Basic Criteria for creating a Smart City

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To cite this article:

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Article Info	Abstract
	Nowadays, non-smart cities face challenges such as climate change, population increase versus resource depletion, transportation problems and lifestyle changes, while in the model of smart cities, the urban area can cope with most of these challenges. Although the term smart city is not a fixed term and so far it has not been defined, in other words, there is no standard definition for this term. We can say that a smart city is a developed urban area that produces a sustainable economy. Designing and creating an ideal place for people to live by increasing the quality of life through high optimization of both city components (both soft and hard components) with multiple areas, Governance, Economy, People and the Environment, Mobility and the Built Environment. This article clarifies some of the prominent variables facing most cities in terms of the challenges of the natural environment, the built environment, mobility, and social and economic characteristics that slow down the development wheel towards achieving a better life for the population. Most of these problems and challenges can be solved by drawing up a city development policy based on the principles of the smart cities. This article also develops a scientific approach to explain the concept of smart cities, explains the benefits of applying this model to cities, and suggests a new set of the dominant components of smart cities worldwide.

Introduction

Cities contribute to climate change and are in turn affected by its consequences, and to overcome these challenges, consumers must focus on technology-driven solutions; The need for smart solutions to achieve sustainable energy sufficiency, fresh and potable water, transportation efficiency and resource management is growing. This requires rethinking - we have to think smart to identify challenges, ask relevant questions, and choose the best tools.

This article will explain some of the prominent variables facing most of the world's cities, in terms of the challenges of the natural environment, the built environment, mobility, and social and economic characteristics, which slow down the development wheel towards achieving a better life for the population. Many of these problems and challenges can be solved by drawing up a city development policy based on the principles of the world's major smart cities.

Smart cities have an opportunity to meet these distinct challenges. They provide an environmentally friendly approach to climate change and process creation with efficient resource management. The smart concept increases

the quality of life for its residents.

Recently, most articleers and IT companies have proposed the idea of smart cities focusing on specific problems in the city and providing smart solutions to those problems for example, smart grids, smart meters, smart healthcare, smart traffic management system, smart energy, smart buildings. But the goal in this article is to develop a scientific framework to explain the concept of the smart city, its tools, benefits and components.

Article Problem

The term (smart city) is very popular nowadays especially in the media and means many different aspects between people in different contexts. Some experts have used the term as a depiction of a developed, green and sustainable city, while others have used it to describe a city that makes extensive use of ICT in all its parts and processes.

The term smart city is not a fixed term and so far there is no specific definition for this term, in other words, there is no unified definition of "smart city" because this term is used in different context and aspects. However, most scientists and specialists have not reached a unified definition of a smart city. Also, there is no clear idea of the advantages of this type of city and what we can offer our cities. So far, the components and indicators of the smart city are not normative and are still not clear, not fixed and changing due to the point of view of specialists.

Article Goal and Objectives

This article aims to develop a scientific approach to explain the concept of a smart city, to explore the benefits of applying this model to cities.

Article Methodology

To achieve the goal of the article, the author will rely on a literature review to reveal the current definitions proposed by several scholars to develop the definition of smart city and clarify the goals and benefits of smart cities.

Previous Studies on the field of Smart cities

The idea of a Smart City is recent in the context of policies and the latest studies of cities and urbanization. The primary focus in most studies and articles seems to be focusing on information and communication technology (ICT), although many dimensions play a critical role in the city.

Relatives of the Smart City

Here are some of the city brands such as Digital City, Intelligent City, Ubiquitous City, Creative City, Knowledge City, and Learning City, which will be similar to the Smart City in their respective fields and participate in the six

dimensions of the Smart City, namely Economy, People and Governance mobility, environment and living. (Giffinger, 2007).

Digital City

Specialization: Information technology in society.

Digital City refers to the connected community that connects broadband telecom infrastructure, soft computing infrastructure, its open industry standards-based services and cutting-edge facilities to meet the needs of the government with its employees and people. The main objective of the digital city is to create an environment for the exchange of information, cooperation and experience for all residents in all places (Yovanof and Hazapis, 2009).

