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DEVELOPMENT PRIORITIES OF RUSSIAN MEGACITIES IN COMPARISON WITH SMART CITIES SINGAPORE AND BARCELONA

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Abstract: The purpose of this study is to determine the development priorities of the Russian megacities of Moscow and Ekaterinburg based on comparison with the indicators of infrastructural and economic development of smart cities in Singapore and Barcelona. Various methods of comparative assessment of smart cities are analyzed and the problem of a comprehensive analysis of the development of modern megalopolises is posed. Based on the author's model 7I and the matrix of indicators of the development of smart cities, a comparison was made of data characterizing the formation of a digital society in the cities of Singapore, Barcelona, Moscow, Ekaterinburg. As a result of the analysis, some lagging behind the indicators of the development of Russian megacities in comparison with the data on the development of Singapore and Barcelona were identified. The priorities for the development of the Russian cities of Moscow and Ekaterinburg in the direction of the further formation of a digital society are proposed. The results obtained are the basis for the development of large Russian cities in the context of urbanization and digitalization of the urban environment. The results of the study will help form the priorities for these cities based on their comparison with the leading cities in the field of smart development, which will significantly improve the quality of life of the local population and increase the competitiveness of Russian cities.

Keywords: **smart city; model; digital economy; municipal government; urban planning; sustainable development; assessment**

1. INTRODUCTION

In the past two decades, the concept of "smart city" has become more popular. Cities play a pivotal role in social and economic aspects around the world and have an enormous impact on the environment [1]. According to the United Nations Population Fund, 2008 marked a year in which more than 50 percent of all people, 3.3 billion, lived in urban areas, a figure expected to rise to 70 percent by 2050 (UN, 2020). In Europe, 75 percent of the population already lives in urban areas, and this figure is expected to reach 80 percent by 2030. The importance of urban areas as a global phenomenon is confirmed by the proliferation of megacities with populations of over twenty million in Asia, Latin America, and Africa. As a result, most of the resources are now accumulating in cities around the world, contributing to their economic importance [2,3].

Smart City is a term that appeared at the end of the 20th century, when it became clear that without IT technologies it was impossible to solve the pressing issues of multi-populated agglomerations [4]. The main problem at that time was ecology, so the first concept of Smart City was the idea of a “garden city” - an autonomous multifunctional residential area.

The concept of a smart city began to include the need for competent planning of all aspects of municipal life: economy, transport network, utilities, healthcare, education, environmental and public safety. During this period, technologies of the future appeared, which made it possible to re-evaluate the processes of urban life and direct them in the right direction, among which we can mention technologies of big data, the Internet of things, etc. [5,6].

Big Data - Big Data processing. This technology has been widespread since 2008. It made possible the processes of collecting and processing all the data that determine the life of the city. Receiving information is carried out by sensors, video cameras, temperature and air quality sensors, all kinds of devices capable of transmitting information about the environment. Modern technologies - the Internet of Things and social media - are also a source of information for Big Data. The key point of Big Data technology is the methods of computer processing of large arrays of heterogeneous information. Big

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Data-based forecasts allow city authorities to make decisions based on the actual situation and ways of its development. Automation of emergency response systems allows city services to instantly receive the necessary information from the Data Center, come to the rescue on time or carry out the necessary city work.

Internet of Things - Internet of Things (IoT) is the construction of smart networks on the Internet for the interaction of objects with each other. On this basis, it is possible to synchronize their action in different situations, without specifying the program of operation of each object separately. The transition to IoT took place in 2008-2009, when the number of things, using sensors connected to the Internet, surpassed the number of living network users. The Internet of Things has its own stages of development: smart object → smart home → smart city → smart planet. In the " smart city" phase, devices and homes are combined into intelligent systems using sensors. Such sensors are increasingly being introduced into the urban environment in the field of transport, ecology, and other areas.

One of the aspects of digitalization of cities is the creation of a digital twin of the urban environment. This approach, based on the modeling of urban systems, allows researchers to study the problems of urban development in all aspects. The effectiveness of the work of all city services - police and transport, energy supply and housing and communal services, health care and education - will be visible briefly. The digital model will help city officials see breakthrough points and direct resources and efforts to the right places. The impetus for the formation of smart cities will be provided by the introduction of 5G technology - the fifth generation of mobile communications. A powerful telecom infrastructure will ensure the development of the Internet of Things.

