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DRIVERS AND BARRIERS FOR SMART CITIES DEVELOPMENT

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Abstract
Recently, cities have become the key element in the national administration system shaping the planet's future appearance. The concept of smart cities is gaining popularity, so today every city strives to become smart. In this article, authors give a detailed analysis of the world experience of the smart cities creation. The principles, participants of urban planning and mechanisms for implementing public-private partnership were considered during this study.
As a result, authors point out factors, both facilitating and impeding the development of smart cities. The key drivers of this process include mature infrastructure, wide use of ICT, the involvement of citizens in the city development and the expansion of public-private partnership. The conflict of interests between municipal authorities, citizens and business and the problem of information security hamper the smart city development.
Keywords: smart city, smart city development factors, public-private partnership, infrastructure, city development strategy

1. INTRODUCTION

Over the past decades, cities have become an essential element in the national administration system shaping the future appearance of our planet. A landmark year in the world urbanization was 2008 when it was recorded for the first time in history that more than half of the world's total population live in cities. Moreover, the urbanized population in 2050 is expected to reach 70% (UNFPA, 2007). Development of megapolises inevitably translates into a surge in consumption of resources which negatively affect the environment.

Urban planning has a primary impact on the economic and social life. In addition, it determines the state and prospects for environmental development. The concept of "smart city" is an anthropological approach addressing the problem of sustainable urban development. It involves the implementation of information and communication technologies (ICT) in the management of urban assets for the effective use of resources and improving the quality of services and the standards of living provided to citizens (Albinov et al., 2015).

2. CURRENT STATE OF INTERNATIONAL RESEARCH

Scientists are actively studying the theoretical and practical aspects related to the functioning and development of smart cities. The concept has both proponents and opponents. The former approve that the smart cities entail positive social changes through the introduction of ICT, improving management and developing human capital. The latter emphasise negative consequences of innovations due to blind spots in the planning and introduction of innovations.

The evolution of the smart city concept from its origins to the most modern views is introduced in Eremia et al (2017). The authors believe that this concept rooted from the emergence of the term "urbanism" in 1898. The pioneers of smart city concept were all scientists who worked in the area of urbanistics. The term "sustainable city" appeared in the 1950-s, the concept of "digital city" became popular in the late 1990-s, but the term "smart city" has been widely used since 2009. Furthermore, you can come across the concept of "eco-city", but researchers believe that it is appropriate to use it only within the framework of the sustainable city concept. The concept of the smart city is based on the principles of continuous competition and development aimed at ensuring a higher quality of life.

The first reasoning about the concept of smart city began both in the scientific community and among practitioners in the 1980-s.They discussed that any place could become a new Silicon Valley if it strived to create a global networked city with widespread, highly integrated economic centers connected by massive networks of airports, highways and other types of communications, or to the build a so-called "intellectual city" with advanced ICT (Harris, 1992).

The creation of smart city is often a strategy to alleviate the problems caused by the growth of urban population and accelerated urbanization (Chourabi et al, 2012). The main factors which form the integrative structure of smart city are: city management, technology, municipal government administration, political program, communications, economics, infrastructure and environment.

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In this context not only leading companies in the information technologies, such as IBM, Intel, Siemens, Cisco and SAP, but also scientific and philanthropic organizations are placed in smart cities (Glasmeier and Christopherson, 2015).

The role of information technologies in smart cities is described in Harrison and Donnelly (2011). The authors explain the hypothesis that the increasing availability of information will encourage creation of the urban systems models (for citizens, entrepreneurs, public organizations and the government) which describe how cities operate, how residents "use" and treat the city, what problems they face and what solutions can be suggested and applied.

The use of ICT in smart cities can bring a number of benefits, such as: reduction of resources consumption (especially energy and water); the decline of carbon dioxide emissions and improvement of existing infrastructure usage (Harrison and Donnelly, 2011). By the end of the 21st century the overwhelming majority of people will live in cities, and the development of urban potential and active construction will be stopped. However, in the coming decades, information technologies will determine the trends in the development of smart cities.

Regarding social aspects of smart cities development, attention should be paid to existing legal standards, planning requirements and implemented social practices (Carvalho and Campos, 2013; Carvalho, 2014; Yigitcanlar and Lee, 2014). Some researchers suggest using the concept of the socio-technological origin of innovation for a better understanding of the smart city transition process and the expansion of the scope of new IT solutions (Elzen et al, 2004; Kemp et al, 1998; Schot and Geels, 2008).

The most common classification divides all concepts of smart city into two groups stating that:

- active development of ICT is sufficient to reach all necessary aims of a smart city.
- the use of ICT in isolation from other factors of smart city development will not entail the desired results (Angelidou, 2015; Komninos et al, 2013; Wolfram, 2012; Cocchia, 2014; Kummithaa and Crutzen, 2017).

The overwhelming majority of researchers consider the development of city as an ongoing process without any time limitation. However, some authors believe that this process is finite, and in the last decades of the 21st century the development of urban potential and active construction will cease (Harrison and Donnelly, 2011).

The aim of this article is to provide deep and thorough analysis of key determinants of smart cities development (both favoring and impeding) revealed in the regarded cases: Europe (Barcelona), the

USA (Charlotte), Asia (Shanghai and Tokyo). The formal hypothesis of the article consists of differences of these determinants in each case which, in their turn, depend on geographical, historical and socio-economic background. Investigation of this question is particularly interesting because comparison of European, American, Asian smart cities permits to reveal and understand the differences in corresponding approaches in determining the concept of smart cities.

3. RESEARCH METHOD

The authors used case study method to explore the potential of the smart cities development in Europe (Barcelona), the USA (Charlotte), Asia (Shanghai and Tokyo). It can facilitate the understanding of key drivers and barriers to the smart city development.

The choice of Barcelona as a case is explained by the fact that the city has made significant progress in modernizing the urban environment and has been repeatedly awarded the title of one of the best smart cities of the planet (McGrath, 2017).

Charlotte was chosen for analysis since it is a large industrial, transportation and cultural center of North Carolina in the US and it actively develops the concept of a smart city nowadays.