The term 'Digital City' also refers to a set of virtual practices implemented in a sustainable manner by residents and groups in a city to interact, simulate, explain, reinforce, observe and achieve communication for daily activities in the city. social communication. So the digital city is a virtual interface model where daily activities in some aspects of traditional and social interaction are carried out outside the city and transformed accordingly (Michel, 2005).

Smart City

Specialization: Information technology in the built environment

A smart city is a city that contains all ICT infrastructures (Besselaar and Koizumi, 2005). Exuberant work in innovation is a distinctive feature of intelligence because all new problems are solved, so it is considered the main feature of intelligence (Komninos, N. 2002). The smart city focuses on the development of urbanization, city growth and the requirements of urban residents. A smart city requires the effective integration of advanced information technology with operating and service philosophy (Insigma, 2012).

A smart city collects and stores many sources of information in real time to create an information technology infrastructure. And exchange and share data through collaborative applications. And will also create a platform that provides an efficient and flexible tool for making and implementing decisions related to the management and operation of the city, as well as for the provision and management of public services, with the ultimate goal of achieving Harmonious development for a safer, greener, efficient and convenient urban place (Insigma, 2012).

City is Everywhere

Specialization: Information technology in society

U-City is the concept of integrating ubiquitous computing into the urban environment. We can describe it as

integrated information and social systems, which connects every device and network service information through wireless networks, RFID tags, and sensors. The Ubiquitous City is an extension of the Digital City and has the same concept of ubiquitous access (Anthopoulos, 2010). It makes abundant computing devices established throughout the city, like; buildings, roads, bridges, and landscapes. It aims to build a city where any inhabitant can get services anywhere and anytime utilizing these devices (Lee, 2008).

The City of Creativity

Specialization: People, the economy and the built environment

Creative City was an idea developed by urban scholar Charles Landry in the late 1980s and became a global movement producing a new example of urban planning. The Creative City is a creative aspiration as it encourages an open imagination that impacts organizational culture and presupposes the need to create conditions for people to think and plan to act with creativity in connecting opportunities and addressing the urban problem.

These ranges may address displacement; To create wealth or improve the visual environment. Assuming that ordinary people could happen extraordinary if given the opportunity.

Creativity is an applied imagination in the city. Not only creative artists and workers in the creative economy have an impact, but also social workers, businessmen, scientists and government employees Edvinsson (2006).

Knowledge City

Specialization: People

Edvinsson (2006) defined a City of knowledge as "A City that encourages nutritional knowledge". He mentioned that It has many characteristics and aims to make information accessible for everyone by establishing a network of public libraries and linking them to the libraries in the world. To make this possible, governments have provided communication technologies to all citizens, with all facilities, cultural and educational services and tools. The City of Knowledge has a network of schools with technical teachings throughout its area, simplifying collective and civic associations by providing electronic resources, knowledge and cultural activity. An urban knowledge city that is open to diversity, fostering face-to-face relationships and allowing citizens of other countries to express themselves.

Learning City

Specialization: People

Cities are not just places where people live and work. They are also places that bring people entertainment, culture and education. Learning City provides many learning tools to meet the needs and aspirations of its citizens through

the combination of local resources. Learning Cities present local solutions to local challenges. For example, Education City means a learning community where materials and tools are available to enhance personal growth, maintain social resilience and create wealth. This idea is similar to the City of Knowledge (Li, 2008).