The concept of a smart city is based on various directions for the development of the urban environment, improving the quality of life of the urban population, obtaining the best long-term ratio of costs and benefits, considering a systematic approach to solving problems in one direction or another of the development of the urban environment. Smart city development ideas represent the possibilities of managing cities or urban areas in a modern way using the latest technical means, digital technologies in accordance with the principles of environmental protection and while maintaining the trend to save resources. The use of digital technologies in various spheres of human activity can significantly improve the functionality of modern cities [7].

When discussing the concept of a smart city in the literature, the role of advanced technologies in the functioning of the city is a characteristic and essential element. However, in recent years, an increasing number of state and municipal organizations, technology companies, research associations are engaged in determining the criteria for the development of certain cities that are not related only to the use of digital technologies that make it possible to distinguish between smarter and less smart cities [8].

Thus, the availability and quality of modern technologies are not the only indicators of the development of smart cities. Some researchers include in this concept the relationship between digital infrastructure and cost-effectiveness. Others point out that agglomeration growth problems are usually solved by creative means, stakeholder engagement, human capital, and innovative ideas [9]. Therefore, smart cities should focus on innovative solutions that allow the development of modern cities by qualitatively and quantitatively increasing their productivity [10].

In the context of the development of smart cities, technology has significant social significance. They must be useful to society and respond to key social problems. Technology must be transparent and must address critical ethical security and privacy concerns. In addition, digital technologies in the context of smart city development should contribute to the development of equity, inclusiveness, and social responsibility. An-other feature of smart city technology is that it must be flexible, open, and scalable. Digitalization must be creative, foster collaboration and integration of ideas from different stakeholders. In the context of the development of smart cities, digital technologies must build bridges between social, cultural, and other differences between citizens and benefit from diversity [11].

Thus, we can conclude that the introduction of digital technologies into the processes of the urban environment significantly changes the social environment and creates the basis for the development of new institutions of a digital society. A significant part of the activity is transferred to the virtual environment, which, in turn, requires the formation of new principles of behavior and interaction. Thus,

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with the development of smart cities, factors of a cultural, institutional, and social nature are becoming increasingly important [12, 13].

Active attempts to develop smart cities are being made in Russia as well. In 2019, the Ministry of Construction of the Russian Federation ranked Russian cities according to the degree of development of Smart City technologies in them. One of the most important characteristics of a smart city, which stands out in Russia, is the activity of citizens in solving urban problems. All smart decisions of the city authorities will not succeed without e-readiness - the willingness of citizens to use electronic services, which implies wide Internet access, free Wi-Fi on city streets and in public places. The city portal is the main service for communication with ordinary citizens: here you can send a complaint, ask a question, get acquainted with information about the work of city services and take an initiative to improve the urban environment. An effective solution for the development of a smart city is an application that allows users to solve a complex of problems, whether it is paying for utilities, making an appointment with a clinic, or finding a suitable school for a child.

There are many definitions of smart cities. The concept of "smart city" has arisen recently. Moreover, there is no unambiguous and accepted interpretation of this term yet. Initially, the word SMART hid an abbreviation, where each letter denoted one of five key requirements for effective goal definition: the goal according to the SMART principle should be Specific, Measurable, Achievable, Realistic and Timed. It turns out that a “smart city” is a city that can be effectively managed [14].

The very concept of a smart city originated in the late nineties. It was then that the progressive part of humanity first realized that the future lies with the development of the IT sector. Initially, this idea developed exclusively in an ecological and nature conservation context. But today Smart City is an all-encompassing reality. In a broad sense, the concept of Smart City implies ensuring a modern quality of life using innovative technologies that provide for the economical and environmentally friendly use of urban life systems [15].

According to the definition proposed by C. Harrison [16], "smart city" means a city that "combines engineering infrastructure, IT infrastructure, social infrastructure and business infrastructure to use the collective intelligence of the city." T. Nam understands a smart city as "... a high-tech and intensively developing city that unites people, information and elements of urban infrastructure using modern technologies to create a competitive and innovative economy, as well as a high quality of life" [16].

