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## Review of The Definition of Smart Cities

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### ABSTRACT

The rapid growth of urban areas necessitates the need for cities to adopt innovative strategies in addressing various challenges such as traffic congestion, air pollution, elevated crime rates, waste management difficulties, inefficient energy usage, and more. In response to the escalating urban issues, a collaborative effort has emerged among local government bodies, businesses, non-profit organizations, and the residents themselves, all united by the vision of creating smarter cities. The smart city concept centers on the harmonious integration and synergy of human capital, social assets, and Information and Communication Technology (ICT) infrastructure. Its objective is to promote sustainable economic development and make better the overall quality of life. This paper therefore focused to define smart cities and ways of improving smartness of city. It also adopted review of literatures to explore the elements and components of smart city in order to arrive at a comprehensive definition of smart city.

**Keywords:** Smart Cities, ICTs, Congestion, Businesses, Review.

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## 1. INTRODUCTION

The concept of the smart city represents a relatively recent development that has witnessed a notable surge in adoption over the past few years (Kourtit, 2012). Both the terms "smart city" and "digital city" have progressively gained prominence in scholarly works and technical documents. Also politicians, city governments and hi-tech companies use smart city concepts to refer to the ideal city, which is more suitable to respond to the needs of its citizens (Hollands 2008). During the last fifty years, the world population has been moving from the country to the city, generating an increasing number of urban problems (Caragliu et. al. 2009). To face the increasing problems of urban areas, local public government, companies, not-for-profit organizations and the citizens themselves need to embrace the idea of a smarter city, use more technologies, create better living conditions and safeguard the environment. Globalization and technological advancements has a great influence on the development and transformation of cities. The new challenges combine competitiveness and sustainable urban development simultaneously (Giffinger et al. 2007). Rapid urbanization creates an urgency and imperative for cities to find smarter ways to manage the accompanying challenge e.g., traffic congestion, air pollution, high crime rate, difficulty in waste management, wasteful energy consumption, and so on (Nam & Pardo, 2011a; Nam & Pardo, 2011b).

Governments and researchers since the 1990s have been using the term ‘Smart Cities’ as a fashion label, this could be because it can help certain cities to distinguish and promote themselves as innovative. Being a Smart City is an aspiration for some cities that have been developing long term plans to achieve this purpose. But, this is still a challenge for others that are facing this process sightlessly basically because the concept is still ambiguous (Caragliu et al, 2011). Giddens (1999) suggested that the modernization process in the cities are linked to risks and many of them are “manmade risks”, that have arisen because of the development of new technologies and the advances in scientific knowledge which are associated to the smartness of the city. In this context, Liotine, Ramaprasad and Syn (2016) considers the term Smart City as an anthropomorphism (attribution of human characteristics to the city) because it is based on the ability of the city to sense and respond to its challenges smartly—using natural and artificial intelligence embedded in the city’s information systems.

A large literature survey about smart city and digital city scientific papers, realized by Annalisa Cocchia observes that these themes have been studied from twenty years ago (Dameri & Cocchia, 2013). Therefore the idea of a city able to be smart and digital, that is, to use technology and especially ICT to improve the quality of life in urban space, is quite old (Tokmakoff & Jonathan, 1994). Smart city is a multidisciplinary concept and to define ‘Smart’ is difficult. The first attempts to define the concept were focused on the smartness provided by information technology for managing various city functions (Nam & Pardo, 2011b; Townsend, 2013). Lately the studies have widened their scope to include the outcome of the Smart City such as sustainability, quality of life, and services to the citizens (Anthopoulos, 2015; Lee & Lee, 2014). Murgante and Borruso (2015) warned that cities, in the rush of being considered part of the “Smart umbrella”, can be susceptible to ignore the importance of becoming sustainable and if they focus solely on improving technological systems they can easily become obsolete.

