

Smart cities: competition in the digital ecosystem world

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Abstract — This article promotes existing theoretical research, focusing on the time-varying effects of a smart city, in the face of growing global competition for digital ecosystems. The findings show that the timely introduction of digital ecosystems can significantly affect various parameters of the quality of life such as safety, time and convenience, health, environmental quality, social connection and civic participation, jobs and cost of living. Smart solutions are becoming an effective tool for the long-term innovation of cities around the world. On the other hand, the existing old infrastructure is a natural brake on the development of cities and is no longer able to provide the modern pace of development on the basis of new digital principles. It is important to note that, for the development of a smart city, it is necessary to unite all efforts, within the framework of partnership and collaboration of business, authorities, citizens and technology companies. The author of the article assumes that when assessing the effectiveness of incentives, two aspects of resource provision should be taken into account - financial and human. Analyzing the best practices and strategies, the work highlights priority areas for the development of modern digital ecosystems for smart cities, based on which municipal authorities can continue their effective development on the way to building a smart city. Thus, the work contributes to the existing discussion about the directions of development of smart cities.

Keywords— *smart city; competition; digitalization; ecosystem; economy*

I. INTRODUCTION

Today's cities are under significant pressure in terms of improving the quality of services, stimulating the competitiveness of the local economy, improving the system of providing services, increasing efficiency and reducing costs, increasing efficiency and productivity, and solving the problems of congestion and the environment. The presence of such pressure factors makes one think about the choice of "smart" solutions for cities and conduct experiments with various applications of smart infrastructure and digital ecosystems [1].

II. MATERIALS AND METHODS (MODEL)

A. DEVELOPMENT OF THE CONCEPT OF A «SMART CITY»

The concept of a "smart city" (smart city), which emerged in the early 2000s [2], was primarily aimed at developing technologies and infrastructure. Since then, at a substantive level, this concept has undergone certain changes, but has not lost its relevance.

The term "smart city" does not have any typical, generally accepted definition or set of terms for its explanation. In 2014, the International Telecommunication Union report reviewed more than 100 definitions related to a smart city, and the result of this analysis was the following definition: "A sustainable smart city is an innovative city that uses information and communication technologies (ICT) and other means to improve the quality of life, effectiveness of urban activities and services, as well as competitiveness while ensuring that the needs of present and future generations meet the economic, social and environmental concerns max "[3].

The concept of a smart city initially described how to use the IT infrastructure to create a virtual city space in the information society [4]. At the next stage, the smart city was mainly associated with the strengthening of the role of intellectual technologies in increasing the efficiency of urban development [5]. Finally, today it is increasingly common to talk about a smart sustainable city (SSC), in which information and communication technologies and other tools, on the one hand, are used to improve the quality of life, the functioning of a city and the provision of urban services, and strengthening competitiveness, and on the other hand, they meet the needs of present and future generations, without adversely affecting the economic, social and environmental components of the city [1].

It should be noted that all existing concepts and definitions of a smart city emphasize various aspects of the functioning of the urban ecosystem, paying particular attention to the development of information technologies, transport and telecommunications infrastructure, initiatives aimed at improving economic and political efficiency and allowing for the most effective realization of social potential.

B. NEW PARADIGM OF "SMART CITY"

As a result of further research and transformations, the new paradigm of socio-economic and spatial development of a smart city was first applied in Silicon Valley, Cambridge Science Park and Sophia Antipolis. Having shown its effectiveness, it rapidly began to spread in the leading cities of Europe, North America, Australia and Asia [6], [7], [8].

If Smart City 1.0 (2008-2013) was an efficient infrastructure, and Smart City 2.0 (2014-2017) was primary digitalization, then Smart City 3.0 (2018-2025) is a full-scale digital ecosystem, Within the framework of which, a unified digital ecosystem of technologies and services is being formed that promotes citizen involvement and allows for the exchange of industry data in real time.

Today, the new paradigm of the smart city highlights various collaborations in which businesses, governments, citizens and technology companies initiate and actively develop bold projects to improve and introduce new intelligent urban technologies.