SMART ECONOMY (Competitiveness)
- Innovative spirit
- Entrepreneurship
- Economic image & trademarks
- Productivity
- Flexibility of labour market
- International embeddedness
- *Ability to transform*

SMART PEOPLE (Social and Human Capital)
- Level of qualification
- Affinity to life long learning
- Social and ethnic plurality
- Flexibility
- Creativity
- Cosmopolitanism/Open-mindedness
- Participation in public life

SMART GOVERNANCE (Participation)
- Participation in decision-making
- Public and social services
- Transparent governance
- *Political strategies & perspectives*

SMART MOBILITY (Transport and ICT)
- Local accessibility
- (Inter-)national accessibility
- Availability of ICT-infrastructure
- Sustainable, innovative and safe transport systems

SMART ENVIRONMENT (Natural resources)
- Attractivity of natural conditions
- Pollution
- Environmental protection
- Sustainable resource management

SMART LIVING (Quality of life)
- Cultural facilities
- Health conditions
- Individual safety
- Housing quality
- Education facilities
- Touristic attractivity
- Social cohesion

Figure 1. Six Distinguishing Characteristics of a Smart City (Giffinger 2007)

Meet Classification of Minds, 2014

On March 12, 2014, the Sustainable Cities Conference organized a "Meeting of Minds" under the title; Smart Cities: Turning Information into Action. There was a consensus at this conference to group the components of smart cities into three parts:

- Soft infrastructure: Things that make ideas and plans and include regulations, education, laws, policies, human capital etc.
- Solid infrastructure: Things to be built or planned to be built, which include the built environment, mobility, utilities, energy, water, network etc.
- Technology: This represents the bridge between soft and hard infrastructure as well as the means and tools to build the best livable cities.

| Components	Features
Smart Mobility	Smart Parking, Fleet Management, Intelligent Transport System, Traffic Management, Community Biking, Electric Vehicles, Infrastructure Smart Taxi
Energy and Environment	Smart Building, Smart Grid And Smart Meters, Smart Urban Lighting, Waste Management, Watering Management, Noise Detection
City Economy	NFC Services, Digital Signage, E-Tourism, Connected Retailer
City Management	Smart City Dashboard, Smart City Operations Center, City Maintenance
Security and e-Health	Video Surveillance, Tele-Health and Tele-Care, Emergency Management

Figure 2. Smart City Components (Telefónica, 2013)
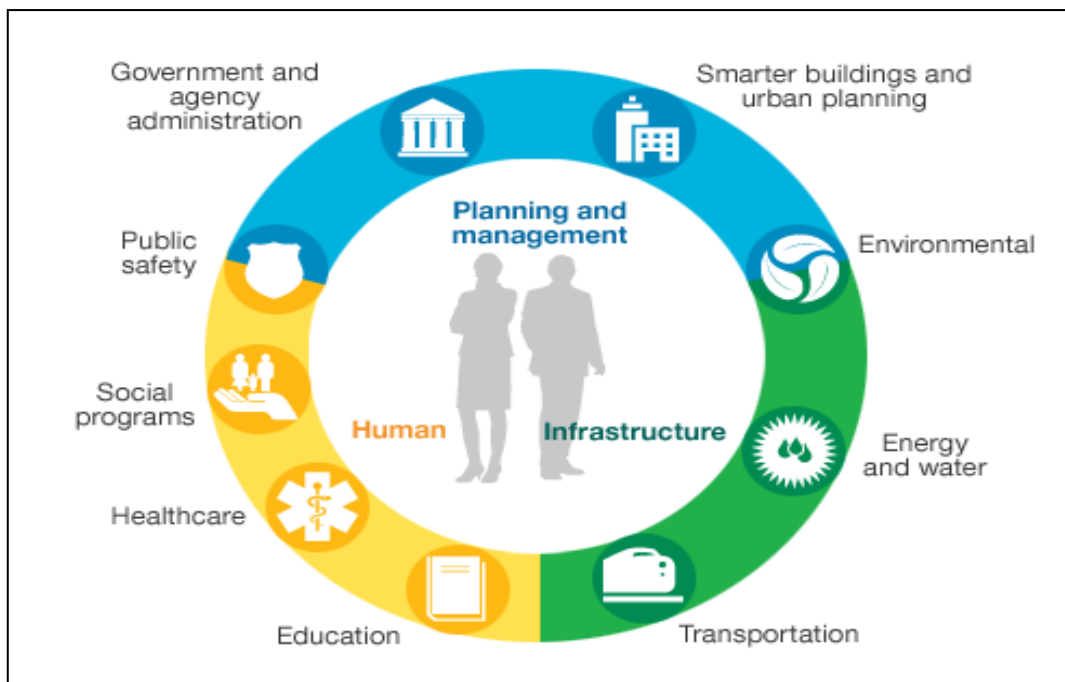
Figure 3. City Components (IBM, 2009)

