of smart cities are presented in the scientific literature? The answers to these questions will be given in the next chapter.

### 3. Theoretical interpretations of the smart city concept

A city is a complex system, comprised from diverse and hardly predictable interrelations between its subsystems. The purpose of the models of smart cities is to find appropriate ways to manage this complexity, especially by solving negative consequences of global urbanization processes and assuring a higher quality of life for urban population (Nam, Pardo 2011b). In other words, smartness should help cities to become more livable and more competent in the global market of resources necessary for successful functioning of the city.

Those complex problems encourage the popularity of the concept of a smart city in scholars’ discussions, policy documents and other literature. Various social-territorial systems — from business parks, business districts (Giffinger *et al.* 2007) to large urban areas - are analyzed as smart.

One should be concluded that smart cities very often are equated to intelligent cities (Allwinckle, Cruickshank 2011), knowledge cities (Kourtit, Nijkamp 2012) and especially to digital cities. Smart city is understood as an outcome of digital city (Li *et al.* 2013) and defined as a combination of sensor networks (Tranos, Gentner 2012; Hancke *et al.* 2013), cyber physical space (Li *et al.* 2013); city with a smart industry that acts in the field of ICT or is ICT based (Lombardi *et al.* 2012). However, as Holland states (2008), progressively smart cities should start with the human capital and IT being as an integral part of social, economic and cultural development.

Table 1 presents several definitions of smart cities that emphasize not only ICT, but also other characteristics important to a smart city.

**Table 1.** The examples of smart city characteristics

Author	Definitions	Characteristics
Schaffers <i>et al.</i> (2012)	“An urban innovation ecosystem, a living laboratory, acting as an agent of change.”	Innovation, change
	“Places generating spatial intelligence and innovation, based on sensors, embedded devices, large data sets, and real time information and response.”	Innovation, spatial intelligence, sensors
Giffinger <i>et al.</i> (2007); Giffinger, Gudrun (2010)	“City well performing in 6 characteristics (smart economy, smart governance, smart people, smart mobility, smart environment, smart living), built on the ‘smart’ combination of endowments and activities of self-decisive, independent and aware citizens.”	Self-decisiveness, independence, awareness
Coe <i>et al.</i> (2001)	“A city whose community has learned to learn, adapt, and innovate”.	Learning, adaptation, innovation
Hall (2000)	“A city that monitors and integrates conditions of all of its critical infrastructures.”	Monitoring, integration
Toppeta (2010)	“Smart cities are those that are combining ICT and Web 2.0 technology with other organizational, design and planning efforts to de-materialize and speed up bureaucratic processes and help to identify new, innovative solutions to city management complexity, in order to improve sustainability and “livability.”	ICT technologies, new innovative management solutions
Mishra (2013)	“It is a type of city that uses new technologies to make them more livable, functional, competitive and modern through the use of new technologies, the promotion of innovation and knowledge management.”	New technologies, innovation, knowledge management

End of table 1

Author	Definitions	Characteristics
Harrison <i>et al.</i> (2010), cited by Chourabi <i>et al.</i> (2012)	A city “connecting the physical infrastructure, the IT infrastructure, the social infrastructure, and the business infrastructure to leverage the collective intelligence of the city.”	Connectivity of infrastructures, intelligence
Caragliu <i>et al.</i> (2009)	Smart city is such city “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 governance.”	Participatory governance, wise management of local resources
Rios (2008)	“A city that gives inspiration, shares culture, knowledge, and life, a city that motivates its inhabitants to create and flourish in their own lives. A smart city is an admired city, a vessel to intelligence, but ultimately an incubator of empowered spaces.”	Inspiration, creativity, intelligence
Winters (2011)	“Smart cities are often small and mid-size metropolitan areas containing flagship state universities. Smart cities are centers of higher education”.	University, higher education

As definitions suggested by different authors reveal, there is no common agreement regarding the content of smart city concept. Each author emphasizes different aspects of a city, ranging from characteristics necessary for local community members to resources/endowments necessary for the city’s functioning. However, some characteristics clearly stand out: most often authors emphasize innovation, novelty, intelligence, creativity, learning – the need of knowledge, also management of different local resources (in particular technological infrastructure). Other important characteristics assigned to smart city are: independence in decision making / participatory governance, connectivity/integration. Smart city should also monitor its environment, be aware of and adapt according to its changes.

Much emphasis in the scientific literature is done on the economical, social and ecological sustainability of smart social systems (including cities) and their development (Tregoning *et al.* 2002;

Hughes, Spray 2001; Grant 2009; Krueger, Gibbs 2008; Caragliu *et al.* 2011; Giffinger 2011; Bătăgan 2011).