Smart city as a topic has been a pioneering field, both in theoretical research and in empirical applications. Academic researchers are still trying to understand what exactly a smart city is, and local governments are trying to realize prototypes of smart city or, at least, of smart projects. This paper therefore focused to define smart cities and ways of improving smartness of city. It also explored the elements and components of smart city in order to arrive to a comprehensive definition of smart city.

## 2. RECENT DEFINITIONS OF SMART CITY

There is no common consensus about what “smart” really means in the context of the information and communications technology (ICT) (Cellary 2013). Although this term has become fashionable, it is also broadly used as a synonym of almost anything considered to be modern and intelligent. Smart, in purely definitional terms, has many synonyms, including percipient, astute, shrewd, and quick (Gil-Garcia et al. 2014). Moreover, smart is synonymous to efficient, when it is linked to devices (Meijer and Bolivar 2016). In the context of international debate about smart cities, principal recent definitions are reported in the following. The first use of term smart city was in 2007 (Giffinger, 2007).

The idea of smart cities is rooted in the creation and connection of human capital, social capital and Information and Communication Technology (ICT) infrastructure in order to generate a greater and more sustainable economic development and a better quality of life. In 2008 a little advanced definition could be found. Smart City uses the network infrastructure to improve economic and political efficiency, and to allow the social, cultural and urban development (Hollands, 2008).

In 2011 an extension is proposed. A city may be called 'smart' when investments in human, social capital, traditional and modern communication infrastructure fuel sustainable economic growth and a high quality of life, with a wise management of natural resources, through participatory governance (Schaffers et al. 2011). In a Smart City, networks are linked together, supporting and positively feeding off each other, so that the technology and data gathering should: be able to constantly gather, analyse and distribute data about the city to optimize efficiency and effectiveness in the pursuit of competitiveness and sustainability; be able to communicate and share such data and information around the city using common definitions and standards so it can be easily re-used; be able to act multifunctional, which means they should provide solutions to multiple problems from a holistic city perspective (Copenhagen, 2012).

A first complete definition in terms of system is given in 2013. Smart Cities should be seen as systems of systems, and that there are emerging opportunities to introduce digital nervous systems, intelligent responsiveness, and optimization at every level of system integration (MIT, 2013). A smart city uses information and communications technology (ICT) to its livability, workability and sustainability. In simplest terms, there are three parts to that job: collecting, communicating and "crunching." First, a smart city collects information about itself through sensors, other devices and existing systems. Next, it communicates that data using wired or wireless networks. Third, it "crunches" (analyzes) data to understand what's happening now and what's likely to happen next (SCC, 2013).

A Smart City consists of not only components but also people. Securing the participation of citizens and relevant stakeholders in the Smart City is therefore another success factor. There is a difference if the participation follows a top-down or a bottom-up approach. A top-down approach promotes a high degree of coordination, whereas a bottom-up approach allows more opportunity for people to participate directly (EP, 2014). Definitions can be classified referring to: input, activities and outputs to implement a smart city; objectives (outcomes and goals) to reach implementing smart city solutions.

### **2.1. Elements of Smart Cities**

Caragliu, Del Bo and Nijkamp (2011) found some elements that could characterize a smart city. They include (i) utilization of networked infrastructure to improve economic and political efficiency and enable social, cultural, and urban development; an underlying emphasis on business-led urban development; (ii) a strong focus on the aim of achieving the social inclusion of various urban residents in public services; (iii) profound attention to the role of social and relational capital in urban development; and (iv) social and environmental sustainability as a major strategic component. Albino, Berardi and Dangelico (2015) also identified some common characteristics of a smart city that include: (i) a city's networked infrastructure that enables political efficiency and social and cultural development; (ii) an emphasis on business-led urban development and creative activities for the promotion of urban growth; (iii) social inclusion of various urban residents and social capital in urban development; and (iv) the natural environment as a strategic component for the future.

