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A REVIEW ON MEASURING THE SUCCESS OF SMART CITY INITIATIVES

Abstract: *It is estimeted that by 2025, in cities or urban areas, almost 75% of the world's population will live. Challenges associated with increasing the number of urban population, the development of Internet technology and the transformation of traditional cities has led to a new concept – Smart City concept. To understand the success of initiatives and projects of smart cities, a comprehensive set of factors is reviewd, along side with different methodological approaches for measuring Smart City initiatives. In the context of Smart Cities, it is also important to mention a set of norms that can help in measuring this kind of initiatives, but can also be a foundation for further investigation and new measurement methodologies.*

Keywords: *Smart city, management, ISO 37120, ISO 37106*

1. Introduction

The development of smart cities is a process driven by urbanization and the challenges associated with the management of the urban environment in which a number of people resides. Urbanization or the process of moving people from rural to urban environments has been driven by the decline in productivity of labor as well as greater employment opportunities in urban environments. (Uttara et al, 2012) The increase in the number of urban population results in an increase in the challenges associated with ecological problems which undermines the sustainability of the system. However, the size and speed of urban space development is not uniform in all economies, but it is important to emphasize the existence of a trend that indicates gradual growth of the urban population. Estimates indicate that by 2025, in cities or urban areas, almost 75% of the world's population will live. (Cui and Shi, 2012) Challenges associated with increasing the number of urban population, the development of Internet technology and the emphasis on the transformation of traditional cities into the smart city concept can, as a result, have the development of smart solutions used in areas such as traffic system management, general city process management, development of digital city infrastructure etc. (Paliaga and Ernes, 2018) Furthermore, the concept of smart city implies the implementation of sensors by which information is collected on the basis of which the city can be managed. Sensors are classified in several categories depending on their application and purpose. Some of the examples are the use of technical sensors to monitor air quality, presence and radiation levels, water presence etc. In addition, sensors can be used to identify the quality of life of urban residents by monitoring their health status, etc.. (Bačić et al, 2018) However, with some advantages of using modern technology, there are also challenges associated with the potential for misuse of data collected by sensors, as well as the challenges associated with disturbing the privacy of urban residents. The Smart City

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concept encompasses several dimensions of the urban environment. In the literature, different authors have different views on the dimension and scope of the smart city concept, but it is certainly recommended to study the smart city through sustainability - ecological, economic and social components. Within the sustainability component, other components are defined that determine the concept of smart cities such as transport, energy, education, construction, infrastructure, water, etc., and sustainability development, which is also correlated with the sustainability of urban structure as a system.

2. Smart city – conceptual definition

In literature, a large number of conceptual definitions of smart cities are encountered, depending on the aspect of the observation. Hall et al. (2000) observe the smart city as a city that integrates the monitoring of all factors and phenomena associated with infrastructure, including roads, railways within the city, bridges, overpasses, water supply systems, and all to provide an optimal service to residents. (Hall et al, 2000) Harrison et.al (2010) adds the need to connect infrastructure with sensors and technology that allows infrastructure management and they define smart city as the one that connects the infrastructure it wants to manage with sensors and with information technology based on it can be managed. So, the smart city is described as a city that is surrounded by technology, or that in its infrastructure has implemented technological solutions that change the aspect of which its inhabitants observe the processes within it. Aspects of urban processes are the way energy, traffic, people and other segments of the city are managed. (Harrison et al, 2010)

Nam and Pardo (2011) emphasize the importance of the existence and use of web 2.0 technology that enables the interaction between the system and its user. Accordingly, the same authors define the smart city as a city that combines information and communication technology with Web 2.0 technology to enable all processes in the city to be accelerated . (Nam and Pardo, 2011) However, the emergence of industry 4.0 certainly needs to include the technological achievements and discoveries of the industry mentioned in the conceptual definition of the smart city. The concept of a smart city within itself combines concepts of smart environment, smart living, smart management, smart economy, smart transport that determines smart society. (Kumar et al, 2017) In accordance with such a defined smart environment, ie the systems that surround it and which are integral to the smart city, it is necessary to access the development of the associated technology that will enable the processes associated with the mentioned components to proceed. One of the technologies applied to this is the IoT as well as the use of the associated sensors that collect all the data needed to make a decision.