These characteristics well correspond with characteristics of a smart social system suggested by the members of research project “Smart development of social systems”. However, one should emphasize that the concept of “smart city” proposed by various authors is rather fragmental and does not involve its main dimensions. The arguments and insights to the latter statement are provided below.

*The size of a smart city.* If to follow the definition of Winters (2011), one should state that it is much easier to become smart for smaller and medium-size cities. However, if we understand cities as self-organising social systems characterized by a variety and abundance of inter-connected agents (Barthelemy *et al.* 2013), which possess different abilities, it could be argued that larger cities have more opportunities to become smart by applying adequate methods to empower and unite these qualities. Also, one should criticize the statement that smart cities can be understood only as particular metropolitan areas with universities. In such case, the smartness of, for example, resort towns couldn’t be discussed because many of them have no universities. Furthermore, the main aim of smart city researchers is to find the ways for smart development of entire social system instead of concentrating on only one particular aspect of it.

*Smart city and learning.* An interesting definition is provided by Coe *et al.* (2001). It emphasizes a city as a community that has learned to learn, innovate and adapt. As it can be seen, learning is also one of the main characteristics in the model of smart systems (Fig. 1). However, this definition is too broad. At first, it doesn’t explain the specifics of the city – its main subsystems, such as economics or politics, also its processes and infrastructures.

*Smart city as an innovation ecosystem.* A well developed innovation ecosystem that is characterized as a complex combination of various top-down and bottom-up initiatives (Schaffers *et al.* 2012) and necessary resources for creativity and innovation (Zhang, Fu 2013) is crucial for smart cities. However, for a better understanding of smart cities, other dimensions, such as intelligence or learning, should be included. Also, it is not enough to emphasize that smart city is an innovation ecosystem but one should mention that smart city is a city whose development is based on the existing innovation ecosystem and if this ecosystem does not fit in the preferences of a particular city, this innovation ecosystem is being developed in smart ways.

*Smart city vs digital city.* As it was already mentioned in the text, digitality is very common in the definitions of smart city. Although digitality is one of the dimensions presented in the model of a smart social system (see above) and it acts as characteristics of a smart city, however, intelligence, innovations, city governance processes etc. are based not only on ICT technologies.

It is important to mention the perspective of researchers (Nam, Pardo 2011a) who acknowledge that while technological aspects of the city are emphasized in the literature, city's organization and policy often remain neglected. According to Nam and Pardo (2011b), smart cities are those cities that strive for innovations not only in technologies but also in organization and policy, while newest ICT are just a tool for a smart management and policy.

*Smart city and creativity.* The importance of creativity is highly emphasized in the definition of Rios (2008). Smart city is understood as a subject that inspires its inhabitants to create. However, one should conclude that smart cities develop both creativity and innovations. The latter can be understood as commercially successful products that are created from creative ideas (see, for example, Wright 2007).

*Smart city and intelligence.* Intelligence can be described as one of the most important characteristics of the smart city. Not only because it is an essential ability to scan external environment and adapt to changing circumstances, but also because an existing approach seeing smart city as intelligent one. For example, according to Rodrigues and Tomé (2011), smart cities are medium size intelligent cities (whereas intelligent cities are both knowledge and digital cities). Smart cities are very broadly analysed by Hollands (2008), but the author seems to be using smart and intelligent cities as synonyms. Urenio research<sup>1</sup> tries to create environments supporting R&D, innovation, human skills and intelligence and also does not make any clear distinction between intelligent and smart cities. However, it should be noticed that intelligent cities are not the same concept as smart cities, but the smart city without acting intelligently (scanning its environment and detecting signals from it as well as perceiving changes in order to make successful decisions and seeking its own goals) cannot adequately respond to changing environment.

Various forms of capital are quite common in the definitions of smart cities. According to Cruickshank (2011), the basis of smart cities is a developed social and environmental capital. Also,

much attention is paid to human capital: the smartness of people (Giffinger *et al.* 2007; Giffinger, Gudrun 2010) can be understood as their self-decisiveness, independence, awareness (Ibid.), creativity (for example, Hollands 2008; Rios 2008).

Some authors try to define a complex structure of dimensions and characteristics of a smart city. The following characteristics are presented in the article of Caragliu *et al.* (2011):

- the “utilization of networked infrastructure (including business services, housing, leisure, life style services and ICT) to improve economic and political efficiency and enable social, cultural, and urban development” (Hollands 2008, cited by Caragliu *et al.* 2011);
- “emphasis on business-led urban development” (Hollands 2008, cited by Caragliu *et al.* 2011);
- the opportunities for citizens to receive public services;
- a stress on high-technologies and creative industries;
- a focus on social and relational capital;
- social and economical sustainability.