A number of conceptual variations are often achieved by replacing the word “smart” with alternative adjectives, such as “intelligent” or “digital.” The label “Smart City” is a fuzzy concept. There is no single template for building a Smart City, not a single universal definition of this concept. This term was first used in the 1990s. At that time, the focus was on the importance of new ICTs in relation to modern urban infra-structure. The California Institute for Intelligent Communities was one of the first to focus on how communities can become smart and how a city can be designed with information technology in mind. A few years later, the University of Ottawa's Center of Management began to criticize the idea of smart cities as being too technological a concept. In addition to the technological aspects, according to the researchers, smart cities have strong governance-oriented capacities that emphasize the role of social capital in urban development.

A comprehensive approach to characterizing a smart city is presented in the work Cities in Motion Index (CIMI), developed in 2014 by the Center for Globalization and Strategy at the IESE Business School of the University of Navarra. The Center for Globalization and Strategy is an expert structure that studies the effects and consequences of globalization for competitive business and society, assists companies in improving their strategic positions in international markets by developing concepts and generating data. The CIMI Indicator System is a research platform whose mission is to develop a Cities in Motion model that combines an innovative approach to city management and a twenty-first century city model based on four factors: a sustainable ecosystem, innovative activity, equal opportunities for citizens and well-connected territories. CIMI's goal is to support the implementation of valuable ideas and innovative tools that help make cities more resilient and smarter, and to support local development. The CIMI indicator system was the first of its kind, proposing to assess the level of development, sustainability and “intelligence” of a city using a synthetic indicator, which is a function of a number of available indicators of the development of various urban sectors, including: city government and citizen

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participation; international fame; urban planning; social justice; local government; mobility and transport; technologies; human capital; environment; economy.

Since 2014, more than one hundred cities in the world have been assessed annually based on CIMI, and the indicator methodology has undergone some changes over a five-year period: in 2014, the assessment was conducted for fifty-three indicators grouped into ten sectors, and in 2019 the number of indicators increased to ninety-six. but the number of sectors was reduced to nine - "city government and citizen participation" and "local government" were combined into one group - "city government". We can say that the CIMI system of indicators includes indicators that characterize not so much the use of SMART technologies and ICT, but the result of their application, which affects the state and level of development of the city. Since these indicators are assessed annually, it allows us to track in dynamics how cities are changing under the influence of the ICTs used [17-19].

Currently, the assessment of the development of smart cities is associated with the measurement of changes caused by the introduction of modern technologies. The technology of smart cities has the greatest impact on changes in the social, economic, and environmental spheres, increasing the sustainability of the development of territories. Sustainable development of urbanized areas is increasingly associated with the introduction of smart technologies, the creation of sustainable social and management solutions. In this regard, the development of Russian cities based on the concept of a smart city will form the preconditions for sustainable development of the territory.

The purpose of this work is to compare large Russian cities Moscow (Msc), Ekaterinburg (Ekb) with the world's leading cities Barcelona (Brc) and Singapore (Sgp) in the implementation of smart city ideas, as well as to develop recommendations for Russian cities in the direction of using smart solutions to increase the sustainability of their development.

2. METHODS

To ensure development and positioning themselves well, cities must identify their strengths and the chances of positioning and securing comparative advantage in certain key resources when compared to other cities of the same level. These days, even if they are common, modern rankings differ in their approaches or methods. They pursue specific goals focused on the interests of individual participants in the digitalization of the urban environment. In addition, local authorities publicly discuss ranking results if their own city does not have a high ranking. Due to the different interests behind the rankings, the indicators used and the methodological approaches, it is also normal for one city to occupy quite various places in different rankings. In addition, medium-sized cities are often not considered when they are not recognized globally, which in fact would already be a particularly advantageous position. For ranking, a sample of the urban sample is required.

Different cities have different priority goals and objectives, but all smart cities have three things in common:

1. Availability of a secure information and communication technology (ICT) infrastructure.

On the one hand, an infrastructure must be created to guarantee residents access to information services at any time and in any place in the megalopolis, on the other hand, information centers on the components of the "smart city" must be created. The main tasks of such centers are to ensure the integration of various systems and the provision of certain information services depending on the category of users. It is not enough just to provide the user with access to information, you need to ensure the convenience of using this data.

2. The city should have a well-built and integrated management system.

Numerous “smart city” systems will operate harmoniously only with strict adherence to uniform standards. It is important to have effective management and analytical tools to accurately read possible negative and positive trends. It is almost impossible to do without Business Intelligence tools (methods and tools for translating raw information into a meaningful, convenient form). The need for them is especially acute in the field of security, where the life and health of people often depend on the correct interpretation of data.

