SMART CITIES AND SMART, SUSTAINABLE AND INCLUSIVE REGIONAL DEVELOPMENT

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Abstract

This scientific article is an empirical observation of the smart city concept and how it can be developed sustainably and inclusive on long-term. The paper also highlights some of the most significant trends in the development of smart cities and cultural-creative local communities. The main results of the research showed that a viable model of smart and sustainable development of a city can be considered Vienna, a city whose development is based on a quadruple-helix collaboration, holistic strategy, top-down approach and a multi-dimensional vision. The paper also showed that new information and communication technologies will continue to innovate smart development strategies, and the biggest international corporations will become step by step leading trendsetter of future cities, transforming utopia into reality.

Keywords: Smart Cities, ICT, Local Communities, Best Practice

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1. Introduction

Nowadays, the whole world is in a process of transition from the "classic" cities to the "smart" cities. This process is supported and driven by the continuous development of information and communication technologies (ICTs), which creates a new model of municipal cooperation between administration, corporations, academia and citizens.

Although many theoretical and practical research has been carried out in the last decade regarding the development of smart cities, this topic is still

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insufficiently debated and analyzed, with a large gap between utopia and reality.

Thus, the objectives of this scientific paper is to empirically observe the concept of "smart cities", to determine how it can be created and future trends in terms of long term smart, sustainable and inclusive regional development.

In order to achieve these objectives, in Section 2 we will present a synthesis of the international scientific literature that analyzes the development of smart cities, in Section 3 we will highlight a number of best practices regarding the strategies for creating a smart city, in Section 4 we will try to determine the new trends globally, and in Section 5 we will show the main conclusions drawn from this research.

2. Literature review

Anthopoulos (2017) defines smart cities as new or existing cities or regions that use ICT and innovation as fundamental factors on which a number of six-dimensional challenges can be managed: people, environment, governance, economy, life and mobility.

The development of smart cities globally is constantly increasing. According to Singh (2010), the number of cities that have implemented smart development strategies and initiatives based on the opportunities offered by ICT was only 41 in 2010, and as Lee and Hancock (2012) show, their number has increased to 143.

The increasing trend in the number of smart cities is also highlighted by Manville et al. (2014), showing that only in the Member States of the European Union there are about 500 such cities.

Janssen et al. (2016) highlights the two main characteristic elements of smart cities, namely: smart infrastructure and smart services. Between the two elements there is a direct connection, meaning that smart infrastructure (made up of hardware equipment, members of the local community, organizations, data and software applications), developed based on new ICTs, generates smart services that improve the standard of living and the quality of life of the citizens.

Given the mutual influence between smart cities and local communities, we can consider that smart citizens represents a third main characteristic element of smart cities.

Thus, for a smart city to develop sustainably and to create a high living standard of its inhabitants, it is necessary for them to use the most of

smart services and to be actively involved in developing new ones, depending on current or future needs.

There are some studies, such as Hsiaoping's (2017), which shows that citizens are willing to use smart services, developed based on ICT, if they are high quality and are made through truly innovative concepts in order to ensure them at the same time confidentiality. The more they use smart services, the higher is their quality of life.

In the scientific literature there is still no consensus regarding how the concept of "smart cities" it is understood. This is noted by Komninos and Moura (2018), who analyzed a number of scientific studies on this topic and reached the general conclusion that the development of smart cities is approached through several distinct visions, which gives rise to contradictions regarding the better strategy for the development of these cities.

These contradictions are: (1) ICT based strategy or holistic strategy; (2) double-helix collaboration model or quadruple-helix collaboration model; (3) top-down or bottom-up approach; (4) mono-dimensional or multi-dimensional vision.

Regarding the first contradiction, the divergence of views stems from the fact that certain researchers or companies in the ICT field consider that the implementation of the solutions offered by information and communication technologies in urban infrastructure is the only element that must be emphasized for the development of smart cities.

On the other hand, there are researchers like Komninos (2014), Yigitcanlar and Lee (2014) or Grossi and Pianezzi (2017) who contradict this assumption and argue that the sustainable development of smart cities is not only based on the agglomeration of ICT solutions in urban infrastructure, but it is a complex socio-technical system that combines technological development with social, economic, cultural and environmental factors. Thus, these researchers consider that the development of urban infrastructure based on ICT solutions is only a sole part of the smart development process of a city, but long-term sustainable development requires, in addition:

- developing the capacity of citizens to use the new ICTs;
- optimizing the strategies according to historical and cultural evolutions and local specificities;
- developing a knowledge-based, collaborative and sharing economy;
- optimizing the natural resources.