### **2.2 Component of Smart Cities**

Technology is considered one of core components of a smart city in practical research (Dirks et al. 2010; Dirks & Keeling, 2009; Dirks et al, 2009), (Giffinger et al, 2008 & Giffinger et al. 2009), (Washburn et al. 2010). ICTs are a key driver of smart city initiatives (Hollands, 2008). E-government research offers knowledge of technology-related challenges government projects usually face. For example, Ebrahim and Irani's (2005) study of e-government adoption highlighted the challenges in using technologies for e-government projects.

Notably, the lack of IT skills and (cross-) organizational (cultural and political) challenges are identified as main technological challenges instead of technical concerns. Managerial and organizational factors do not draw much from smart city research, but instead the factors have been discussed in the extensive literature on e-government and IT projects. Smart city initiatives may differ from general e-government initiatives in the light of their specific focus on localities and strategic goals for making cities smarter. However, previous paper (Chourabi et al. 2012) suggested many commonalities between e-government or public sector, IT projects and smart city initiatives. Managerial and organizational factors that influence e-government projects broadly comprise of project size, managers' attitudes and behavior, organizational diversity, alignment of organizational goals, multiple goals, compliance to change, and perceived turf.

There is an increasing need for better governance to manage initiatives or projects to make a city smart (Griffith, 2011). Some studies identify the importance of governance for a smart city in various contexts. According to Johnston and Hansen (2011), smart governance involves the implementation of processes with constituents who exchange information in accordance with rules and standards. Mooij (2003) emphasized a smart governance infrastructure that should be accountable, responsive, and transparent. Odendaal's (2003) case study found smart governance promotes collaboration, data exchange, service integration and communication. Giffinger et al.'s (2007) model to assess European mid-sized smart cities views smart governance as a core of smart cities. In their model, smart governance represents citizen participation and transparent processes. Scholl et al. (2009) identified stakeholder relations as one of critical governance factors to determine success and failure of e-government projects.

The Smart City Initiatives Framework includes four other components. The framework emphasizes both people and communities, because it is critical to refer to the members of a city, not only as individuals but also as communities, groups, and segments of the whole population that have their own wants and needs (Chourabi et al. 2012). Regarding the importance of people and communities, social and human capital is considered a core component of a smart city (Giffinger et al. 2007). Smart city initiatives welcome residents to participate in the governance and management of a city. Urban economy is a major driver of smart city initiatives, and economic competitiveness is one of important properties of a smart city (Dirks et al. 2010; Dirks & Keeling, 2009; Dirks et al, 2009), (Giffinger et al. 2007). In turn, economic outcomes of smart city initiatives include business creation, job creation, talent attraction, workforce development, and retention, and improvement in productivity. In addition, smart city initiatives are forward-looking in terms of preserving and protecting the natural environment and improving and leveraging the built infrastructure (Hall, 2000). Thus, smart city initiatives have an impact on environment-friendly development, sustainability, and livability of a city.

Anthopoulos et al. (2016) performed a comparative analysis on existing smart city conceptual models. These models synthesize a smart city ecosystem, which consists of eight (8) components that establish cyber-physical integration and—with the incorporation of standardization perspectives—concern:

1. Smart infrastructure: city facilities (e.g., water and energy networks, streets, buildings etc.) with embedded smart technology (e.g., sensors, smart grids etc.).
2. Smart Transportation (or smart mobility): transportation networks with enhanced embedded real time monitoring and control systems.
3. Smart Environment: innovation and ICT incorporation for natural resource protection and management (waste management systems, emission control, recycling, sensors for pollution monitoring etc.).

4. Smart Services: utilization of technology and ICT for health, education, tourism, safety, response control (surveillance) etc. service provision across the entire city.
5. Smart Governance: smart government establishment in the urban space, accompanied by technology for service delivery, participation and engagement.
6. Smart People: measures that enhance people creativity and open innovation.
7. Smart Living: innovation for enhancing quality of life and livability in the urban space.
8. Smart Economy: technology and innovation for strengthening business development, employment and urban growth.

These components are interconnected and require data collection and ICT infrastructure, to be embedded within city hard infrastructure to deliver smart services to city actors, while governance is necessary in order for the subsystems to be orchestrated and succeed in smart city mission.