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3. A smart city must have smart users.

ICT is useless in the absence of competent users who can interact with intelligent services. A smart city should not only expand access to smart devices for all categories, but also provide training to work with them. Moreover, the larger the solution is implemented, the more users will have to be trained at a time, respectively, the more expensive this process will be.

The transformation of industrial cities into "smart" ones is a global trend that involves a radical restructuring of the municipal management system, including a change in goals and objectives, as well as performance indicators. The main driving force is the active participation of citizens in the life of the city and its management using intelligent information systems [20].

“Smart city” is a modern strategic development that combines numerous factors of urban development into a single system. The Smart City project is a unique program for the complete reconstruction and modernization of the city's infrastructure with fundamentally new centralized management capabilities, a new level of services and security. The project is based on an information communications system - a network that includes various urban objects of administrative, economic, housing, public and commercial activities. At the same time, a center for processing and managing information is being created, new services, services and programs are being introduced for the administration, organizations, and residents of the city [21].

As a result of the creation of such systems, it is possible to carry out centralized and operational management of urban infrastructure facilities; qualitatively increase and increase the volume of housing and communal services; to update and reconstruct the existing engineering networks.

Smart City systems provide the ability to centrally collect various information related to the life of the city, its operational processing, and the provision of results in the form and quality that are necessary for the administrative apparatus of city management. Thus, the level of security of the city will increase; new commercial and social programs for city residents will appear, as well as fundamentally new areas of activity that can attract investment in the development of the city's economy [22].

The importance of cities in the development of the country, and indeed of the entire world, is growing every year, as is their population [23]. However, rapid urbanization is accompanied by the emergence of a number of problems related to electricity, water supply, transport, sanitation, education, and health services. Resolving them requires new and comprehensive strategies that can not only eliminate pressing difficulties, but also ensure further progress [24].

There is a need for a new model, a new paradigm of city management, which would be able to ensure the most efficient use of natural resources and at the same time ensure a high standard of living. Such a model could be the concept of a “smart city.” This is a modern strategy for combining numerous factors of urban development, aimed at modernizing infrastructure with fundamentally new opportunities for centralized management, a new level of services and security. This city development strategy is based on technological advantages that allow centralized collection of various data, processing and displaying them in the form and quality that are necessary for the administrative apparatus to effectively manage the city [25-27].

The approach to managing a smart city can also differ depending on a number of factors. But on average, we can say that the essence lies precisely in the integration of various state and non-state organizations into a unified system that can provide "smart" services and providing convenient opportunities.

The object of this study was large cities that are actively introducing digital technologies to improve the living comfort of their residents. For comparison, the cities of Singapore (seven million inhabitants), Barcelona (1.6 million inhabitants), as well as Moscow (twelve million inhabitants) and Ekaterinburg (1.4 million inhabitants) were selected. The subject of the research is economic relations in the formation of a digital society in the city. The research method is system logical analysis of key indicators of the development of smart cities. As an information base, we used analytical reports, data from federal and regional programs for the development of smart cities.

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3. RESULTS

In world practice, there are many options for the concept of "Smart City", but the basic principle of formation should be based on the structure of the controlled elements of the city and consider the specific goals and objectives that it faces [28, 29]. Such a matrix approach allows one to assess the evolution of the development of a smart city and its main characteristics. For comparison, we took such cities as Moscow, Ekaterinburg, Barcelona, and Singapore. We compared city data for three blocks: Infrastructure, Integration, Interfaces for all six components (Smart Economy, Smart City Environment, Smart Management, Smart People, Smart Environment and Smart Mobility). The results of the study are presented in table 1.