Shanghai is one of the largest cities not only in China but in the whole world. It combines the functions of the most important industrial, financial, commercial, scientific and cultural center of the country, as well as the world's largest seaport. Moreover, it is the first smart city in China (Cocchia, 2014).

Tokyo was considered because it is one of the first smart cities in the world, successfully holding this status for several decades.

During the research, the following key components of smart cities were studied:

- Principles of urban planning.
- Participants of city planning.
- Mechanisms for implementing public-private partnerships.

As a result of the study, authors identified factors that facilitate and hamper the development of smart cities.

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4. RESULTS

4.1. Principles of urban planning

The heart of any city development are the principles of urban planning. The urban planning process includes activities aimed at the development of infrastructure, regulation of construction and land use, and environmental protection. In smart cities, the principles of urban planning are of paramount importance, so they were considered first.

4.1.1. Barcelona

Currently, the capital of Catalonia is well known as a leader in innovative planning. On the international arena, Barcelona was recognised for its accessible open spaces and convenience for pedestrians. The fundamental principle of modern urban planning policy in Barcelona is to create a more efficient city while respecting the interests of local residents (Antsiperova, 2014).

In 2013, the City Council of Barcelona realised the importance of developing a clear strategy for the smart city and demonstrated its readiness to become the first high-tech city in Spain. The purpose of such strategy was to use new technologies for the promotion of economic growth and the well-being of citizens. It was reflected in the principles of creating smart Barcelona:

- Presence of own city model ("mantra of the city": the city of productive areas, keeping pace with the development of society, eco-friendly, energetically self-sufficient).
- Rethinked urban systems (not just upgraded ones).
- Established interaction of the city services with partners.
- Encouragement of long-term investments for sustainable development.
- Improvement of the quality of urban environment through increasing public spaces.
- Changed city organization through IoE and IoT.
- Cooperation with other cities (Barcelona Smart City, 2014).

The strategy included three directions: international positioning, international cooperation and smart local programs. As of 2016, 24 programs and more than 240 projects were created (Gascó, 2016).

The leading principles of urban planning in Barcelona include:

- Focusing on creating public facilities in remote neighborhoods.

- Pivot the city to the Mediterranean by creating access to beaches suitable for use.
- Ensuring a decent level of service in each district.
- Restraining the growth of the city by focusing on redevelopment rather than on the construction of new objects.
- Use of land plots for secondary development.
- Restoration of famous courtyards (open space within each quarter) (Nelson, 2017).

Thus, Barcelona's city development strategy is aimed at ensuring the standard of living, social and urban development through implementing new technologies, establishing reliable communication between centre and remoting districts, improving the ecological situation. In addition, this strategy takes into account not only the administration vision of the process of city's development but also attracts personal opinions of the residents of Barcelona. However, this strategy interlinks with high risks of budget deficit for this program, the surge in the cost of buildings in local neighborhoods and information asymmetry, which can impede sustainable development of Barcelona in the future.

4.1.2. Charlotte

The current principles of urban planning, which guide Charlotte's development, can be formed into groups on the subject of their regulation (Charlotte Region Transit Station Area Joint Development, 2003). The first step is to single out the desire to develop and encourage the expansion of urban public areas, such as parks and recreation areas, state educational organizations, transport communications. This strategy is most effectively implemented in the suburbs, where additional public transport stops are created and quarters around them are landscaped.

Secondly, the city realizes active social policy. One of the priorities is to support people with different levels of income, different ages and opportunities. This principle is actively implemented in the construction of social housing, including housing for low-income families, housing, suitable for cohabitation of several families with external assistance. The building program takes into account the needs of the residents. For example, elderly people and people, requiring special care, have the opportunity to help each other and communicate. Thus, the problem of socialization is solved and quality of life of certain citizens groups is raised.

Another important principle is the co-operation of private capital and the efforts of the administration. Among other things, the city is ready for the expansion of comfortable shopping areas and squares,

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which on the one hand creates additional jobs and leisure opportunities for residents, and on the other, brings profit to the business.

At the same time, it is noted that one of the prerequisites for creating new zones and complexes is to integrate them into the general context of the surrounding landscape in such a way that the city's appearance is harmonious, and the residents feel comfortable and all the city districts were connected (Charlotte City Council, 2010). This policy contributes to the fact that residents are involved in urban planning and feel their role in the fate of the city.

Urban planning also takes into account the negative consequences for the surrounding nature and tries to minimize them. Local authorities not only renew the forest fund destroyed as a result of modern construction, but also strive to increase it by creating new green spaces.

Thus, Charlotte principles of city planning affect both directions of city improvement, such as the creation of new infrastructure facilities, the development of transport system, the construction of socially-oriented housing, and conditions for the implementation of these projects, such as attracting private capital, recovery the historical appearance and care for the environment. The key drivers of Charlotte's development are implementing sound social policies and seeking for a balance between destruction and construction particularly concerning urban public areas (parks and other nature recreation areas). It's vital to note that government and public cooperation also plays an important role in city's development.

4.1.3. Shanghai

The implementation of urban planning in China is carried out in accordance with the Law on Urban Planning of China (Musa, 2016). This Law is formulated to determine the size of the city, the directions of its development, the realization of the economic goals and social development, and the implementation of rational construction in accordance with the needs of socialist modernization.

The Law also takes into account the provisions related to the plan for the development of Shanghai, the creation of new areas and improving already existing ones, the implementation of city planning. According to the Law, the following principles of urban planning in China are applied:

- The city plan is announced by the People's Government after its approval.
- The use of land and all development projects in the planned urban area should be corresponded with the city's plan.

- Constructions can be carried out only after obtaining a permit for the planned use of land for construction.

In Shanghai, the implementation of urban planning management is currently carried out on the basis of the Urban Planning of Shanghai for the period 1999-2020, approved by the State Council of China on May 11, 2001 (Kitchin, 2015). The key provisions of the Comprehensive Development Plan of Shanghai are: openness to the world, the establishment of interaction between the center and the outskirts, socio-economic development, concern for the environment and preservation of the historical heritage (Komninos et al, 2013).

