

Implementation of world and Russian indicators of the “smart city” concept in the environmental parameters of the development of urbanized territories

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Abstract. In recent years, one can observe more intensive anthropogenic development of urban areas in the world and in the Russian Federation. This has led to the growth of urban agglomerations and a high level of urbanization, which negatively affects not only the environment, but also the social and economic components. One can note the trend in the development of digital technologies. The introduction of new technologies aimed at improving the lives of the population and creating sustainable development of the subject also has an environmental context. There is a noticeable similarity between the criteria of a “Smart City” and the goals of achieving sustainable development. They have a common direction - the creation of a comfortable and sustainable urban space, where the environmental, economic and social components will function in a single system and balance each other. But the main limitation of the implementation of this concept in Russia is the lack of funding and its uneven distribution across regions. The smart city management system should be a complex whole of interconnected elements, where the functioning of a separate part ensures the operation of the entire system as a whole. The result should be an increase in the efficient functioning of government bodies and an improvement in the quality of life of the population preserving the environment.

1 Introduction

The concept of a “Smart City” was formed on the basis of the challenges associated with the constant increase in the level of urbanization and, as a result, increased pressure on all parts of the urban economy. A unified management system must be created, which includes infrastructure, economy, environment and population.

The concept of “Smart City” initially began to develop in the countries of the European Union, the Persian Gulf and Asia, and today is being implemented in many countries. Each

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state forms its own development strategy based on historical aspects, cultural values and regional problems [1].

Modern cities face economic, social and environmental problems. At the same time, more and more attention is being paid to environmental problems, which are becoming increasingly important, in particular, air and water pollution, noise pollution, as well as problems of waste formation, accumulation and disposal. Thus, there is a negative impact of urbanization processes on health, since this can lead to a deterioration in the quality of life of the population.

Therefore, there is an urgent question about the formation of a sustainable urban environment, where both a high quality of life of the population, city safety, and the preservation of the natural environment and resources will be simultaneously achieved.

2 Materials and methods

In 2020, UN experts conducted studies, among which it was revealed that 56.2% of the world's population lives in cities. And in the future, if trends continue, by 2050 the urban population of the planet will be 68.6%. Therefore, the task of city governments becomes to improve the well-being of the population living in cities, provide them with the necessary services, as well as preserve the environment for sustainable development.

When considering a modern city, it is noted that it must be environmentally friendly, safe and at the same time include dynamically developing sectors of culture and education. The increasingly rapid development of information and communication technologies and the informatization of the economic sector are a consequence of the fact that city management is viewed in conjunction with the inclusion of innovation in all spheres of people's lives.

The "Smart City" project is designed to make the use of energy-efficient, cost-effective solutions widespread throughout the Russian Federation, not only in the public utilities sector, but also in the formation of the urban environment

There are some differences in the interpretation of "Smart City" in Russian and foreign practice. At the present stage of research, it is noted that the definition of Russian experts reflects a more technological approach, in contrast to foreign practice.

In 2021, the IMD World Digital Competitiveness Ranking agency conducted a study to study digitalization processes in all countries. As a result, according to the overall indicator, Russia took 42nd place (43rd place in 2020); in the "Knowledge" indicator – 24th place (in 2020 – 24th place); in terms of "Technology" – 48th place (in 2020 – 47th place); and in terms of "Future readiness" indicator – 47th place (in 2020 – 53rd place) [2].

On May 18, 2022, the Russian Ministry of Construction announced the creation of a smart city standard. This document defines the implementation of measures for the digital transformation of municipal services and management systems.

The International Organization for Standardization (ISO) published the ISO 37120:2014 standard "Sustainable development of communities - indicators of urban services and quality of life" in 2014 and in 2016 ISO 37101:2019 "Sustainable development in communities. Management system. General principles and requirements" [3].

For Russia, these standards were adapted in 2015 and 2018, respectively. GOST R ISO 37120-2015 "Sustainable community development. Indicators of quality of life" is aimed at creating uniform indicators of the quality of life in the city and is used to organize monitoring of the dynamics of city development and comparative analysis of cities. GOST R ISO 37101-2018 "Sustainable development in communities. Management system. General principles and requirements" sets itself the task of creating a unified conceptual apparatus, requirements and approaches when organizing smart city management systems. Also, in addition to standards, ratings of smart cities were created. Examples in

international practice are: Smart City Index, IMD Smart Index and IESE Cities in Motion Index. They conduct a comparative analysis of cities among themselves and evaluate the success of the implementation of developments and projects [3].