To achieve the result, first of all, a basic framework, namely its basic ecosystem, which contributes to the prosperity and effective development of the entire city and its individual clusters is required. Such an ecosystem primarily grows in cities where synergies and diversity of layers [9] are closely intertwined, forming an effective scientific and innovative basis of a smart city:

- *knowledge base*: including educational institutions and R & D;
 - *industrial structure*: affects the progress and initial development of a smart city;
- A. *quality of life and urban amenities*: it provides all the necessary smart city, which in turn affects the migration of workers who form the knowledge base of the city;
 - B. *urban diversity and cultural mix*: a tool to encourage creativity;
 - C. *accessibility*: encourages and facilitates the transfer and transfer of knowledge;
 - D. *social equity and inclusion*: minimizes social inequality and negative tensions;
 - E. *city scale*: large smart cities can offer a greater set of knowledge, greater variety and choice between knowledge and business.

To understand how synergies are formed as a result of the internal interaction of the whole diversity of layers, it is necessary to understand the essence of the definition of "ecosystem". The term was first coined and introduced into circulation by the British ecologist A. Tensley in 1935 [10] to designate a system consisting of a group of living beings and their environment in which they live, and the interaction established between them. Later in 1993, this definition was applied by the American scientist D. Moore [11] to designate a system of participants with their cooperative connections, which he called the "entrepreneurial ecosystem". By this concept, he understood business clusters that can accumulate a stream of talents and knowledge if they share geographic proximity.

In 2010, D. Eisenberg [12] developed a more holistic definition and in 2013, with minor additions, recognized a wide range of participants at the International Economic Forum [13]. In accordance with this definition, the business ecosystem consists of eight elements: politics; financial industry; culture; infrastructure to support entrepreneurship; human capital (including education) and affordable markets. According to the author between these elements there are complex relationships, and only the entire set of elements, and not taken only a few individually, contributes to the development of entrepreneurship.

The combination of all factors, taking into account their interconnectedness are the key to success [14]. That is why in countries where attempts were made to use one or two elements of the ecosystem, the expected results were not obtained [12].

C. CRITERIA FOR EVALUATING THE INTELLECTUALIZATION OF URBAN RESULTS.

There are currently no generally accepted criteria for assessing the degree of intellectualization of a city, and therefore several of the most well-known indices used in international and Russian practice can be cited:

- Easypark. Smart Cities Index;
- PwC. Data-driven cities;
- National Research Institute of Technology and Communications (NIITS), rating "Indicators of smart cities";
- MSM Skolkovo, Index of the digital life of Russian cities.

A number of efforts are being made to develop comprehensive performance indicators for smart cities and, within the United Nations (UN), the Inter-Agency Group is developing a set of such indicators with a view to transforming them into a global index of sustainable smart cities [1].

Focusing on them, cities as well as governments can have a big impact on the growth and successful launch of the internal ecosystem of smart cities, which is important for the economic growth of each country.

III. RESULTS AND DISCUSSION

Despite the fact that the real size of the global smart city technology market is rather difficult and even harder to predict how they will change in the medium and long term, some attempts are being made in this direction. Thus, according to the estimates of the research company Markets and Markets, the market volume in 2017 was 424.68 billion US dollars, and by 2022 it will already reach 1.2 trillion US dollars [15]. Under the data of the international analytical agency Frost & Sullivan, smart cities by 2025 will create tremendous business opportunities with a market value of more than 2 trillion US dollars [16]. The growth of the market is also due to the fact that as it develops, in addition to traditional IT companies and infrastructure giants, new types of players are beginning to emerge - small and medium-sized technology companies, engineering and consulting companies.

According to McKinsey Global Institute (MGI), a general view of the ecosystem of smart cities will look like it is shown in Fig. 1, and the total volume of future markets by 2025 will reach over 56.2 trillion US dollars.

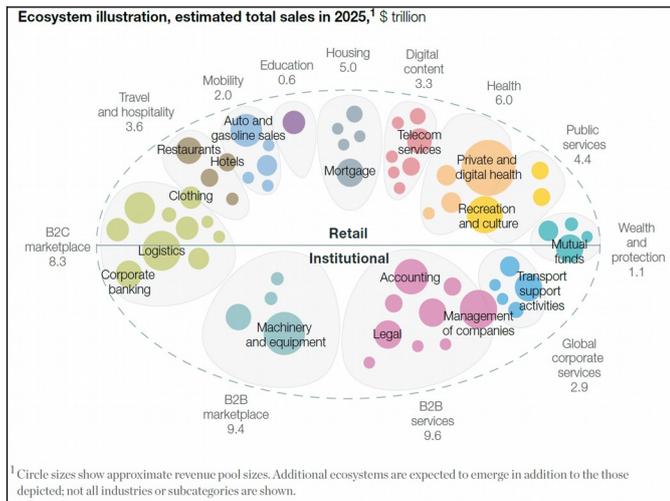


Fig. 1. The Ecosystem of Smart Cities by 2025
Source: IHS World Industry Service; Panorama by McKinsey; McKinsey analysis [17]

The application of the concept of smart-cities opens up wide opportunities for various countries. MGI's assessment showed [18] that digital applications of a smart city can affect various parameters of quality of life, such as: safety, time and convenience, health, environmental quality, social connection and civic participation, jobs and cost of living (see Table 1).