Thus, based on the analysed principles of urban planning in Shanghai, we can conclude that it is carried out from top to bottom. This system is associated with both shortcomings and benefits. On the one hand, it is known that at the planning stage the government follows political interests, and the involvement of the public in this process is minimized (Angelidou, 2015). In a market economy, the planning system is too sluggish (p. 284), it also does not take into account the regional ties (ibid), does not give details at the micro level (ibid, pp. 285). On the other hand, the Master Plan is a convenient tool for regulating the actions of municipalities “towards a more balanced development”.

4.1.4. Tokyo

Tokyo is one of the largest cities in the world. Greater Tokyo (the city itself and its metropolitan area) form the "megaregion" in terms of GDP. Furthermore it is one of the largest cities in terms of population (Florida, 2008). According to statistics portal Statista, by 2020 in Greater Tokyo will be about 38.3 million people (Statista, 2017). In 2016, the population of Greater Tokyo was 38.1 million people (United Nations, 2016).

A few dozen years ago, the air in Tokyo was so polluted that oxygen wending machines were placed on the streets (Sinyugin, Sluka, 2004). This situation is explained by the fact that Japan produced ready-made materials from imported raw materials. At the same time, the policy of using personal cars for own mobility began to entail transportation problem (Plisetskiy, 2014). Due to the fact that the Japanese islands are in a seismically active zone, the country was often struck by natural disasters. The set of the formed problems has caused a search for their complex decision.

Remarkably, the driver of the urban environment improvement was the earthquake that occurred in 2011. It caused an explosion at the Fukushima nuclear power plant. In order to prevent the spread of radioactive contamination throughout Japan, the work was quickly begun on isolating the emergency

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block. At the moment, the emergency site is controlled by intelligent systems that react to changes in the radioactive background and warn of possible problems (Pham, 2015).

The key principles of urban planning in Tokyo are based on security; energy efficiency (reasonable use of electricity, its economy); cleansing the city of pollution.

In 2016, the "Action & Legacy Plan" was adopted, establishing the priorities for the development of Tokyo until 2020. According to the plan, the city should become increasingly diversified, smart and safe. This document was adopted, in particular, with the aim of creating the most comfortable urban environment in the run-up to the Olympic Games in 2020, which will be held in Tokyo.

By 2020, the city authorities are planning to achieve a 95% or more earthquakes sustainability of buildings. To increase this figure, it is necessary to carry out the work to strengthen the foundation, the construction of new buildings with the addition of more damage-resistant materials. Also, for the safety of the citizens, each house is supplied with special beacons and alarms, which are designed to notify residents about an earthquake.

The city uses intelligent systems of training specialists to prevent the consequences of natural disasters. There are models and simulators at the disposal of specialists, robotic mechanisms that help rationally use resources to combat natural calamities and their consequences.

Thus, the key drivers of Tokyo's development are geographic peculiarities of the region which accelerate elaboration and implementing new technologies and breakthrough engineering solutions. Nevertheless, then again these geographic peculiaritites determine the success of city's development and can be impedements in some spheres.

Common features in the urban planning of the considered smart cities are social and economic development, infrastructural development and environmental care in order to improve the quality of life of their citizens. In Barcelona and Charlotte, much attention is paid to the improvement of remote areas. However, in Barcelona, more funds are allocated for the redevelopment of housing and secondary construction, rather than for the construction of new buildings. In Shanghai, actions are being taken to establish an infrastructural link between the center and the outskirts. In Charlotte and Barcelona, among other things, programs are being implemented to preserve the historical appearance of the city. A distinctive feature of urban planning in Tokyo is improving the safety of citizens due to frequent natural disasters.

4.2. Key stakeholders for smart city development

As it was mentioned, urban planning is an essential part of each city, one of its main processes. Not only city authorities are involved in this process, but also companies, investors and residents. The composition of participants in urban planning, their functions and forms of ownership influence on the effectiveness of the implemented plans and programs for the city development. Therefore this section will consider the structure of urban planning in smart cities.

4.2.1. Barcelona

Below there is a model reflecting the stakeholders involved in the transformation of Barcelona into a smart city (Ajuntament de Barcelona, 2017).

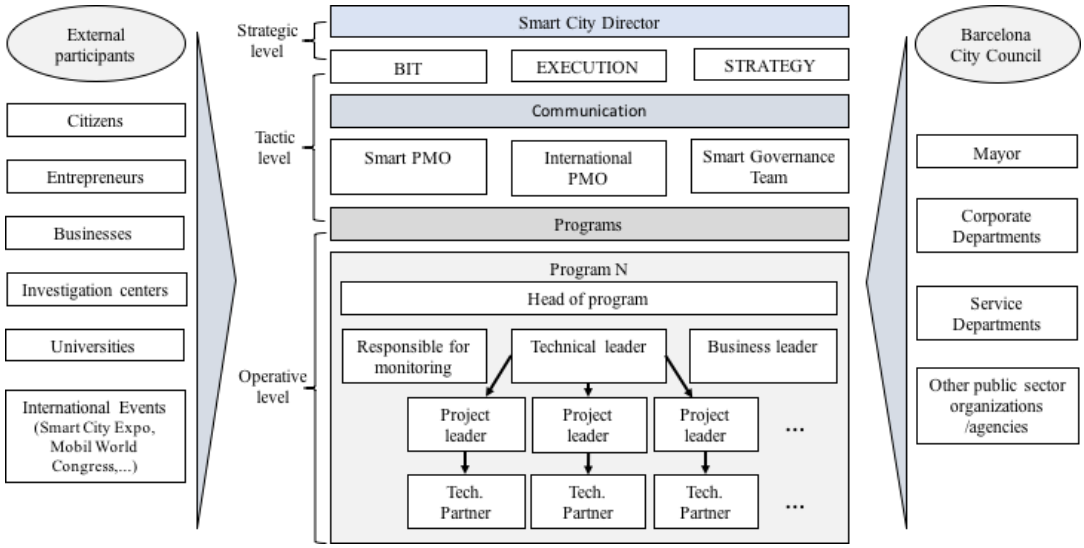

FIGURE 1 - PARTICIPANTS OF URBAN PLANNING
Source: Ferrer (2014).