3. Success factors of the Smart City initiatives

To understand the initiatives and projects of smart cities, a comprehensive set of factors is proposed, which are used to study and compare with the factors of the city within the concept or some of the project is developed. In addition to the before mentioned sustainability, certain internal and external factors are taken into account in shaping, implementing and using smart city initiatives. Factors that create a framework for describing smart cities and designing initiatives are grouped into eight groups. These eight groups of factors include: management and organization, technology, governance structure of the city, politics, people and community, economy, infrastructure and the natural environment. (Chourabi et al, 2012)

Top management and commitment to organizational changes play a particularly important role in the success of innovation. Within the group of management and organization factors, the role of managerial leaders is important. Apart from innovativeness, the main role is to develop an unique set of goals that people can devote. Leaders should develop their management skills of the entire organizational network. For a successful implementation of a smart city initiative, leadership is necessary. Through digital technology and infrastructure / applications, digital networks connect organizations, social groups and businesses located in the city area. (Nam and Pedro, 2011) Participatory governance and involvement of citizens (under different stakeholder roles) are key concepts in many areas of smart cities. The governance structure of the city must be oriented towards the realization of this concept, because governance is the core of the initiative of smart cities. It transparently maintains the decision-making process and enables citizens to be better involved in the implementation, monitoring and evaluation of the initiative. (Castelnovo et al, 2016Transformation from a plain city to a smart city also involves the interaction of technological components with political and institutional components. Political components represent different political elements (city council, city authorities and cities) and external pressures such as political programs and policies that can influence the outcomes of IT initiatives. Institution willingness, such as removing legal and regulatory barriers, is important for the smooth implementation of smart city initiatives. (Mauher and Smokvina, 2006) People and communities are one of the key components of smart city initiatives. Smart City represents a spatial area that brings together ICTs and people to improve innovation, learning, knowledge, and problem solving. Despite the emphasis on technology, the human factor is key to technology management and innovation development. The economy is the main driver of all initiatives, and it is considered that a city with a high degree of economic competitiveness has one of the qualities of a smart city. Also, one of the key indicators for measuring city competitiveness is the city's capacity as a driver of economic growth. The built environment encompasses various physical infrastructures that are built on the natural environment of the urban area. It includes city infrastructure such as roads, bridges, tunnels, buildings (residential, business and recreational), pipelines, electrical and communication lines, etc. Within the concept of a smart city it is important to emphasize the ecological and economic sustainability of built infrastructure, but also the challenges of city authorities in managing old and worsened infrastructure. Different aspects of the built environment contribute to the desirability of the city. The main functions of some of the built infrastructure are of vital importance for the protection of life and property of the inhabitants. (Garcia et al, 2015) Sustainability is one of the key strategic elements of a smart city. A regional sustainability is prerequisite for harmonized development of each state. (Savovic et al, 2016.)

In a world where resources are scarce and where cities increasingly base their development and wealth on tourism and natural resources, cities must guarantee the safe and renewable use of their natural heritage. A smart city should have an environmental monitoring system, for example, internal and external monitoring and measurement of air quality, and telemetry of noise and pollution. (Gabrys, 2007)

3.1. ISO 37120 Sustainable development of communities

In May 2014, the International Organization for Standardization published the first

international standard on city information, ISO 37120, which includes 100 indicators for city services and quality of life. The standard is developed within the Global City Indicators Facility, which has more than 250 cities around the world. (Zdraveski et al, 2017)

ISO 37120 certificate or Smart City certification, helps cities measure progress, with the ultimate goal of improving the quality of life in the city. The standards are developed by the leading experts of ISO Technical Committee on Sustainable Development (ISO / TC 286), using the knowledge and experience of 250 cities. The certificate sets a number of standardized indicators and thus ensures a unique approach of measurable indicators for all applicants. ISO 37120 defines and establishes methodologies for a set of indicators to manage and measure the success of city services and quality of life. It applies to any city, municipality or local government that is bound to measure its performance in a comparable and verifiable manner, regardless of size and location. ISO 37120 establishes a set of standard performance appraisal indicators that ensure a unified approach to what is measured and how this measurement is to be carried out. In addition, the International Telecommunication Union defines various key performance indicators for smart sustainable cities through the ISO / TR 37150 standard for fire and emergency response, health, education, security, transportation, energy (percentage of urban population with authorized electrical service), water (percentage of city population with drinking water supply), social equality, technology and innovation (such as the number of internet connections per 100,000 people), CO2 levels and reduction strategies, and buildings (such as energy consumption in residential buildings). Also, an indicator of ICT success in smart cities is suggested, using factors such as the environmental impact of the city, the ratio of renewable energy sources to total energy consumption and energy management frequency. (Khatoun and Zeadally, 2016) ISO 37120 is of great importance when it comes to indicators that determine whether smart city initiatives are good for supporting city services and quality of life or not. The importance of this norm in this context is that ISO 37120 provides the necessary indicators. If these indicators are in accordance with ISO standards, smart city technology has the potential to improve city services and quality of life. (Arman et al, 2015)

3.2. ISO 37106 Sustainable cities and communities

ISO 37106 provides guidance to leaders in smart cities and communities (from the public, private and voluntary sector) on developing an open, collaborative, citizen-oriented and digitally enabled operational model for their city that puts their vision for a sustainable future to work. This document does not describe a unique model for the future of cities. Instead, the emphasis is on processes that enable the innovative use of technology and data, together with organizational changes, and which can give each city a specific vision for a sustainable future in a more efficient, effective and more agile way. This document provides proven tools that cities can apply when operating a vision, strategy, and policy program that has developed after the adoption of ISO 37101, a management system for sustainable community development. They can also be used, in whole or in part, by cities that are not bound by the ISO 37101 management system.