TABLE I. INTELLIGENT SOLUTIONS OF A SMART CITY

Parameters	Solutions	Results
Safety:	- traffic safety; - data-driven policing; - optimized emergency response.	- 30-40% fewer crime incidents; - 30-300 lives saved each year; - fist responders arrive 2-17 minutes faster.
Time:	- public-transit apps; - intelligent traffic management; - new, dynamic mobility option.	- 15-20% shorter average commute; - workers regain 15-30 minutes/day; - reduced gridlock improves productivity.
Health:	- improved chronic-disease treatment; - data-driven public-health interventions; - digital tools for a better patient experience.	- 8-15% lower disease burden; - health effects from air pollution reduced by 8-15%; - cities become catalysts for health and wellness.
Environment:	- air-quality monitoring; - energy-use optimization; - electricity, water, and waste tracking.	- greenhouse gas emissions lowered 10-15%; - 30-130 kg less solid waste per person/year; - 25-80 liters of saved per person/day.
Connectedness:	- apps for person-to-person connections; - apps connecting the public to local government; - apps that connect	- digital connections build real-world connections; - public can report problems, weigh in on planning; - online communities link neighbors.

	neighborhoods.	
Jobs:	- E-career centers, digital hiring platforms; - Digital administrative processes for small businesses; - Data-driven education, online retraining.	- 1-3% boost to employment; - Fewer barriers for smart-ups and small businesses to grow; - Residents can acquire skills.
Cost of living:	- Digitized land-use and permitting processes; - Dynamic electricity pricing and usage tracking; - E-haling and microtransit option.	- 1-3% reduction in citizen expenditures; - Fewer barriers to building more housing, lowering costs; - Some people give up private cars.

Source: Smart Cities: Digital Solutions For A More Livable Future [18].

The broad sector of the ecosystem direction (Fig. 1) of smart cities, as well as the range presented in Table 1 of the results from the possible implementation of these solutions, reflects the fact that the applications being implemented work differently in cities and this often depends on such factors as physically obsolete infrastructure and initial points of connection to it.

Today it is already clear that solutions for the smart city are widely used by people all over the world, and in some cities almost every inhabitant has already entered the daily life (Fig. 2)

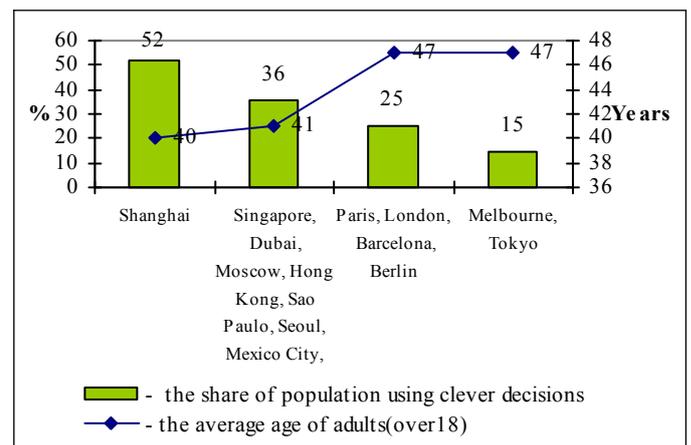


Fig. 2. Using smart solutions in different cities
Source: Compiled by the author on the basis of data McKinsey Global Institute (MGI) [19]

As seen Hong Kong, Dubai, Mexico City, Moscow, New York, Sao Paulo, Seoul, Singapore and Shanghai make up a group of cities, the average level of using smart solutions in which exceeds 36%, the same rate of use of the most popular applications ranges from 70 to 80% .

According to the national innovation report [20], it is clear that the current state of the Russian innovation ecosystem is in an unsatisfactory state (Fig. 3).