These ratings include a certain number of cities around the world in the ranking. It should be noted that in all except the Easypark index, the largest Russian cities - Moscow and St. Petersburg - are also included in the list of studies. Table 1 presents a comparative description of the results of the city study as of 2020 and 2021.

Table 1. International ratings of Smart Cities (Compiled from [4-7]).

City/country	Cities in Motion	IMD Smart city index		Global cities index		Easypark
	2020	2020	2021	2020	2021	2021
London (Great Britain)	1	15	22	2	2	1
New York (USA)	2	10	12	1	1	2
Paris (France)	3	61	61	3	3	13
Tokyo (Japan)	4	79	84	4	4	11
Reykjavik (Iceland)	5	–	–	–	–	–
Copenhagen (Denmark)	6	6	7	20	21	1*
Berlin (Germany)	7	38	50	15	13	5
Amsterdam (Netherlands)	8	9	17	23	22	4*
Singapore (Singapore)	9	1	1	9	9	4
Hong Kong (China)	10	32		6	7	19
Auckland (New Zealand)	35	4	9			49*
Geneva (Switzerland)	34	7	8	16	16	–
Helsinki (Finland)	22	2	6	38	43	7
Oslo (Norway)	12	5	3	53	46	3*
Taipei (Taiwan)	27	8	4	26	24	–
Zurich (Switzerland)	11	3	2	22	13	5*
Moscow (Russia)	87	56	54	20	18	–
Saint-Petersburg (Russia)	124	73	79	80	78	–

* cities in the megacities group with a population of 600,000 to 3 million people.

When comparing the position of world cities, it is impossible to single out a city that would occupy first place simultaneously in all international rankings.

Russia also has its own methods and accepted indicators for assessing “Smart Cities.” There are two most common indices: the urban environment quality index and the urban digitalization index (City IQ).

The urban environment quality index was formed by the Ministry of Construction and Housing and Communal Services of the Russian Federation. The calculation methodology was approved by Decree of the Government of the Russian Federation of March 23, 2019 No. 510-r. The assessment uses data from 6 main spaces and 6 criteria; in the overall system, the calculation methodology includes 36 indicators.

When calculated, each of the 36 indicators can receive from 0 to 10 points. The maximum score can be 360. Moreover, it is believed that if the index is in the range from 0 to 180 points, then the urban environment is unfavorable, and if it is in the range of 180-360 points, then the urban environment is favorable [8-9].

The urban digitalization index “IQ of cities” was developed by the Russian Ministry of Stream. The calculation method was approved by order of the Ministry of Construction of Russia No. 924/pr in 2019. The main goal is annual monitoring and assessment of the effectiveness of digitalization of the Russian municipal economy. The final version represents a point value during a comprehensive assessment of 47 indicators covering 10 areas. When calculating, each subject can score a maximum of 120 points, each indicator can receive from 1 to 12 points. After the final assessment, based on the sum of points, the city is assigned to one of three groups.

Despite the fact that the "Smart City" concept is gradually developing, generally accepted criteria and indicators for assessing the digitalization and intellectualization of cities have not yet been defined. There are different approaches to assessment, both in foreign and Russian practice.

One of the first studies on the topic of “Smart City” is the Rating of Central European Cities, developed by the Vienna Technical University. Initially, this technique was considered only with a population of 100 to 150 thousand people. In this ranking, the greatest attention is paid to the areas of “lifestyle” and “economy”. They account for 26% and 22% of the considered criteria, respectively. The remaining areas are studied evenly and account for approximately 15% of all indicators. At the same time, the area is considered separately based on the state of the environment [10].

3 Results

Among the analyzed practices, only the urban environmental quality index does not provide for monitoring and assessment of the state of the air environment. The ranking of Central European cities does not include waste management. Also, together with the “City IQ” index, they do not pay attention to the quantity and quality of green areas. The UNECE-ITU methodology does not provide for monitoring the quality characteristics of housing. Both the rating of Central European cities and the urban environment quality index do not develop systems for alerting residents about emergencies. It is the European UN assessment system that covers and analyzes the state of the main components of the environment. Among the Russian methods presented, the “City IQ” index includes almost the entire range of key indicators of the state of the environment.