Figure 1 shows that the Director for Strategic Development of Barcelona as a smart city (Smart City Director), with the support of the Barcelona Institute of Technology for the Habitat (BIT), is developing the final strategy and common standards for the execution of programs and projects. Further, through communication, this information sequentially spreads to lower levels.

At the tactical level, there are: Smart Personal Management Office, International Personal Management Office (PMO) and a group of smart management. Smart PMO was created to coordinate local projects, which are classified under the tag “Smart City”. Similarly, International PMO brings together projects implemented at the international level.

In the scheme above, the implementation of programs and projects has an operational level. At the head of any program is the program manager, who is subordinated to the following employees: responsible for monitoring, business leader and technical leader. The latter manages several project leaders, managers, in turn, technical partners.

Participants in urban planning exist outside the three-level structure and exert a decisive influence on it. So, the external environment affects the internal environment from two sides: from the state (represented by Barcelona City Council) and external participants. BCC is involved in planning the development of the capital of Catalonia through the control of the mayor, the activities of corporate and service departments, organizations and agencies of the public sector.

To sum up, the main feature of Barcelona as the smart city is its inclusiveness, since not only city authorities, but also ordinary citizens, entrepreneurs, business, research centers and universities take an active participant in the city development.

4.2.2. Charlotte

In the city of Charlotte, an established government structure has developed (Marstall et al, 2010). The city council is a fully elected body with broad powers, it is headed by the mayor. Also there is a position of a city manager, who directs the current activities of the professional administration and approves the composition of the council, in other words, represents the executive branch of power, is responsible for implementing the plans developed and approved by the city council. Among the main functions of the city council is the development of a strategy for further development of Charlotte, the choice of goals and means to achieve them. It is the city council that plays a key role in the formation of Charlotte as a smart city.

The key participants of urban planning within the concept of smart city can be conditionally divided into two groups: people specializing in a certain direction of development and members of the administration, assistants to the city manager. Altogether there are more than forty departments and divisions in Charlotte (Charlotte: City Departments and Divisions, 2017), however, only some of them are taking a major part in the implementation of smart city projects:

- CATS - department responsible for commuter and intercity communication.
- CDOT - the Department of Transport, engaged in the development of transport infrastructure within the city.

- I&T - Department of Technology and Innovation, responsible for the implementation of modern technologies in the management, monitoring and analytical system.
- The N&BS Department for Suburban Development and Cooperation with Business has undergone reorganization and was split out into two departments at once: the Department of Economic Development and the Department of Housing and Suburbs.

Each department is led by a director and his managers responsible for certain areas of their respective department's work. The work of the departments is supervised by the assistants of the city manager.

The city administration strives to improve the efficiency of its employees and implement the concept of "municipal services are our business" (Marstall et al, 2010), providing competitive services to the public. Forms of cooperation between the state and business will be discussed in the next section.

4.2.3. Shanghai

In Shanghai, there are a number of organizations that carry out urban planning. The operational functions of the representative sample are described below.

Shanghai Urban Planning Exhibition Center provides online information on city planning, organizes exhibitions of world-famous artists, designers and architects, as well as scientific and educational exhibitions (Shanghai Urban Planning Exhibition Center, 2017)

The following organizations are subordinate bodies of the Shanghai Municipal Government:

- Shanghai Municipal Development and Reform Commission has 19 main functions, ten of which relate to urban planning.
- Shanghai Municipal Housing, Land and Resources Administration Bureau is responsible for the following areas: housing, land, geology, mineral resources and housing reform..
- Shanghai Municipal Planning, Land and Resources Administration is also one of the municipal government departments whose main functions are urban planning.

4.2.4. Tokyo

The main participant of the urban planning process in Tokyo is the Bureau of Urban Development (Planning Tokyo's Urban Development, 2016). Currently, three plans developed by this organization are being implemented.

The Urban Development Vision for Tokyo (see Table 1).

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TABLE 1 - THE MAIN CONTENT OF THE URBAN DEVELOPMENT VISION FOR TOKYO

Program objectives	Activity areas
To maintain and develop urban dynamics for international competitiveness. Ensure coexistence with the global environment. Restore beautiful urban spaces. Preserving cultural heritage. Create a comfortable and safe city. Establish communication between residents, municipality, corporations and NPOs (non-profit organizations).	Improvement of regional transport infrastructure. Establishment of centers that enhance economic viability. Implementation of the transition to a "low-carbon" city. City landscaping. Creating attractive urban spaces. Achieving better environmental conditions. Creating a safe, sustainable city.

Source: prepared by the authors on the basis of Planning Tokyo's Urban Development (2016).

City authorities, the Urban Development Bureau, residents, energy companies, other corporations, and NGOs participate in the implementation of this plan.

The Master Plan for City Planning describes several areas:

- Planning of urban spaces - determines the future vision of the city from a long-term perspective and the path to its achievement.
- Renovation of the city - involves the reconstruction of the city.
- Development policy for residential areas - a long-term plan to improve the quality and affordability of housing for citizens.
- Policy for increasing resilience to natural disasters - redevelopment of the city and residential areas to improve the level of public safety.

The Master Plan for Housing

Frequent earthquakes, as well as the continuing aging of the population, led to a revision of priorities in housing. The main principle of housing is maximum security for a comfortable living and staying in the city. The plan is implemented by the city authorities, the Bureau, construction organizations, who are themselves being guided by the needs of citizens.

Thus, in each of the considered smart cities, there are certain bodies that are engaged in urban planning, it can be one organization, like the Tokyo City Bureau of Development, or a vast network of organizations, like different centers, administrations and commissions in Shanghai. In the urban planning of Barcelona, the key role is played not only by the city authorities (the City Council and the director of the smart city), but also ordinary citizens, entrepreneurs, businesses, research centers and universities. In this direction, Tokyo is constantly establishing communication between residents, the municipality, corporations and NPOs.