A very popular model of smart cities is presented by Giffinger *et al.* (2007) and Giffinger (2011). It is comprised of six main dimensions:

- *smart economy* that is characterized by innovation spirit, entrepreneurship, economical image/trademarks, productivity, flexibility of labor market, international embeddedness and ability to transform;
- *smart people* that are qualified, creative, cosmopolitan, socially and ethnically plural, flexible, open-minded, tending to learn life-long and participating in public life;
- *smart governance* that is characterized by participation in decision making, public and social services, transparent governance, political strategies and perspectives;
- *smart mobility* (transport and ICT) is described through a local and international accessibility, availability of ICT infrastructure, sustainable, innovative and safe transport systems;
- *smart environment* is evaluated by an attractiveness of natural conditions, pollution, environmental protection and sustainable resource management;
- *smart living* is characterized by cultural facilities, health conditions, individual safety, housing quality, education facilities, touristic activity and social cohesion.

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<sup>1</sup> <http://www.urenio.org/>

Chourabi *et al.* (2012) offered eight dimensions to evaluate initiatives of a smart city, i.e.: governance, organization, policy, people and communities, economics, built infrastructure and natural environment while modern IT are the basis for any initiative of a smart city.

Nam and Pardo (2011a) created a conceptual model of a smart city, based on the relative concepts of smart cities:

- *technology factors* (smart, mobile and virtual technologies and digital networks) are based on the studies of digital city, intelligent city, ubiquitous city, wired city, hybrid city and information city.
- *human factors* (human infrastructure and social capital) are defined while analyzing creative city, learning city, humane city and knowledge city, while
- *institutional factors* evaluate governance, policy and regulations /directives.

Lombardi *et al.* (2012), in order to analyze the performance of a smart city, complemented a classical triple helix model with a civil society that empowers universities, governments and industries. They emphasize four policy visions (prototypes) of smart cities: entrepreneurial cities, pioneering cities, livable cities and connected cities.

Leydesdorff and Deakin (2011) emphasize the following dimensions of cities: intellectual capital, wealth creation of industries and democratic government of civil society.

The efforts of being smarter can be also understood as a sign of smartness: Smart city is “a city striving to make itself “smarter” (more efficient, sustainable, equitable, and livable) (Natural Resources Defense Council n.d., cited by Chourabi *et al.* 2012).

Authors of the research suggest that the formation of a smart city very much depends on urban governance. Its types depend on socio-cultural context of the city. It is important to note that governance should be based on intelligence: intelligence empowers social system to define its position towards other systems in the constantly changing, uncertain environment and to undertake adequate behavior. This social system is able to identify and eliminate/decrease its weaknesses and effectively achieve its aims, just if it knows what other systems are around, what systems it belongs to, i.e. being capable to scan and absorb relevant information from external environment on the basis of existing knowledge.

#### 4. Conclusions

The concept of “smart” has become increasingly popular object of research in almost all fields of science. Social scientists analyze it in various contexts as well: smart education, smart economy, smart governance, smart communities, smart cities and many other. Although the concept receives high attention from both practitioners and researchers, it still lacks a clear definition. Literature sources suggest a great variety of its content elements.

Cities, as a home for more than a half of the world’s population, face many complex issues of development. In order to solve them more effectively and assure urban sustainability, a new model of city development – a “smart city” model – has been proposed. Again, as cities are extremely complex social-territorial systems (systems of systems), smart city concept has many different definitions. In order to identify its key characteristics, a large number of smart city concepts were analyzed and the decomposition of the definitions’ content was made.

Results of analysis show that there is no common agreement among researchers on the basic characteristics of both smart social system and smart city. The most common characteristics of a smart city, met in the literature, are as follows: monitoring of environment, learning, intelligence, managing resources (people, infrastructures), innovativeness, connecting / networking, applying ICT technologies, adapting to environment.

They in general reflect the characteristics of smart systems and their development, defined by the team of the project “Smart development of social systems” (Kaunas University of Technology), such as intelligence, learning, digitality, innovativeness, knowledge management, sustainability, networking and agility. However, the most of concepts of smart cities in the scientific literature emphasize just some dimensions. In such a case, only the analysis of all these diverse concepts and their interrelationships reveals the concept of smart city as a whole.

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