4. Literature review on measuring Smart City iniciative

Numerous authors present solutions for the measurement of smart cities, which will enable cities to compare and define the best

practices of smart cities. Despite the complexity of this kind of measurement, the authors offered different methodologies. The authors Priano and Guerra (2014) awarded points for each surveyed city for each of the defined indicators (electronic administration, pollution, energy efficiency, renewable energy and broadband). They then estimated how each city solved identified problems (management, mobility, environment, and connectivity) by awarding a "0" to those problems for which no solution was offered and "1" for those being considered. As an initial approximation, they considered that all the initiatives were comprehensive, meaning they were applied to the city as a whole. Finally, they assumed that the citizens' assessment of a smart initiative was also included. (Priano and Guerra, 2014)

Authors Carli, Dotoli, Pellegrino and Ranieri (2013) measure smart cities by several categories. The first category refers to indicators that look at the physical infrastructure of a city (eg capillaries of public transport networks), urban property (eg green areas) and general context conditions (eg air quality). The second category includes indicators that are prone to measure the satisfaction and well-being of citizens. Examples of this category are: satisfaction with school quality, satisfaction with the transparency of bureaucracy, etc. Useful additions to objective indicators are subjective indications. Subjective indicators are important because they provide a more complete and articulated vision. The second dimension of the overall measurement includes indicators based on methodologies and calculation techniques. Most of these indicators come from traditional repositories such as list results, statistical registers, etc. (Carli et al, 2013)

Authors Kitchin, Lauriault and McArdle (2015) emphasize that there are different types of measuring indicators. Individual indicators consist of measurements or statistics pertaining to one occurrence. For example, the total number of unemployed or the unemployment rate in which the total number of unemployed is standardized in relation to total workforce. The most desirable individual indicators are direct measures that are well-defined and unambiguous. They can be considered as a quantitative measure and have strong representativity (measures that state that measures). Composite indicators combine several individual measurements using a weighing system or statistics to create a new derived measure. The deprivation index, for example, usually combines several indicators such as household income, work status, well-being and health status, and access to services to ensure a single overall rating. (Kitchin et al, 2015)

Hajduk (2016) considers the most practical way to measure city performance using the ISO 37120 standard. ISO 37120 is a set of standardized indicators that provide a unique approach to what is being measured and how measurement is carried out. Generally, ISO 37120 defines indicators divided into 17 topics. These indicators can be used to monitor the progress of sustainable city development. In order to plan the city's future needs, the current resource efficiency must be taken into account. Indicators have been developed to help cities learn each other by allowing comparisons across a wide range of performance measures and sharing best practices. (Hajduk, 2016)

5. Conclusion

In order for a city to prosper, all key city systems must work together using all their means to overcome the challenges facing the city. City's "smartness" describes its ability to unite all of its resources and to work effectively with the greatest possible efficiency to meet the set goals. A smart city can have one or more smart components, including smart transport, smart grid, smart health care, and smart management. Smart cities with minimal implementation and operation costs are key to long-term

sustainability. The need for smart cities grows day by day with increasing population numbers and limiting land resources. (Mohanty, 2016) City's attractiveness is directly linked to its ability to offer basic services that support growth opportunities, create economic value, and create competitive differentiation. The proliferation of new forms of data - either collected from sensors embedded in the built environment or collected from social media - has offered new opportunities for understanding urban processes that will, according to the concept of smart cities, differentiate between places and make them more competitive. In short, these new sources of data and new ways of analysis, visualization and understanding of data reconfigured the social and spatial processes of urban management and economic development. In the era of economies of knowledge, urban areas should not just redistribute their local wealth, but also invest in the quality of life of their citizens. In this context, Smart City is a broad term that encompasses many different socio-ecological aspects and ICT applications. Despite the recent growing interest in this issue, public administration still needs support to structure the concept of city intelligence, include its implications, identify benchmarks at the international level, and find opportunities for improvement, and as one of the possible ways of measuring that improvement is the use of ISO 37120 or others the standard offered by ISO as a roof organization.

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