Table 1. Smart Cities Components Group (done by the auther)

2007 Giffinger		2009 IBM		2013 Telefónic		2014 Meeting of the Minds	
smart economy	• innovation spirit • leading businesses • Economic image and branding • productivity • labor market flexibility • international integration • The ability to transform	Planning and management	• Public Safety • Smarter buildings and urban planning • Administration and government agency.	smart navigation	• smart parking • Fleet management • intelligent transportation system • traffic department • cycling community • Electric Vehicle Infrastructure • Smart Taxi	soft infrastructure	• systems • education • laws • Policies • Human capital
smart people	• qualification level • Lifelong Learning Convergence • Social and ethnic pluralism • Flexibility • creativity • Cosmopolitanism / openness • Participation in public life			Energy and the environment	• smart building • Smart grid and smart meters • smart urban lighting • waste management • irrigation management • noise detection		
Smart Governance	• Participation in decision making • public and social services • transparent judgment • Political Strategies and Perspectives	infrastructure	• Energy and Water environment • Transportation	city economy	• NFC Services • digital signage • e-tourism • Online retailer	solid infrastructure	• Built environment • Mobility • Services • energy • Water • Networks
smart navigation	• local accessibility • (Inter)national accessibility • Availability of ICT infrastructure • Sustainable, innovative and safe transportation systems			city management	• smart city control panel • Smart City Operations Center • city maintenance		
smart environment	• Attractive natural conditions • pollution • environment protection • sustainable resource management	human	• social software • Health Care • education	Electronic health and security	• video surveillance • Telehealth and telecare • emergency management	technology	The bridge between soft infrastructure and hard infrastructure
smart life	• cultural facilities • health conditions • Personnel safety • housing quality • Education facilities • tourist attraction • social cohesion						

Built Environment

The Smart built environment includes Smart buildings, Smart lighting, Smart grids, water and waste management,

safety and security.

Smart Buildings

Intelligence here means the infusion of technology into buildings (residential and non-residential), which relates to power supply, automation, control, lighting, heating and efficient use of available water.

Intelligent management systems in buildings help reduce energy costs and carbon dioxide emissions by 20 to 30%. Building automation systems (BAS) such as Intelligent grids of electronic devices, monitoring and control systems for power supply, lighting, heating, air and water management, as well as security systems (for example, toxic substances and fire safety) in the integrated network reduce maintenance and energy costs to a big limit.