Dameri & Cocchia, (2013) tries to put the basis to define the smartness of a city starting from its core components: land, infrastructures, people and government.

- i. Land means the territory, that is, the geographical area upon which the city rises up.
- ii. Infrastructures is a large element, it includes all the physical, material components of a city such as buildings, streets, transport facilities, and so on.
- iii. People include all the citizens, not only the city inhabitants but also who works, studies or visits the city.
- iv. Government means the local political bodies which have the power to govern the administrative aspects of the city.

Smartness in a city comes to play when there is (a) effectiveness (b) environment consideration and, (c) Innovation (Casalino et al. 2013 & Dameri, 2012).

- a. Effectiveness means the capacity of a city to supply effective public and private services to several subjects, such as citizens, companies, not-for-profit organizations; and in detail to different categories of citizens such as students, workers, elder men and women, and so on. It requires the subjective role of several stakeholders in the smartness definition. Therefore, a smart city is not smart for itself, but if it creates public value for people.
- b. Environmental consideration regards the increasing impact that large cities have on the environmental quality of urban areas. One of the main pillars of smarter cities is to prevent a further environmental degradation. The main impacts regard energy consumption, air and water pollution, traffic congestion, land consumption. A smarter city therefore acts to reduce all these aspects to preserve the environmental quality.
- c. Innovation means that a smart city should use all the new and higher available technologies to improve the quality of its core components, to deliver better services and to reduce its environmental impacts. Technology is therefore a central aspect of smarter city, used at the service of smart initiatives for the quality of life in city.

To improve the smartness of its core components, a city should transform them into more effective, environmental and innovative ones (Chourabi et al. 2012). Therefore, a smarter land means cleaner territory, water and air, a reduced consumption of land for new buildings, environmental reclamation and so on.

Smarter infrastructures should be cleaner, more effective in serving the citizens and answering to their needs, using high technology, ICT and mobile devices to spread e-services and information. Smarter people means citizens more informed, more aware about the city goals and the role of technologies in improving the quality of urban land, infrastructures and services, an easier access to the Internet and all the mobile and on-line services and finally a strong decreasing of the digital divide. A smarter government uses ICT and all the new technologies to implement e-government and e-democracy, improving the quality and accessibility of supplied public services and the people satisfaction for the local administration (Nam & Theresa, 2011; Casalino et al. 2013).

### 3. CONCLUSION

Smart city is a multidisciplinary topic, aiming to indicate an innovative urban strategy to improving the quality of life in urban areas, especially in large cities. Academic researchers are still trying to understand what exactly a smart city is, and local governments are trying to realize prototypes of smart city or, at least, of smart projects. However, different definitions have been postulated and from the study of literature we can see the real meaning and context of city being smart.

Smart city comprises of elements such as utilization of networked infrastructure, social inclusion of various urban residents in public services, role of social and relational capital in urban development, and social and environmental sustainability. Its components include land, Infrastructure, citizens, and government. To improve the smartness of its core components, a city should transform them into more effective, environmental and innovative ones. Therefore, a smarter land means cleaner territory, water and air, a reduced consumption of land for new buildings, environmental reclamation and so on. Smarter infrastructures should be cleaner, more effective in serving the citizens and answering to their needs, using high technology, ICT and mobile devices to spread e-services and information.

Smarter people means citizens more informed, more aware about the city goals and the role of technologies in improving the quality of urban land, infrastructures and services, an easier access to the Internet and all the mobile and on-line services and finally a strong decreasing of the digital divide. A smarter government uses ICT and all the new technologies to implement e-government and e-democracy, improving the quality and accessibility of supplied public services and the people satisfaction for the local administration.

Therefore, smart city should comprise all its

- i. elements such as utilization of networked infrastructure, social inclusion of various urban residents in public services, role of social and relational capital in urban development, and social and environmental sustainability, and
- ii. Components such as land, infrastructure, citizens, and government.

Exclusion of one or more of its elements and components makes the definition of smart city incomplete.

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