Having studied the criteria of the "Smart City" and the indicators of "Sustainable Development", it is possible to conduct some comparative analysis. One can note a noticeable analogy between the criteria of the "Smart City" and the indicators of the eleventh goal for achieving sustainable development.

SD strategy indicators (goal 11)	Urban Environment Quality Index	Urban digitalization index “IQ” of cities
Population living in emergency housing	Share of area of apartment buildings recognized as unsafe in the total area of apartment buildings (%)	Share of apartment buildings equipped with automatic building condition monitoring systems
Ratio of residential building commissioning rate to population growth rate	no analogue	no analogue
Cities with a favorable urban environment	Level of external design of urban space (%)	Availability of an online monitoring system for atmospheric air and water
Illumination of cities	The share of illuminated parts of streets, driveways, embankments at the end of the year in the total length of streets, driveways, embankments	The ratio of the number of street lighting poles in the city that are covered by energy-efficient smart lighting systems to the total number of street lighting poles in the city
Area of green spaces within the city limits	Share of green public areas in the total area of green spaces (%)	no analogue
Share of buses equipped for people with limited mobility	Share of accessible public transport for people with limited mobility in the total number of public transport units (%)	Availability of intelligent management of urban public transport

Fig. 1. Conjugate analysis of analogue indicators of the concepts of “Sustainable Development” and “Smart City” (Compiled from [9, 11, 12]).

4 Discussion

When comparing methods for assessing “Smart Cities” in Russia and abroad, you can use indices and ratings. For foreign practice, there is an earlier start to the implementation of the concept in cities, and, consequently, more detailed models and early results of decisions made.

The main international ratings are Smart City Index, IMD Smart Index and IESE Cities in Motion Index. Their lists also include Russian cities - Moscow and St. Petersburg. However, it is impossible to single out a city that would occupy first place simultaneously in all international rankings. The world leaders are: London, Singapore and New York.

Also, when conducting a comparative analysis between the indicators of achieving “Sustainable Development” and “Smart City”, similarities were identified: the main task is to create a comfortable and sustainable urban space, where the socio-ecological-economic sphere will exist in balance.

Russia has adopted its own methods and indicators for assessing “Smart Cities”. There are two main indices: the urban environment quality index and the urban digitalization index (City IQ). At the same time, the coverage of the environmental sphere is 11% and 30%, respectively. The city with the highest level Moscow is a leader in the implementation of digital technologies and is also a pilot site at the federal level.

International and Russian practices of identifying criteria characterizing “Smart Cities” have both similar and different features. In all methods, environmental monitoring occupies a special place; the involvement of the population in the urban environment management system is especially important. However, it is in foreign methods that more attention is paid to component-by-component environmental monitoring.

An analysis was made of the degree of implementation of the Smart City concept in the constituent entities of Russia. It was revealed that in the two main methods for assessing digitalization, the coverage of the socio-ecological-economic sphere is uneven. The social component predominates, while the environmental component takes last place.

When considering the environmental component in the regions, certain indicators can be identified: atmospheric air monitoring, water monitoring and the MSW management system. The passports of 89% of subjects provide for a waste management system, 33% for an atmospheric air monitoring system, and 22% for a water monitoring system.

Achievement of the planned results must be achieved by the end of 2024. However, some entities have already begun to implement measures for the three main environmental indicators into the system. Of the eight practical activities being implemented, four are aimed at improving the waste management system, three are aimed at monitoring studies of atmospheric air, and one activity is being implemented as part of monitoring water bodies.

When identifying methodological recommendations for the Volgograd region, it was highlighted that the region is characterized by positive dynamics of digitalization of the urban environment. However, the main funds are aimed at improving housing and communal services, transport and social services. Particular attention in the region is provided for the implementation of an intelligent video surveillance system and “smart” traffic lights. When analyzing the environmental situation in the period 2019–2021. One can especially note the improvement in the situation with MSW waste. There is active activity to eliminate unauthorized landfills, create infrastructure for separate waste collection, as well as create new technological capacities.

5 Conclusion

The criteria of the concept have a common direction - the creation of a comfortable and sustainable urban space, where the environmental, economic and social components will function in a single system and balance each other.

It should be noted that foreign and domestic practices in determining the indicators and indicators of a “Smart City” should be based on open data from government authorities, both at the subject and country level.

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