The second contradiction arises, on the one hand, between ICT companies, which suggest that smart city development strategies focus on a collaborative model in which only two parties are involved (technology providers and local authorities), and on the other hand, renowned researchers such as Kourtit et al. (2014) or Selada (2017), which highlights the importance of intellectual capital and civil society as the third and fourth component of the collaborative model.

Further, the top-down approach regarding smart cities development implies that smart development strategies and initiatives start from the administrative level and are based on a long-term vision, while the bottom-up approach places civil society in the leading position and emphasizes the active involvement of citizens in the development of ICT solutions designed to meet urban needs.

The fourth contradiction concerns the aggregate vision of smart cities.

On the one hand, it is sustained a mono-dimensional vision, which presents smart cities as spaces that invest in ICT in order to meet goals such as: smart transport, smart buildings, pollution reduction, resource efficiency.

This goals are centered on a energy-driven interpretation, referring to the use of ICT to create cities with low CO_2 emissions and efficient in terms of resource utilization. This type of vision is supported especially by the European Commission.

On the other hand, it is supported a multi-dimensional vision, in which smart city development strategies are focused on several areas: economy, government, living standard, people, environment, health and mobility.

The multi-dimensional vision is sustained by authors, such as Manville et al. (2014) and corporate firms, like Cisco Systems.

Development strategies for smart cities are found throughout the world, and they are designed and implemented according to local needs and specificities of each region.

In this regard, there are many scientific studies who is investigating the process of implementing these strategies in cities belonging to different regions and cultures.

For example, Grimaldi and Fernandez (2017), Taylor Buck and White (2017) or Grossi and Pianezzi (2017) analyze how these strategies are applied in cities across Europe, while other authors such as Schreiner (2016), Alvin Yau et al. (2016) or Fietkiewicz and Stock (2015) relates to cities in America and Asia.

Given these issues, we will further present a series of best practices regarding some of the most representative strategies for developing smart cities and culturally-creative local communities. In this way we can see which visions to develop smart cities is mostly used in practice.

3. Best practice

According to the study entitled "Smart City Strategy Index (SCSI) 2019", conducted by Roland Berger, which measures the complexity and initiatives of urban centers in terms of smart development, Vienna ranks first in the standing of the 153 states globally that have a official strategy for long-term smart and sustainable development.

This achievement is due to the rigorous way in which the strategies of smart development are applied, the digital agenda, as well as the complex system of monitoring the implemented projects.

Vienna ranks first among the cities that make considerable progress in implementing advanced strategies and smart development projects in most areas, the number of new and completed projects, as well as in terms of determining the results.

On the other hand, Mercer Quality of Living Survey, which evaluates 231 cities internationally based on 39 factors, including political, economic, environmental, health, transportation, education, public services, infrastructure, etc., ranks Vienna in 2019, for the tenth year in a row, in the first place in the standing of cities with the highest standard of living.

Considering these aspects, we believe that the city of Vienna is one of the best practice that we can analyze from the point of view of smart development strategies, in order to determine which of the visions presented in Section 2 lead to effective fulfillment of the smart development objectives of a region.

Further, we will present a series of such smart solutions according to the Smart City Wien website.

Vienna has implemented and constantly creates new smart development solutions so as to face imminent urban challenges such as: increasing the number of inhabitants, the level of traffic and mobility conditions, the level of pollution, the climatic conditions, the use of resources.

The capital of Austria is part of the Smarter Together project, next to the cities of Munich and Lyon. Through this project, co-financed by the European Union, is seeking innovative solutions to protect citizens against severe weather conditions and to improve the quality of urban life at the

aggregate level by creating and implementing clean energy systems, effective data management, e-mobility, buildings redevelopment etc.

The Smarter Together project is carried out through over 30 partners from various fields (administration, industry, research). At the same time, through this project, it is supported and encouraged the involvement of citizens in the development of new innovative initiatives.

Regarding the smart initiatives for improving the quality of the environment and mobility, the Austrian capital administration, in partnership with the MAN company, initiated a project to build the first 100% electric vehicle for municipal waste collection. Once it is used, it will reduce the level of CO_2 emissions and also the noise level during operation.

Besides the benefits for the community, through this project Vienna manages to fulfill the European Directive regarding the use of eco-friendly vehicles for public services.

On the other hand, given the global warming and the increasing temperatures especially during the summer, the city of Vienna has initiated an smartt solution to adapt the city to the climatic changes. This solution consists in planting 24 trees / km, water supply points for humans and animals, as well as installing cooling arches in those sections of the road where there is a higher temperature.

