

7I-Model for Smart City Development

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ABSTRACT

The subject of the study is the development of smart cities, the effectiveness of the socio-economic systems of which is ensured by the introduction of advanced digital technologies. The research method is a logical system analysis of previous studies highlighting the development priorities of smart cities and attracting authors' results on institutional modeling of economic activity. The purpose of the study is to develop a system of sequential priorities for the development of smart cities based on institutional modeling of the stages of the formation of a digital society. As a result of the study, the author's model of smart city development priorities is presented (the "7I" model), it is shown that the basis for the development of smart cities is the following stages: engineering infrastructure, institutes, communication and communication systems, data integration, user and technical systems interaction, innovations, application of innovation in the components of a smart city. It was determined that these stages of the development of smart cities are based on the use of advanced digital technologies and their applications: big data processing, the use of cloud technologies, digital platforms, blockchain technology, as well as shared economy, crowdsourcing, Internet of things, etc. It is concluded that the development of smart cities corresponds to the national interests of states in the formation of a digital society and ensures the safety of life in the context of the application of digital technologies.

Keywords: Smart city; Digital society; Development priorities; Modeling, 7I.

INTRODUCTION

In the past few decades, the trend of urban development through the introduction of digital technology has become one of the dominant ideas in the formation of modern urban space. This became possible with the advent of innovative technologies, such as the Internet of things, digital platforms, blockchain. Already, there are a significant number of predictions about how digital technologies can change socio-economic relations in the near future. In the past few years, studies that are at the junction of the study of technology, society and the environment are especially

relevant. This was a kind of response to the increasing problems of an economic, environmental and social nature. Advanced technologies, especially modern digital innovations, are increasingly seen as a tool to overcome the prevailing socio-ecological-economic contradictions [1].

In solving problems of a regional and municipal scale, the idea of the need to implement digital technologies in urban environment management processes, digitalization of urban space, and the use of digital technologies in solving energy, environmental, and transport problems is developing more and more actively. This set of ideas in the scientific literature is defined as the concept of "smart city". A significant progress in the development of digital technologies helps to create a holistic design of future city, which is increasingly based on smart technology and is increasingly associated with the implementation of the concept of smart development [2].

The social, economic and technological changes associated with globalization, digitalization and urbanization form the basis for the development of smart cities. Cities are faced with the need to combine economic competitiveness and urban development on a sustainable basis, improving the quality of life of citizens. Although the concept of "smart city" is the result of research in the field of digital technologies, this concept is increasingly being investigated in other areas of scientific research, including economics, ecology, and sociology. This indicates the need to consider this phenomenon from a socio-economic point of view. This approach makes it possible to assess the state of the current urban environment and the prospects for the development of cities of the future [3].

Civil society is an integral part of the development strategy of smart cities, which requires improving communication channels between citizens and decision-makers, as well as creating conditions for the transparency of decision-making procedures and developing the capabilities of modern digital devices. The use of achievements in the field of artificial intelligence in the management of modern cities, the processing of large amounts of data and cognitive algorithms contribute to increasing the efficiency of urban space management. Similar tools to increase efficiency are also used in other areas of the development of smart cities, such as transport, education, and healthcare. For example, modern transport systems use in their work large amounts of unstructured data processed in real time, ensuring the functioning of transport in large cities, which is a typical example for reasonable urban projects. Using the tools of the digital economy, in particular big data, allows to increase the prognostic capabilities of the decision-making system, to extract and analyze data that are not explicitly related to each other. Thus, it can be stated that the development of computational intelligence will make a significant contribution to the processes of socio-economic development [4].

A study of the experience of developing smart cities shows that cities need to actively interact with public and private organizations, as well as with knowledge institutions. Cities should base their smart development models on three main areas, including infrastructure, human capital, and data. In the process of forming smart cities, leaders in this direction faced problems such as providing the necessary infrastructure, creating networks of cooperation, and developing initiatives. During the implementation of smart city projects, both the public and private sectors benefit significantly from this initiative in the context of improving public services, creating innovations, developing business and building cooperative ties. The main components of the smart city strategy are the creation of residential laboratories, electronic services, infrastructure, open data. The concept of a

smart city is widely used as a strategic tool to cover modern factors of urban production in a general framework and to increase the competitiveness of cities. Cities such as London and Barcelona marked the beginning of the development of the smart city model, expecting that it will lead to the effective management of cities, which is a requirement of any modern city. Studies on the introduction of the concept of a smart city in the practice of managing modern cities confirm that such a concept has found application in leading cities in the world, increasing their efficiency and competitiveness [5].