Buildings are Smart and highly energy efficient and intelligent automation when accompanied by integrative low-carbon power supply and smart grid connectivity. In the future, new buildings will have low energy consumption. Smart buildings do only mean internet connection and remote control. It also means that the presence of devices that can alert status data arising inside, and outside homes is information for use by different users (Fig. 4).
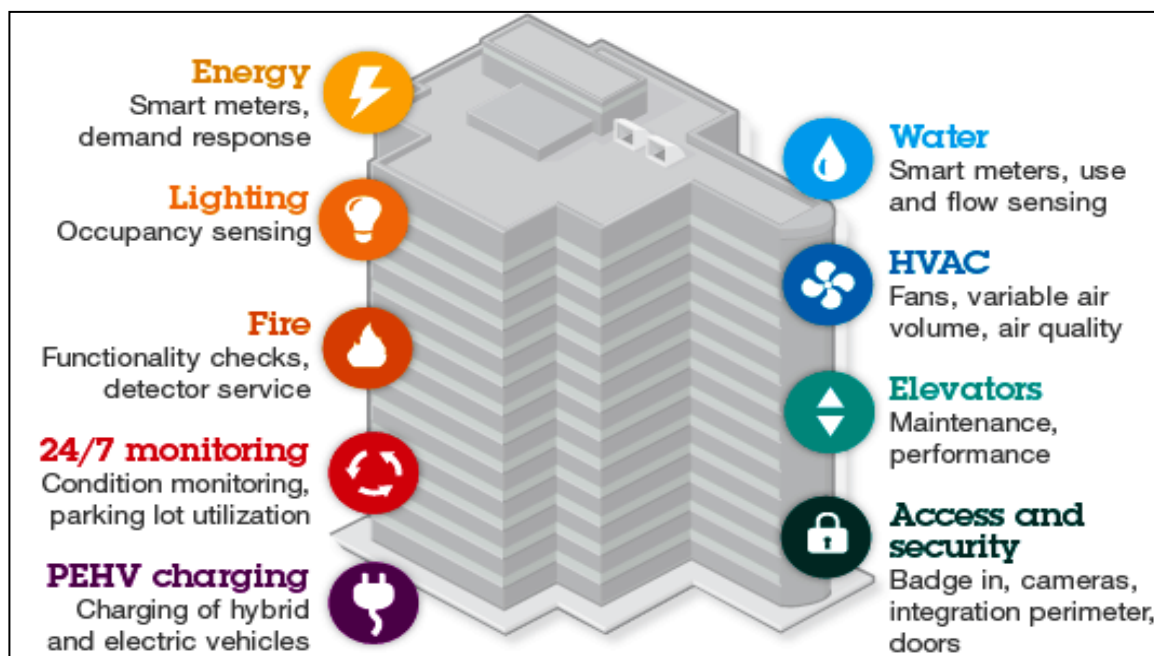

Figure 4. Smart Building Systems
(IBM's Smarter Buildings Survey. April 2010)

Smart Lighting

Lighting technologies have gone beyond the developed technology of the past years, provided a new perspective on cities, and added possibilities for developing these urban lighting strategies. Natural daylight is essential to life. In cities, there is a need for artificial light to help citizens accomplish visual tasks, as summer is not available everywhere and at any time. The effects of light on our mood improve our well-being and biological processes.

The light stimulates productivity and accommodates a 24-hour lifestyle, ensuring safety and comfort.

Good city lighting offers many benefits, for:

- Improving the quality of social and cultural life in urban and city areas.
- The beautiful appearance of the city's urban architecture and landscape.
- Increase the clarity of all visual tasks.
- Improving the safety and usability of streets and roads.
- Motivate and encourage learning and study.
- Improve productivity, and enhance safety and accuracy in the workplace.
- Stimulating benefits and experiences for retail and leisure environments.
- Dealing with the emerging challenges of demographic change and post-ageing populations in cities.