Also related to the climatic conditions, the local administration in partnership with an interdisciplinary team of researchers and other economic agents participated in a research project through which they created a module of ecological facades (BeRTA), cost effective and easy to use, which prevents the accumulation of urban heat and improves the microclimate.

This project is being tested in a region of the city, following which these modules will be available throughout the city. In order to extend this project and to receive support from the citizens, a fund was created through which the costs of the acquisition of these modules can be covered.

In the medical field, new ICTs are used for the development and implementation of innovative medical solutions in accordance with the e-health strategy, including: electronic health register, decision support systems, telemedicine, home monitoring equipment for patients, control and transparency of the medical services provision.

For example, one of the smart initiatives implemented to provide important help to people with health problems is "Fearless", a sensor that not only detects a fall, but also helps prevent them. Basically, this sensor is a much more operative solution to the classic alarm buttons or devices that have

to be worn on the body in order to request help in case of medical emergencies. "Fearless" was developed in an interdisciplinary consortium of researchers from Germany, Austria, Italy and Spain and has been tested by experts from the academic, medical and nursing fields.

Another project undertaken by the Viennese authorities in the smart city field is the use of drones for the maintenance of photovoltaic systems, wind power plants, heating pipes and so on. In this way, the interruption periods of the systems are short, and the functionality and efficiency of the technical installations increases. This project is implemented in a public-private partnership, between Wien Energie and two local start-ups.

Wien Energie is also involved in the city's strategy related to the efficient use of energy resources and the reduction of final energy consumption per capita. In this regard, the company is researching how it can use blockchain technology for decentralized and efficient handling of transactions in the energy industry.

The efficient use of resources plays a very important role in the sustainable development process of the city, which is why many smart projects are being carried out for this purpose. For example, converting excess electricity to heat, using the energy generated by the subway brakes to power the lifts, escalators or lighting, installing smart traffic lights with time and environmental quality sensors that provides important data for different applications.

In addition to all these projects, the city administration of Vienna offers citizens other digital services, such as the "Sag's Wien" application, through which people can apply for a parking permit online or reserve a place for a child in a kindergarten.

Vienna focus in particular on public involvement in order to meet the goal of an smart, sustainable and inclusive long term city development, and in this respect one of the measures to stimulate citizen participation in this process is to provide free access to wireless Internet in schools and public spaces. Another measure is the use of integrated technologies in order to enable and facilitate communication and to help people to carry out certain social activities, individually or within organized groups.

Another way to integrate citizens into the smart city development process is the TREEDAY application, which uses new IT solutions in order to promote a sustainable economy and a sustainable consumption. Thus, in exchange for reducing carbon dioxide emissions, users of this application are rewarded with discount coupons that can be used to purchase a wide range of

goods and services. On the other hand, through this project it is encouraged a rational use of resources.

All these are only part of the projects implemented by this city in order to develop smart in the long term. In practice there are many other such innovative projects, carried out through the collaboration between state institutions, public organizations, private companies, partially state owned companies, academia and citizens. These projects include:

- applications for simplifying the use of public spaces and services;
- the food bank that saves tons of food wich is subsequently donated to people affected by poverty;
- programs to encourage ongoing cooperation between undertakings;
- energy efficiency projects;
- information activities on new technologies and the results of research projects, as well as activities for attracting young people in research and development;
- carrying out initiatives through ICT companies meant to generate measures to combat the lack of highly qualified specialists and to support the development of digital skills;
- complete and efficient administrative services through digital governance.

As we could see from these examples, Vienna has implemented many projects and advanced strategies of comprehensive development in the long term, and in order to remain competitive, the city expands its technological infrastructure, including by implementing the new 5G standard.

Following this masterplan, we can determine that the model of smart development of the city of Vienna, first in the SCSI 2019 ranking, has the following characteristics: quadruple-helix collaboration, holistic strategy, top-down approach and multi-dimensional vision.

The capital of Austria demonstrates that for a truly smart, sustainable and inclusive development in the long-term, it is necessary a collaboration of all the agents that form this aggregate system: administration, academia, companies, citizens.

In terms of development strategies, they are based on innovative solutions offered by information and communication technologies, but in order to be able to respond to all challenges, ICT solutions are correlated with social, economic, cultural and environmental factors.

On the other hand, the strategies presented indicate in particular a top-down approach, starting from the administrative level, based on a long-term vision, but a certain bottom-up approach is highlighted, in which the citizens are placed in the leader position.

The last contradiction identified in the scientific literature is the mono-dimensional vision vs. multi-dimensional vision.