Table 1. Indicators of economic and technological development of smart cities

City → / **Indicator ↓**	Ekb	Msc	Sgp	Brc
Percentage of production robotization,%	24	42	90	59
Percentage of buildings using integrated management systems,%	36	55	63	56
Percentage of employees of municipal organizations with a personal computer,%	12	37	78	54
*Number of institutions of higher education per 100 thousand inhabitants,%**	46	61	100	78
Percentage of solid waste disposal, %	15	34	61	39
Percentage of the public transport network of the total length of roads,%	14	78	82	66
*Number of open datasets (smart economy),%**	60	70	80	100
*Number of open datasets (smart living),%**	50	80	100	80
*Number of open datasets (smart government),%**	30	50	100	70
*Number of open datasets (smart people),%**	40	60	100	100
*Number of open datasets (smart envoirenment),%**	40	70	100	90
*Number of open datasets (samert mobility),%**	70	100	100	80
Percentage of purchases in electronic form,%	40	100	100	80
Percentage of utilities with an electronic interface,%	50	80	100	80
Percentage of public services in electronic form,%	50	60	80	100
Percentage of students using the electronic educational environment,%	85	90	100	100
*Number of environmental information services,%**	40	70	100	90
*Number of transport tracking services,%**	70	100	90	80

* The best indicator among the compared cities is taken as 100%.

First, let us analyze the indicators of the development of the infrastructure of smart cities. The infrastructure of smart cities is the most crucial factor in the development of the urban environment in a digital society. The overall attractiveness of the urban environment for residents of these cities, the ability to attract resources, talented people, and create conditions for sustainable development of the territory, depend on how developed the infrastructure is.

Infrastructure development is a powerful innovation driver, because in cities that pay attention to infrastructure projects, there is a demand for innovation, innovative solutions and technologies that are the basis for infrastructural transformations. Thus, the development of infrastructure is one of the key areas for the formation of smart cities.

To assess the infrastructure, we have selected six indicators in six areas of smart city development: smart economy, smart living, smart government, smart mobility, smart environment, smart people. One

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of the most important indicators of economic development in the context of digitalization is the indicator of production robotization. Comparison of cities in this indicator showed that the highest level of production robotization was achieved in Singapore, while the Russian cities of Yekaterinburg and Moscow lag significantly behind in this indicator.

Another important indicator that characterizes the development of urban infrastructure is the percentage of smart buildings. It should be noted that according to this indicator, the cities under study have comparable values, while Singapore is leading by a small margin.

Another important indicator that we have chosen to study infrastructural development is the indicator of utilization of solid household waste. Modern cities are the main polluters of the environment, a place where a huge amount of waste is generated. Within the framework of the implementation of the concept of a smart city, environmental issues are given special importance. Studies show that in advanced cities, the percentage of utilization of household waste reaches 70%, while Russian cities are still significantly lagging in this direction.

An important condition for the formation and development of ideas for smart urban management is the creation of an effective system for handling digital data. Currently, digital data is considered as the main resource for transformations in socio-economic systems of various levels. Digital technologies, which have simplified the processes of generating, transmitting, analyzing, and interpreting digital data, have significantly increased the role of digital data in management issues. In this regard, the idea of big data is developing at a significant pace, with which prospects are associated with increasing the efficiency of the functioning of economic systems. In this regard, we tried to analyze such indicators as the number of open sets of digital data provided by various municipal structures for their use by a wide range of stakeholders.

In the field of improving the efficiency of interaction between users and technical systems, tasks are being addressed to increase the percentage of purchases made in electronic form, the percentage of electronic services provided in electronic form, the percentage of students using various electronic platforms and digital environments, numerous services in the field of ecology, transport, etc.

A significant indicator of the development of a smart city and the acceptance of this model among businesses is the share of purchases conducted in electronic form. In Yekaterinburg, this figure is two times lower than in other cities under study. This can be explained by the fact that advanced cities are striving to make the procurement process transparent and accessible to suppliers. Thus, municipal authorities are investing significant resources in the digitalization of procurement processes.

The next important indicator characterizing the efficiency of interaction between smart city systems and the local population is the indicator of the number of municipal services that are provided in electronic form. The leader among the surveyed cities for this indicator is Barcelona, known for its development in the field of digital management and interaction with the local population through digital systems. Singapore and Moscow to a certain extent lag Barcelona in this indicator, while the authorities of the Russian capital have recently been paying attention to the development of a system of interaction with the population using digital technologies. Moscow is actively developing the mos.ru municipal digital portal, which provides many opportunities for interaction with local authorities in various areas of the city economy (education, healthcare, business, utilities, etc.).

The next important indicator of the development of a smart city is the indicator characterizing the development of online learning among the population. Online education is becoming a crucial factor for the development of the intellectual capital of the local community, the exchange of knowledge and ideas in the field of urban development, and a driver of innovation processes. In the context of the COVID-19 pandemic, online education has shown its effectiveness and ability to complement traditional forms of the educational process. The study showed that online learning is quite widespread among the observed cities. The leaders in this indicator are Barcelona and Singapore, while Moscow and Yekaterinburg have comparable indicators in this area.