Society attaches great importance to climate and energy protection. Lighting can play a central role in cities conserving energy, resources, and costs. New lighting technologies and controls can achieve savings of at least 40% (Harrison, 2010).
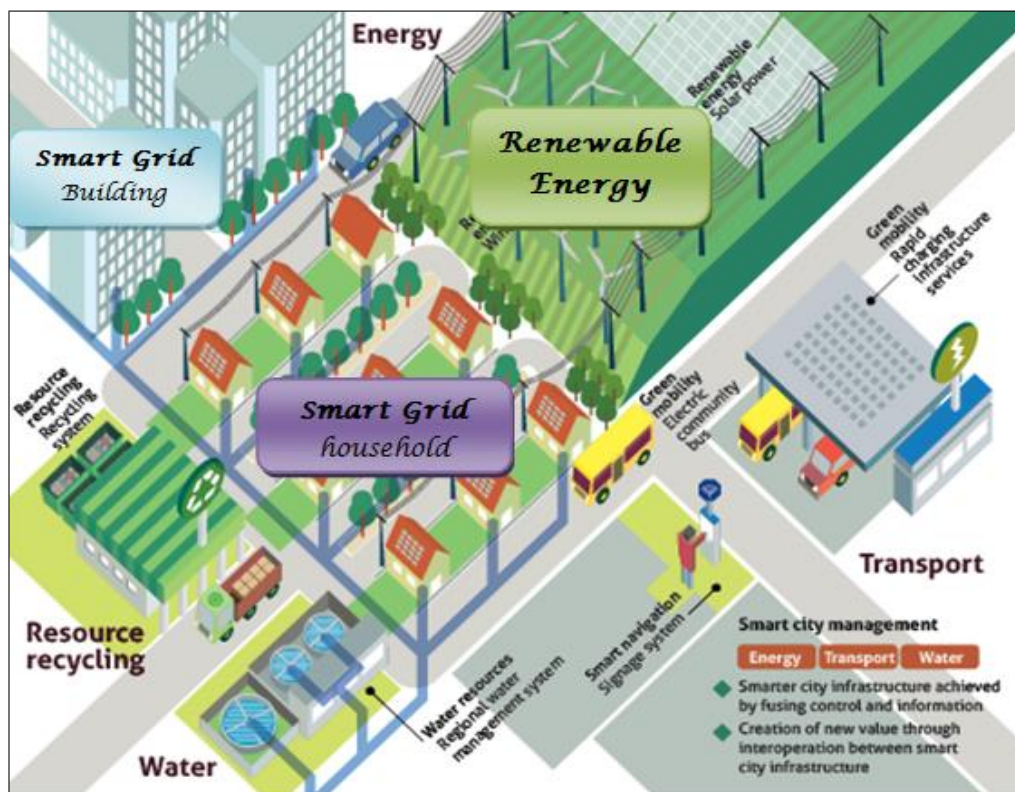

Figure 5. Smart Grids (http://www.greenpurchasingasia.com/content/smart-cities-tomorrow)

Smart Grids

A city cannot be Smart without Smart grids working efficiently. City networks require many technical solutions to deal with problems and threats. The city needs to be able to deal with renewable energy sources with green power generation from large amounts of renewable energy sources, such as wind, solar and hydropower. Smart grids are fully integrated systems. They will be Smart when all network components can communicate with each other to reduce greenhouse gas emissions and increase efficiency (Fig. 5).

Therefore, if cities continue to grow sustainably, an integrated program of Smart grid technologies must be organized, and ICTs such as SCADA (Supervision Control and Data Acquisition) are all essential.

The Smart grid system will advance the production and consumption of electricity in a cost-optimized and environmentally responsible manner. Another priority is to balance power (high, medium and low voltage currents) and the system in particular through its energy storage capacity.

Water and Waste Management

According to the United Nations, worldwide, at least 1.2 billion people live in areas of water scarcity. This problem is the greatest danger to eleventh-century resources. Cities must deal with the concept of low water value. Water management is one of the city's problems, as pressure is increasing on water resources in all cities around the world, and there is a growing need to reduce water use and improve water reuse. The use of technology in water management is the main factor in reducing the costs of producing drinking water and water in general.

When using the latest available technology, higher efficiency will reduce operational costs, and efficiency in the operation of the water system is essential in the city. In terms of energy use, water supply and treatment use 30%-35% of pumps are sold globally to the water industry. Any reduction in the cost of energy used affects not only the quality of service but also the cost of direct citizens.

Furthermore, using waste as renewable energy is critical to the long-term health of people. Electricity used in urban water distribution, and pumping systems account for about 20% of the electrical energy used in the city. Many of these systems can save energy by 30-50%.

Solutions are available for better water management pumping stations, such as automation for optimal pressure management.

Even water management and sewage treatment require extra attention from competent authorities. Moreover, the energy aspect directly affects service continuity and operating costs. Waste management in cities is another essential aspect that, if improperly addressed, directly affects the quality of life (IBM 2009).