4.3. Mechanisms for implementing the strategy of public-private partnerships for smart city

Public-private partnerships allows not only to develop relations between state bodies and business but also to attract additional private resources to the areas under the state jurisdiction, which in turn can improve the efficiency of spending budget funds, as well as the effectiveness of the implementation of state and municipal projects. All this let us conclude that in any smart city the public-private partnership strategy must certainly function successfully. This section will be devoted to the implementation of such strategies in Barcelona, Charlotte, Shanghai and Tokyo including projects realization.

4.3.1. Barcelona

The directions for the strategically important cooperation for Barcelona with various partners can be divided into three categories: private sector, research centers and other cities. At the moment, three conceptual approaches have been developed to turn Barcelona into a smart city:

- Cooperation with companies to create the necessary digital infrastructure of a smart city.
- Transformation and cooperation at the local and international levels through initiatives (Achaerandio et al, 2012).
- Functioning of the city as a "network of networks" (connection of different city networks, for example: energy supply, transport and technology).

Megapolises cannot become high-tech on their own, so city authorities need to cooperate with technology and service providers, infrastructure operators and many other private stakeholders. It is no coincidence that some of the most important events in smart cities are often the result of a public-private partnerships. Examples of specific subjects of these relationships can be found in Table 2.

TABLE 2 - SPECIFIC SUBJECTS OF PUBLIC-PRIVATE PARTNERSHIPS

Private sector entities	Specific external stakeholders
Business	Abertis, Bismart, Cisco, GDF Suez, Green Digital Charter, Endesa, IBM, Intel, Sensing & Control Systems, Schneider-Telvent, Orange, Telefónica, T-Systems, Ros Roca, UPC, Urbiotica
Research centers	The Specialist Centre on PPPs in Smart and Sustainable Cities (PPP for Cities), Public-Private SectorResearch Center at IESE (PPSRC-IESE)
Universities	IESE Business School, ESADE, Universitat de Barcelona, UniversitatAutònoma de Barcelona, UniversitatPolitècnica de Catalunya, UniversitatPompeuFabra, UniversitatOberta de Catalunya
Research centers in Catalonia	Bdigital, i2cat, Barcelona Design Innovation Cluster/ Barcelona Centre de Disseny, IREC

Source: prepared by the authors based on Ferrer (2014), Department for Business Innovation and Skills (2013).

The administration of Barcelona cooperates with the Dublin City Council, the Seoul Metropolitan Government and the City Council of Sant Cugat. The list of partner cities is constantly expanding.

In Barcelona, both local and global smart programs are implemented. Figure 2 reflects smart local programs, distributed across 10 sections: ICT, water, energy, matter, mobility, city scale, public spaces, public and social services, open government, information flows.

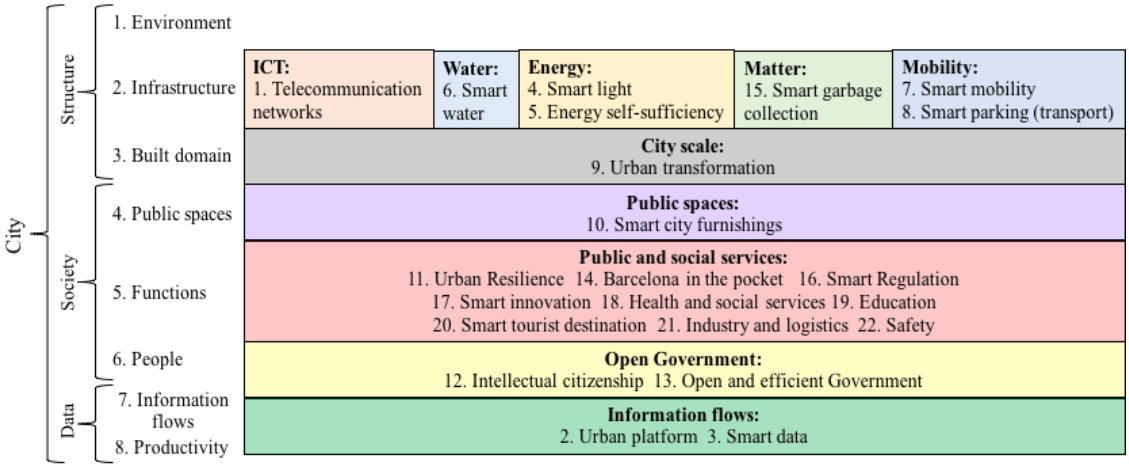

FIGURE 2 - THE CONCEPTUAL MODEL OF BARCELONA
Source: prepared by the authors based on Ferrer (2014), Department for Business Innovation and Skills (2013).

4.3.2. Charlotte

The city of Charlotte can be called a “corporate city”: 292 out of 500 companies in the list of the “Fortune” magazine have their branches there (Marstall et al, 2010). Due to the high concentration of banks and financial institutions, Charlotte is the second largest banking and financial center in the United States.

The practice of public-private partnerships (PPP) has become a tradition in Charlotte. Speaking of benefits of PPP at the lower level we mean improvement of the living standards of citizens and taxpayers by increasing the number of parking lots, public areas, recreation areas, streets redevelopment. The private sector benefits from the transfer of some urban assets or rights, including money, construction or travel rights, land or business, for the implementation of approved projects (Charlotte: Economic development, Public-Private Partnerships, 2017).

Charlotte is the administrative center of Mecklenburg County, North Carolina, therefore, as a rule, not only the city administration but also the county and state administration take part in large mixed public-private projects. However, this work will include a description of projects implemented primarily by the city.

Metropolitan Midtown is a quarter on the outskirts of the city, consisting of office buildings, retail space and residential buildings. In the course of the project for the reconstruction of the block by a private investor, city and district administrations allocated grants to cover part of the costs of building parking spaces. At the same time, neither the city administration nor the county administration has any own material interests in this development project. As for parking lots, the city administration agreed to buy 1,000 parking spaces next to condominiums around the parking lot built during the reconstruction of Elizabeth Avenue. However, the transaction will take place only after the total amount of taxes received from this zone exceeds $25,000,000.

Another example of cooperation between the administration and the private sector is the construction of sports facilities (Rusher, 2010). The city of Charlotte has concluded a series of agreements with the owner of NBA franchises to finance the construction of a sports complex in the suburbs. The city owns the complex, however, the NBA will receive the right to a long-term lease for own benefit. All profits received from the sale of food and beverages will go to cover the debts of third parties. The main share of financing is provided by the city through the issuance of certificates of equity participation.