The development of digital systems in various areas of the urban economy is a priority for modern cities. In the environmental field, various applications and services are being developed to monitor the level of environmental pollution in large cities in real time. Such solutions make it possible to promptly respond

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to excess levels of pollutants and implement measures to reduce the negative impact on the environment. The interfaces of such systems allow a wide range of city residents to monitor the environmental situation and participate in environmental activities. As our research shows, the authorities of Barcelona and Singapore offer a convenient provision of information for users, a developed interface of interaction of environmental monitoring systems. Moscow, despite the general attention to environmental problems, is still lagging in this indicator. As for Ekaterinburg, there is a significant lag in providing quality and timely information on environmental issues. Firstly, in Ekaterinburg, a centralized system for monitoring the environmental situation is not developed, and secondly, the data collected by numerous services do not provide them in real time, which makes it difficult to quickly respond to a worsening situation. Since the problem of environmental pollution is especially acute in Ekaterinburg, local authorities need to focus their attention on creating an effective environmental monitoring system that allows obtaining data on the main indicators of pollution in real time.

As for the transport sector, Moscow is the leader in terms of user interaction and digital systems. Indeed, Moscow attaches particular importance to solving transport problems due to the severity of problems in the transport sector. In this regard, public transport, metro, and other alternative modes of transport are actively developing, which significantly reduce the load on the transport system. It should be noted that Singapore and Barcelona also pay considerable attention to the problems of the transport system. Digital platforms and aggregators are actively developing in these cities, allowing to reduce the load on the transport system by organizing sharing services in the field of taxis, bicycle transport, etc. It should be noted that Ekaterinburg is still lagging the leading cities in this indicator.

To summarize the data used in our study, three diagrams were built that clearly characterize the level of development of the cities under study at three levels: infrastructure level, data level, interface level. As for the generalized level of infrastructure (Fig. 1), we note that the leader in all indicators is Singapore. Our findings about Singapore's leadership are supported by other studies from established organizations and technology companies such as IBM, Cisco, etc.

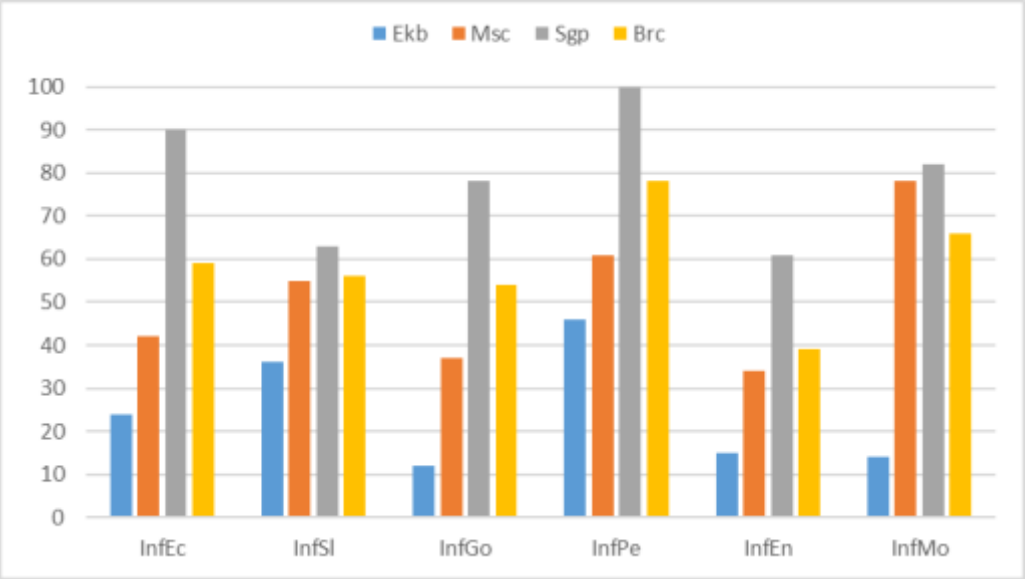

Figure 1. Formation of infrastructure (Infrastructure).