Conclusion

Cities nowadays occupy more than half of the global population, as they are places of social cohesion and financial, intellectual and innovation centres. But cities create different challenges in terms of the environment, as they emit three-quarters of carbon dioxide and consume 70% of energy production, generating large amounts of waste. Demographically, there are large numbers of young people facing unemployment in developing countries. In developed countries, the population is getting older, and they have no capacity for transportation systems within the borders. Energy use and Pollution are on the rise, leading to higher prices for services and impacts on quality of life.

As cities become smarter, they have a chance to solve these different challenges. A smart city provides an environmentally friendly approach to dealing with climate change and makes resource management more efficient; It also increases the quality of life for its residents.

Although the term smart city is inconsistent in terminology and so far it has not been defined, in other words, there is no uniform definition of "smart city" while this term is used in a different context, depending on previous work along the seasons. We can now say that a developed urban area produces sustainable economic development and creates an ideal place for people to live by improving the quality of life, by promoting multiple players; Governance, economy, people, environment, mobility and the built environment. Strengthening these key areas can be achieved through human capital and ICT infrastructure.

This article developed a scientific approach to explain the concept of a Smart city, explained the benefits of applying this model of cities, and also proposed a new "set" of the dominant components of smart cities and which of these components is recommended and implemented in four ranked Smart cities. This proposal integrates the previous classification of Smart city components into two main themes (Soft components and Hard components).

Depending on the analysis of the literature review in the theoretical framework, this article recommends shifting all "non-smart" cities towards Smart cities. Although the transition to a Smart city is not easy and cannot happen overnight, the first step is the determination to achieve this goal, stakeholders will draw a roadmap in collaboration with governments, companies, articles, architects and designers.

This article may serve as a reference for designers, architects, urban planners, articles and policymakers in urban development.

References

Besselaar, P., & Koizumi, S. (2005). *Digital City III.* Information Technologies for Social Capital: Crosscultural Perspectives, Springer.

Giffinger, R., Fertner, C., Kramar, H., Kalasek, R., Pichler-Milanovi, N., & Meijers, E. (2007). *Smart Cities: Ranking of European Medium-Sized Cities, Centre of Regional Science (SRF.,* Vienna University of Technology, Vienna, Austria. Retrieved from http://www.smartcities.eu/download/smart_cities_final_report.pdf

Harrison, C., Eckman, B., Hamilton, R., Hartswick, P., Kalagnanam, J., Paraszczak, J., & Williams, P., (2010, August), *Foundation for Smarter Cities.* IBM Journal of Article and Development.

Lee, S., Han, J., Leem, Y., & Yigitcanlar, T. (2008). Towards ubiquitous city: concept, planning, and experiences in the Republic of Korea. In T. Yigitcanlar, K. Velibeyoglu, S. Baum (Eds.), *Knowledge-Based Urban Development Planning and Applications in the Information Era*. IGI Global, Hershey, PA, pp. 148–169.

Michel, S. L. (2005). the Digital City: The American Metropolis and Information Technology, University of California, Berkeley.

Komninos, N. & Sefertzi, E. (2009). Intelligent cities: R&D offshoring, Web 2.0 product development and

globalization of innovation systems, Paper presented at the *Second Knowledge Cities Summit*. Retrieved from http://www.urenio.org/wpcontent/uploads/2008/11/Intelligent-Cities-Shenzhen-2009 Komninos-Sefertzi.pdf

Yovanof, G. S., & Hazapis, G. N. (2009). An architectural framework and enabling wireless technologies for digital cities & intelligent urban environments. *Wireless Personal Communications, 49*(3), 445-463. Retrieved from http://www.greenpurchasingasia.com/content/smart-cities-tomorrow

IBM Smarter Cities Program (2009). *IBM Smarter Cities Program.* Retrieved from http://smarter-city.liquida.it/

Intelligent Cities, Sigma (2010). *Intelligent Cities, Sigma*. Retrieved from http://www.insigma.com.cn/

Telefónica's vision of a smart city (2013). *Telefónica's vision of a smart city.* Retrieved from https://m2m.telefonica.com/

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