The concept of “Envision Charlotte” (Envision Charlotte, 2017) project implies the use of IT (developed with a help of private sectore) in many areas: the creation of smart energy systems for effective water and energy consumption, virtual platforms for providing educational and medical services, intelligent transport and smart house systems. It was within the framework of this concept that in 2011 Charlotte launched a large-scale “Envision Charlotte” partnership program. The main objective of the program was to reduce electricity costs and, as a consequence, reduce costs in commercial and city administration buildings. For five years, it was planned to reduce energy consumption by 20% (Charlotte, 2017). By June 2017, the energy consumption was reduced by 19%, which is equivalent to $ 26 million thanks to the “Envision Charlotte” project. Based on the success of the initiative, the city expanded the program, including also waste, water and air (Envision America, 2017).

4.3.3. Shanghai

Despite centralized control and the Communist regime, Shanghai became the first city in China to switch from quantitative economic development to a higher-quality growth. Enterprises interact with the government through chambers of commerce, and also take part in projects to support the development plan of Shanghai (Harris, 1992).

One such project is the Shanghai Free Trade Zone (FTZ) (launched in 2013). Thanks to it, foreign investors got access to areas that used to be under the exclusive patronage of the state; the procedure

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for the establishment of foreign financial institutions has been simplified. Also on the territory of the FTZ, free currency conversion and exchange rates are offered on the basis of a market mechanism (Pezzutto et al, 2016).

Also, high-tech parks (that benefit from the discovery of previously limited industries such as healthcare and banking) are created. For example, the Shanghai High Technology Park in Caohein includes 4 centers: a research and development center, a network operations center, a financial data center and a technical innovation center.

Another project is the designation of specialized functional zones for innovation, business, recreation, production and delivery of goods, to attract talent and stimulate economic development (Chourabi et al., 2012).

4.3.4. Tokyo

Tokyo projects are aimed at energy saving, safety, environmental friendliness, increasing the mobility of city residents, automating urban processes, etc. In addition to Tokyo, Japan has truly smart cities, which are almost entirely built on the same principles as Tokyo. Nevertheless, the size of these settlements does not allow them to be called full-scale cities. One of these smart cities is Fujisawa SST, located near Tokyo. It is created jointly with Panasonic. Its area is about 19 hectares, and the population should be about three thousand inhabitants by 2020 (Fujisawa Sustainable Smart Town, 2017). The city has become a springboard for new technologies that will be introduced in Tokyo in the near future. For example, here on the roof of each house there are solar batteries that can provide the house with the necessary energy. In the near future, it is planned to populate several smaller towns: Yamamoto Town, Mogami City, Ishnomaki City, etc. (Japan's Four Major Smart Cities Model projects 2010-2014, 2017). All of these cities have large companies as their sponsors. Most often, these are TNCs with offices around the world: Toyota, NNTData, Mitsubishi, Toshiba, Panasonic and others.

Japan has a Japan Smart Community Alliance, formed by representatives of the automotive industry and transport companies, fuel and energy companies, telecoms operators, authorities, etc. There are 257 member organizations in Tokyo. The four activities of the Alliance - energy, information and communication, infrastructure and lifestyles (creating intelligent solutions that simplify everyday life) (Japan smart community alliance, 2017).

Thus, in all considered smart cities, public-private partnerships strategies are being implemented. This practice is most developed in Charlotte, where the public-private partnerships has already become a tradition and the least developed is in Shanghai, which is not surprising in the conditions of centralized

management and communist restrictions, but the strategy is still successfully implemented - mainly through the interaction of private enterprises and the government through trade wards. The distinction of public-private partnerships in Tokyo from other smart cities is that in the suburbs new, smaller smart cities began to be formed. In Barcelona the City Administration cooperates not only with business representatives, research centers and investors but also with municipal authorities of other cities.

4.4. Drivers and barriers for smart cities development

In the previous sections, the principles of urban planning, the main participants of this process and the strategies of public-private partnerships, including the ongoing projects for the development of smart cities, were considered. The analysis made it possible to identify the main drivers and barriers to the development of smart cities, which will be discussed in detail in this section.

4.4.1. Barcelona

In this section, the factors that positively and negatively affect the development of Barcelona as a smart city will be identified (Table 3).

TABLE 3 - FACTORS CONTRIBUTING TO AND IMPEDING THE DEVELOPMENT OF THE SMART BARCELONA

Drivers	Barriers
Structural factors: ▪ High tourist influx potential. ▪ The activities of Barcelona Activa. ▪ Modern infrastructure (El Prat Airport, Barcelona Port, AVE, etc.). ▪ Innovative area 22 @ Barcelona.	▪ Possibility of inconsistency between the interests of citizens, private capital and political elites. ▪ Barcelona's development strategy is set "from top to bottom". ▪ Austerity policy and urban dynamics lead to land leases.
Strategically-oriented factors: ▪ Broad implementation of ICT and mobile solutions. ▪ Development of public-private partnerships.	

Source: prepared by the authors.

The capital of Catalonia initially had a prepared ground for modernization for several reasons. Firstly, a stable flow of tourists, ensuring the replenishment of the city budget by visiting various attractions by foreigners, has served as a catalyst for the constant changes in Barcelona over the past few years. Secondly, the status of the capital of the Olympic Games became the starting point for the transformation of the city. The urban effect of the Olympic Games did not end after the end of the event. Aiming to acquire an even more prominent position in the world, the cultural infrastructure was improved as a result of the success of the event in Barcelona. Thirdly, much attention is paid to maintaining and strengthening public-private partnerships, which allows not only to implement the latest ICT and mobile solutions but also to create platforms for developing initiatives 22@Barcelona.

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However, at the moment participation of citizens in urban planning is quite discursive (in the business center Media-ICT mainly interact public or semi-public institutions). Also in the pursuit of savings, the city authorities of Barcelona may face some obstacles. For example, land leasing is an unreliable way to form and develop a sustainable city, since after the expiration of the contract it is necessary to renew it, and there are no guarantees that the landlord will agree to the transaction. In addition, there is a risk of an agent problem, which will lead to a deliberate increase by the individual agent of the priority of his project to the detriment of others due to the limited resources of the city.