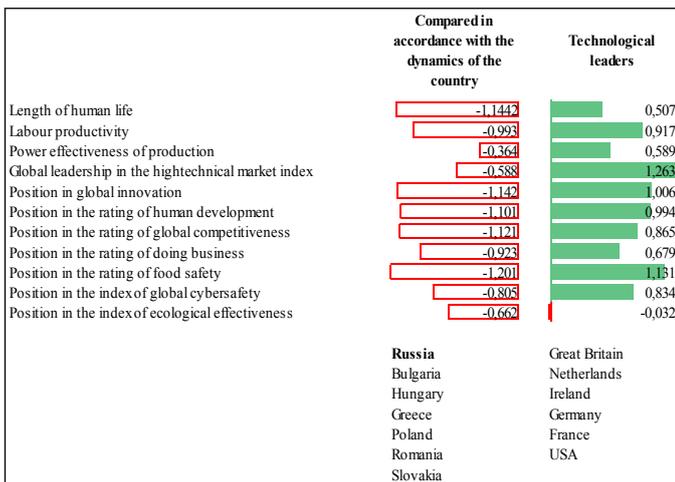


Fig. 3. The level of the Russian innovation ecosystem
Source: Compiled by the author on the basis of the National Report on Innovations in Russia - 2017 [20]

Weaknesses can be traced to a whole group of areas, such as research and development, commercialization, innovation, infrastructure and industry maturity, in government institutions and business values.

Despite the fact that Russia has developed a clear vision and strategy for digital transformation and set ambitious goals, much work must be done to prepare detailed action plans and roadmaps to implement this strategy. The results of the assessment of Russia's readiness for the digital economy are presented in Figure 3.

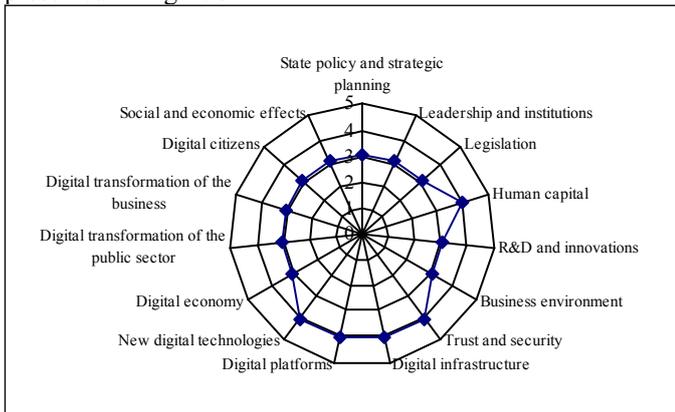


Fig. 4. Results of an assessment of Russia's readiness for the digital economy
Source: Analysis of the current level of development of the digital economy in the Russian Federation. World Bank, Institute of the Information Society, October 2017 [21]

In more detail, Russia's assessments in the framework of digital development are presented in the World Bank's 2016 World Development Report: Digital Dividends review [22]. This report examined the socioeconomic effects of the digital transformation of cities, i.e., digital dividends, and the conditions for obtaining them.

However, it is already clear that it is necessary for the country to make significant efforts to optimize the management of this process, in order to identify the best tools for monitoring and evaluating ensuring the effectiveness of Russia's development in the digital space.

IV. CONCLUSION

The study showed that as their evolution modern cities began to change their own development paradigm. Today, they are becoming more intelligent, responsive and adaptive to new digital technologies. We see advanced cities introducing more effective scientific and innovative solutions, thereby creating successful digital ecosystems that allow them to optimize costs and extract additional socio-economic income from a smart urban environment.

The growing number of smart cities is increasing competition in the digital ecosystem world. According to the author, in the near future we will encounter a downward trend of the wave of social platforms, the outcome of which will be accompanied by a burst of energy through the search for its application. Here, smart cities can direct it into the mainstream of digital ecosystems and the real interaction of the urban community with all interested parties.

However, those city leaders who think about smart technologies in the first place as tools to increase the efficiency of internal bureaucracy can now face problems, both in infrastructure development and in socio-economic. After all, today the smartphone has become the key to the city, it provides instant information about transit, traffic, medical services, safety alerts and news in the communities.

In this regard, the cultivation of digital ecosystems of smart cities should be a priority for modern megacities, where synergies and diversity of layers are closely intertwined, forming an effective scientific and innovative basis of a smart city.

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