Our research has shown that Ekaterinburg lags far behind other cities in most indicators. First, this is due to the lack of financial resources, the lack of opportunities to attract advanced technology companies to the implementation of projects for the digitalization of the urban environment.

Considering the development of the digital data handling system in the studied cities, in general, we can conclude that Moscow, Barcelona, Singapore pays considerable attention to open data issues, their collection and provision for a wide range of stakeholders (Fig. 2). In these cities, special programs are being implemented, and interaction between various organizations on working with digital data has been established. Ekaterinburg lags significantly behind in the creation of open data sets related to

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various aspects of the urban environment. This significantly hinders the development of Ekaterinburg, reduces the opportunity for the development of an innovative component of the urban environment.

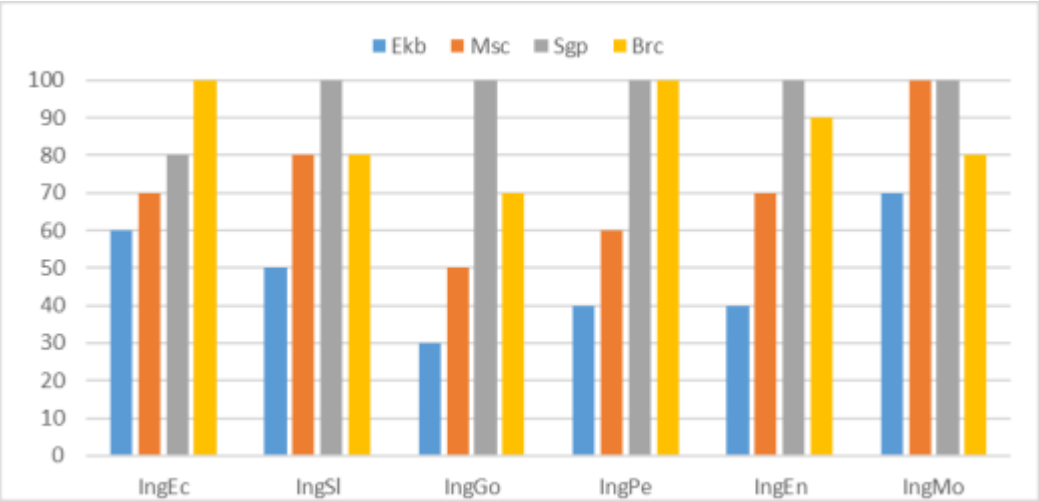

Figure 2. Integration of data on digital platforms (Integration).

Considering the level of interfaces of the cities under study, we note that Barcelona, Singapore, and Moscow have comparable indicators, while Ekaterinburg is almost two times lagging in this direction (Fig. 3). The creation of an effective system for the interaction of digital systems with users is the most crucial factor in the development of a smart city.

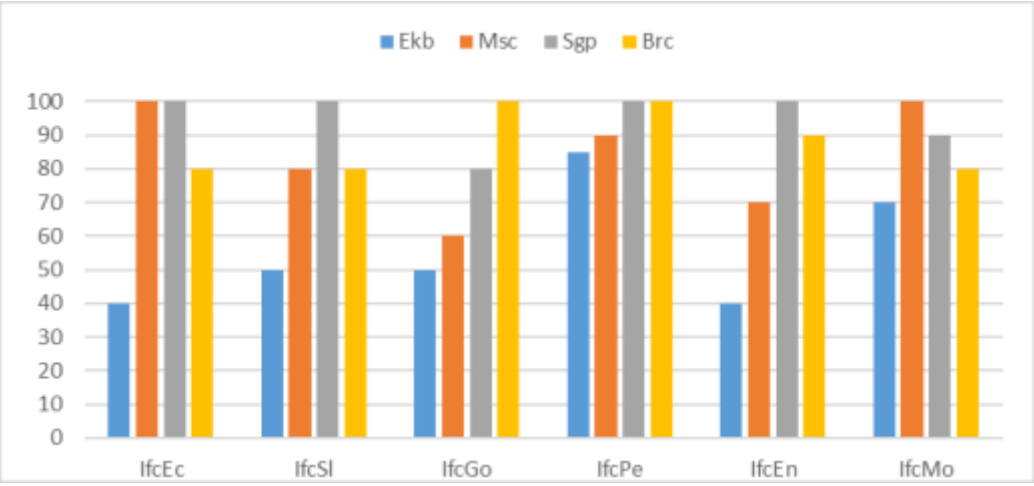

Figure 3. Interaction between users and technical systems (Interfaces).