4.4.2. Charlotte

Apart from the mentioned above factors contributing to the transformation of Charlotte to a smart city two more conditions exist.

One of the mechanisms is internal, informal planning. The other is external planning, that includes visits to other cities and systematical search for new knowledge. Thousands of cities around the world are looking for answers to the same questions of planning and economic growth and solve many similar problems from land taxes to street lighting. Charlotte learns from other cities, adopts their experience.

Due to the crisis of 2008-2011, Charlotte was in a quandary, and its leadership among the smart cities was in question. The main problems faced by the city are racial issues, inequality (especially noticeably in the educational environment, in particular, in schools), as well as immigration from Latin American countries. However, it should be noted that the aggravation of problems led to the fact that the population began to participate more actively in the search for solutions, which is an undoubted success (Campbell, 2012).

In addition to the problems associated with the cyclical deterioration of the economy, Charlotte as a smart city has a number of specific problems:

- Issues related to intellectual property, specifically the problem of access to open data and big data: is all data public or part of the information can be hidden? Many citizens fear that information gathered for improving the quality of municipal services provided can be made public or used for unregulated purposes.
- Security problem: how can you protect urban automated systems (e.g. traffic lights or lighting) from unauthorized attacks? The city administration is concerned about the problem of hacking and access to administrative servers.

- Confidentiality of personal information. Anonymization of data should be part of the smart city system. However, the question of how to achieve anonymity when most of the urban systems are automatized remains open.

4.3.3. Shanghai

In the previous paragraphs, we examined in detail the structure of Shanghai in terms of the principles of urban planning, its key participants, as well as the interaction of business and the state. So what prevents or, on the contrary, helps the development of Shanghai as a smart city?

To ensure that the city received the status of smart it is necessary to provide planning, aimed at the future. This includes digital technology, ecology, etc.

The positive features for the development of Shanghai as a smart city can be combined into the following list:

- Availability of functional zones in the city, which set the development vector.
- One of the lowest prices for resources (including wages) in China at the moment.
- Shanghai is the financial and commercial center of the country, which makes it one of the richest cities.
- But along with the drivers, there is also something that hampers the development of Shanghai as a smart city:
- Shanghai suffers an acute shortage of land resources. Any construction must be coordinated in one way or another, and land can only be rented - all this can hinder the development.
- The government is often not ready to compromise and listen to people's opinions.
- More on land topic – there is also the question of its rational use. It is questioned that the existing system is capable of operating on the rational use of land.
- In addition to a shortage of land, there is also a lack of other resources. Considering the fact that there are more and more people in Shanghai every year, this problem can be especially acute.
- Planning is one of the most "slow-moving" ways of work organization, nevertheless, it is the plan for a period of more than 20 years that is the main document that determines the development of Shanghai.

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4.4.4. Tokyo

In 2020, the Summer Olympic Games will take place in Tokyo. To hold such a large-scale event the city is being prepared in the conditions of constant conflict of interests: when building mega-objects, carbon dioxide emissions increase, as well as accumulation of garbage. The introduction of new technologies, without which it is impossible to develop a smart city, requires large financial investments. For the Olympic Games, immense amounts of money are required, which, in the opinion of even the organizers themselves, may not be able to pay off financially. In addition, the Olympic facilities are often not very popular with the local population. Thus, the money invested in the Olympic Games may not allow achieving the set goals for the programs of the smart city.

In general, some of Tokyo's projects can be assessed as effective. For example, the construction of the Olympic Village will be carried out with the wide use of high-tech solutions and organic materials, individual structures will be attached to autonomous power systems. In other words, the Olympic Village will not only be a comfortable, eco-friendly and progressive place for athletes from all over the world, but also a demonstration of achievements in the field of energy efficiency and home automation. At the same time, many of Tokyo's smart solutions are manufactured in Japan. Private fuel systems "Ene-farm" are created jointly by Panasonic and TokyoGas (Maruta, 2016).

Japan is still the main source of "green" technologies and solutions. According to the Development Program of the smart city of Tokyo until 2020, the countries of the European Union have a genuine interest in Japanese technologies. It is obvious that the demand from the EU countries will stimulate the development of smart Tokyo and relevant technological solutions that contribute to sustainable development of the city. It is impossible to belittle the importance of successfully launched and working projects, ambitious plans for the future. Nevertheless, it is likely that Tokyo will not be able to achieve the planned results by the announced time. First of all, for the reason that the Olympic Games are ahead, Japan will face a serious challenge to reduce carbon dioxide emissions into the atmosphere. Accordingly, to reduce energy consumption by 20%, too, is impossible in such a short period of time (until 2020).

Thus, every smart city in the process of development is facing, both the drivers and barriers to achieving the desired goals. Common factors contributing to the improvement of cities are the developed infrastructure, the widespread use of ICT, the involvement of citizens in the development of the city, as well as public-private partnerships. In Charlotte, one of the most important drivers is the experience of other cities, which the city gladly adopts to its own environment. As for the barriers to development, we can distinguish the following: conflict of interests of municipal authorities, citizens and business; the

problem of information security (automation of urban systems leads to an increased risk of attack by hackers and data theft). In Barcelona and Shanghai, the problem of shortage of land resources is acute: the construction of new buildings is almost prohibited because in order to obtain permission it is necessary to go through a complex system of reconciliation with a high probability of receiving a refusal.

5. CONCLUSIONS AND DISCUSSIONS

The article provides a detailed analysis of the world experience of the smart cities formation in order to identify drivers and barriers for the development of smart cities.

During the study, key components of the formation of smart cities were considered, such as principles and participants of urban planning, mechanisms for implementing public-private sector cooperation. On the basis of these component drivers and barriesrs for smart cities development were identified (see Figure 3).

The analised features were devided into three groups according to their specifity for smart cities: group I — the most common components; group II — middle level of specifity; group II — specific components for each city.