The results presented by us shows that in the city of Vienna a multi-dimensional vision is valid, characterized by development strategies focused on a variety of areas: economy, government, living standard, people, environment and mobility.

4. New trends regarding the development of smart cities and local communities

The smart cities of the future will be developed based on comprehensive and well-defined urban strategies and agendas, which will integrate concepts such as: urban modeling, digital twins, circularity, electric micro-mobility and smart urban spaces.

The future of smart cities is based on an aggregate of the latest technologies, which will be implemented step by step in all aspects of urban life. These technological innovations include: artificial intelligence, 5G standard and advanced data analysis.

The advantages offered by the new 5G standard, including high network speed and viable connections, will enable smart cities to reach a new level of innovative development by creating new technologies and mobile applications that improve almost every aspect of daily life.

High network speed and viable connections offered by 5G and WiFi6, coupled with the fact that more devices can be connected simultaneously than is currently possible without affecting capabilities, will create new possibilities for innovation in areas such as transport management, medicine, housing, learning, efficient use of resources and so on.

On the other hand, it is expected that the uses of technology blockchain be extended to a much larger scale and have uses in financial transactions, real estate, data storage, asset management, nutrition.

In terms of mobility, the classic cars will be replaced by autonomous vehicles. Major players in the IT industry, such as Intel and Qualcomm, are already collaborating with companies in the automotive industry (Ford, Volvo, BMW) to build autonomous car fleets.

Also related to mobility it is expected the increasing use of classic or electric bicycles, scooters and motorcycles and the extension and diversification of sharing services. These measures not only improve the quality of urban transport, but produces a significant reduction in pollution levels - two of the biggest problems of today's cities.

Another trend in smart cities is the increasing use of real-time data processing. Thus, organizations will have to invest more and more in modern and innovative data analysis tools (automatic learning systems and artificial intelligence), because the success of their activity will depend on how quickly and qualitatively they are able to identify market problems and respond to new challenges.

At the same time, special attention must be paid to the growing role that the world's biggest corporations will play in the process of developing smart cities.

One of the best examples is Toyota, which plans to build its own smart city in Japan in order to test the latest technologies in the field of artificial intelligence, robotics, building construction or autonomous vehicles. The city, which will be called Woven City, will be built at the foot of Mount Fuji and will basically represent a living lab where a multitude of interconnections will be established between people, buildings, vehicles and other entities.

The houses will be equipped with artificial intelligence assistants, which will ensure permanent and complete monitoring, including human health, and the automation of all components of the home.

To ensure a healthy climate, the buildings will be built of wood and the entire ecosystem will be powered by hydrogen sources.

In terms of infrastructure, the city will have three types of streets (for pedestrians, for autonomous cars and for slow vehicles), underground paths for goods deliveries, mobile shops, parks and recreational spaces.

Toyota's project is very complex and the expectations are very high in terms of creating a viable and practical model for smart, sustainable and long-term development of the cities of the future.

Although in terms of technological innovation this project represents a transformation of utopia into reality, it remains to be seen if it will be able to solve perhaps the most important challenge of a smart city, namely the inclusive integration of people in this process.

Thus, in order to be sustainable in the long-term, we consider that such a city must find efficient and viable solutions to community problems such as: social inequality, data confidentiality, transparency.

Toyota project is not unique, other companies such as Alphabet, Disney and Facebook have thought similar projects in order to develop their own high-tech communities, and they certainly will not be the last. The world's largest corporations will continue to test such masterplans and implement them on a larger scale, thus building the smart cities of the future.

5. Conclusions

The results of the empirical observation undertaken in this article shows that the development of smart cities is one of the main objectives of the authorities in the countries of the world, and their number is on an upward trend.

Based on the analysis of the scientific literature we have noticed that there are a number of contradictions / visions regarding the optimal strategie for the development of smart cities. Related to this conclusion, our research showed that the smartest city (according to SCSI 2019), Vienna, combines these strategies in order to develop his own masterplan.

Another very important conclusion that emerges from this research is that the new information and communication technologies will continue to innovate how smart cities will develop in the future, and the biggest international corporations will be the main trendsetter in designing their general architecture.

On the other hand, this research opens the way for future research in which we will try to determine which of the strategies identified is applied to the cities of the European Union Member States and at the same time to understand if certain strategies should be changed or completed in order to obtain a more innovative and sustainable development.

Also, in a future research, we will try to determine what are the main implications of the development by big corporations of "their own" smart cities, and if such initiatives can be sustainable on a larger scale.

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