The results of the study allow city administrations to assess the current level of development of modern technologies for city management and solving urban problems. The indicators of smart cities allow you to see the strengths and weaknesses of the city's infrastructure and form the priority directions of development in the future. In general, it can be noted that Ekaterinburg lags significantly behind in terms of data openness for their use. From our point of view, this is due to the inconsistency of various municipal structures in the collection, processing, and provision of data for public use. The development of a data handling system requires certain institutional transformations, the coordination of the interests of most stakeholders, and the solution of problems in the field of cyber security. The concept of open data has already shown its effectiveness in the cities where it was implemented. Open data is a powerful tool for creating innovative products and services, increasing the transparency and efficiency of decision-making in various areas of the urban economy.

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4. DISCUSSION

The analysis of indicators of the development of smart cities demonstrates a certain lag in the pace of formation of a digital society in the Russian mega-policies of Moscow and Ekaterinburg from the smart cities of Singapore and Barcelona (Table 2).

Table 2. Priorities for development of Moscow and Ekaterinburg smart cities

Smart city component	The essence of developmental lag	Development priority
Smart living	The percentage of utilities provided in electronic form in Ekaterinburg is two times less than in Singapore and Barcelona	A new service delivery model needs to be developed, focused on modern technologies and electronic interaction with users
Smart environment	The percentage of waste disposal in Ekaterinburg is four times lower than in Singapore, in Moscow 2 times lower than in Singapore	It is necessary to implement a program for the construction of waste recycling plants
	The number of information services in the environmental sphere in Ekaterinburg is significantly less than in the leading cities of Singapore and Barcelona	Since the problem with ecology is one of the most important for Ekaterinburg, it is necessary to develop digital tools that help to improve the quality of the environment
Smart mobility	The availability of public roads in Ekaterinburg is significantly lower than in other cities under study	It is necessary to implement a program for the construction and reconstruction of public roads in regional centers, incl. Ekaterinburg
Smart economy	The level of production robotization in Ekaterinburg is three times lower, in Moscow it is two times lower than in Singapore	It is necessary to develop domestic innovative products in the field of production robotization and their introduction into the real sector of the economy
Smart government	The provision of employees of municipal services in Ekaterinburg is eight times lower than in Singapore, in Moscow it is 2.5 times lower than in Singapore	It is necessary to provide employees of municipal services with modern computer equipment, as well as develop the appropriate skills to use it

As you can see from the table. 2, not for all components of a smart city have been identified some problems of the development of Russian megacities. So, no development problems have been identified for the component of smart people. Indeed, the indicators in this direction, especially in the application of e-learning, are comparable to the cities-leaders of the world rankings of smart cities - Singapore and Barcelona. In general, we can note the comparability of indicators in the direction of providing open data for their use by a wide range of interested parties.

5. CONCLUSIONS

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In this study, to determine the development priorities of the Russian megacities of Moscow and Ekaterinburg based on comparison with the indicators of infrastructural and economic development of smart cities in Singapore and Barcelona, the following theoretical and practical results were obtained.

First, various methods of comparative assessment of smart cities are analyzed and the problem of a comprehensive analysis of the development of modern megalopolises is posed.

Secondly, based on the analysis of the main indicators of the development of smart cities in the areas of infrastructure, data integration, interfaces, a comparison was made of data characterizing the formation of a digital society in the cities of Singapore, Barcelona, Moscow, Ekaterinburg.

Thirdly, because of the analysis, some lagging behind the indicators of the development of Russian megalopolises in comparison with the data on the development of Singapore and Barcelona was identified.

Fourth, the priorities for the development of the Russian cities of Moscow and Ekaterinburg are proposed in the direction of the further formation of a digital society.

The results obtained are the basis for the development of large Russian cities (Moscow, Ekaterinburg) in the context of urbanization and digitalization of the urban environment. The results of the study will help form the priorities for these cities based on their comparison with the leading cities in the field of smart development, which will significantly improve the quality of life of the local population and increase the competitiveness of Russian cities.

The theoretical significance of the results obtained lies in the development of methodological foundations for the analytical comparison of indicators of the development of smart cities. The practical significance of the results obtained is in the formation of development priorities for the analyzed large cities.

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