Common features (group I) in the urban planning of the considered smart cities are connection of the city center with suburbs, environment protection, planning from top to bottom. Principals similar for two cities (group II) include availability of the smart city strategy or plan; citizen participation in the political process and land lease from the state.Specific principals (group III) are active social policy; redevelopment of the city, etc.

In each of the considered smart cities, there are certain bodies (stakehoders) that deal with urban planning. In the urban planning of Barcelona, a key role is played not only by city authorities, but also ordinary citizens, entrepreneurs, businesses, research centers and universities. In this direction, Tokyo is developing, constantly establishing communication between residents, the municipality, corporations and nonprofit organizations.

In all analyzed smart cities, public-private partnerships (PPP) strategies are being implemented. Each of the cities adopts specific instrumnts exept hight tech parks which are more commom for smart citites. The PPP is most developed in Charlotte and Barcelona, where it has already become a tradition, and the least developed in Shanghai, which is not surprising due to centralized management and the communist frameworks.

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Analysis of key aspects of smart cities development shows that each city use a viriaty of instruments which caused different progress. For example, a more complex smart city approach in Barcelona (creation of special office responsible for smart city, high involvement of citizens in planning, etc.) helped it to become the one of the best smart cities in the world. Shanghai and Tokyo urban planning systems are not so flexible. That`s why these cities implement only separate approaches to smart cities development.

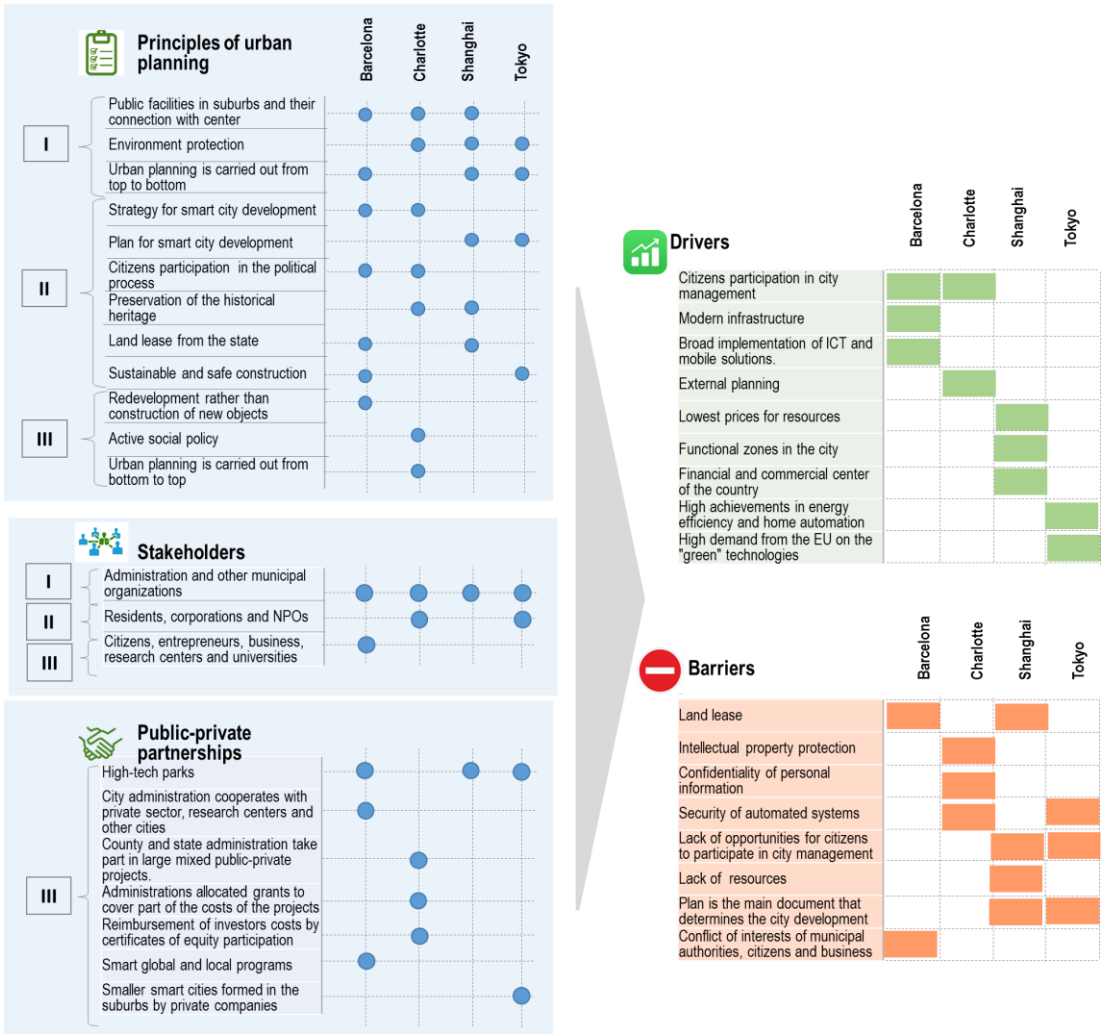

FIGURE 3 - KEY COMPONENTS OF THE SMART CITIES FORMATION
Source: prepared by the authors.

As a result of the study, drivers and barriers of the smart city development were identified. Common to all cities factors contributing to the development are the advanced infrastructure, the widespread use of ICT, the involvement of citizens in the city development, as well as the improvement of public-private partnerships. As for the barriers to development, we can distinguish the following: conflict of interests of municipal authorities, citizens and business; the problem of information security (automation of urban

systems leads to an increased risk of attack by hackers and data theft). In Barcelona and Shanghai, the issue of land resources shortage is acute: the construction of new buildings is almost prohibited because in order to obtain permission it is necessary to go through a complex system of reconciliation with a high probability of receiving a refusal. In these cities, rent of land is common, which is an unreliable way of city development.

A few issues are of interest to the following studies. For instance, the first question is a quantitative assessment of the impact of each emphasised factor. It is important to understand which drivers and barriers have the greatest contribution to the development of smart cities. Moreover, researchers could create a model of the perfect smart city in which will be implemented all kinds of measure to strengthen the influence of drivers and reduce the barriers' impact.

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