Modern trends in the development of urban spaces are oriented towards balanced development, taking into account the interests of various groups of the population. The main directions of development are to ensure safety, social security, environmental well-being, economic justice. At the same time, despite a significant number of studies on smart cities, many issues of their formation and development remain unexplored. In particular, the main directions of the development of smart cities are not indicated, and priority directions are not identified in the framework of the development of the urban environment in the context of digitalization. Thus, the aim of the study is to develop a system of successive stages in the formation of smart cities based on modeling the processes of development of a digital society.

The transformation of modern urban space is due to the incorporation of digital technology into the physical space of cities and the formation of a common digital environment. In such a situation, smart cities are the subject of social and technological research, raising a questions about the interactions of people and technology in the context of digitalization.

Studies of the problems of the development of smart cities in general outline include several directions [6]. Firstly, it is a research in the field of traditional components inherent in each city. This is an important factor in the willingness of cities to master functions based on digital technology. Secondly, this is a direction of research in the field of digital technologies and data transmission networks, which unite the economy at the initial step to a smart city. Thirdly, these are the issues of applied technological capabilities. Often, interconnected real-time control systems such as smart power systems, smart transport, electronic payments and e-government are involved in the system. Fourth, particular attention is drawn to the opportunities of the innovation environment for business. Smart cities form an innovative ecosystem with extensive social interactions that creates economic value through the collection, processing and use of data. The formation of the infrastructure of a smart city through social networks and communities, legal and cultural systems and various forms of social interactions creates the conditions for the development of a smart city based on social sustainability [7]. In recent years, there has been an increase in the number of studies that note the institutional component as the main reason for socio-economic development. In addition, as an important factor in the development of smart cities, we note the social and human capital formed in a certain territory.

The problems of the rational development of cities are increasingly the subject of discussion in the scientific literature. A significant number of studies are aimed at identifying and identifying the barriers and obstacles associated with the development of smart cities. An extensive review of scientific research allows us to group the difficulties of developing smart cities into a number of key areas related to management problems, economic, social, technological, legal aspects. Depending on the specific situation, their combination, as well as the strength of the impact, may

vary. Conducting such studies to identify problem points and bottlenecks in the development of smart cities is useful both theoretically and from a practical point of view, as they can contribute to the development of the urban environment at a faster pace [8].

THE SPECIFICS OF THE DEVELOPMENT OF SMART CITIES

In modern literature there is no single understanding of what a smart city is. This term is currently used as a synonym for almost everything that is considered modern and innovative. In general terms, the “smartness” of a city is characterized by its ability to combine its own resources, efficiently achieving the goals and fulfilling the tasks of socio-economic development and meeting the needs of a citizens. Also, the intelligence of the urban environment can be associated with those opportunities for collecting, processing, managing digital data and making decisions based on them in the framework of solving urban problems.

The lack of a unified approach to understanding the phenomenon of a smart city causes additional difficulties in a number of issues related to modeling the development of a smart city, methods for assessing their development, structural components and stages of formation. In some cases, smart cities are explored as social systems under the influence of internal and external factors. Among internal issues, issues of management, social and urban environment, and entrepreneurship are considered. External factors include digital technology [9].

Following a wider concept of a smart city, a number of researchers consider a smart city from a position of sustainability, focused on the needs of citizens [10]. It is noted that the development of the urban environment is associated with investments in social capital, human capital, transport, digital technologies, which contributes to sustainable economic growth and improved quality of life, rational use of resources and citizen involvement in management processes.

Recently, a smart city is increasingly seen as a large living laboratory for testing innovation. At the same time, the ability of the city to attract human capital, create network structures between different actors through the use of digital platforms that improve urban life and increase local sustainability in terms of people, management, economy, mobility, environment and quality of life is assessed. It is possible to summarize the various definitions of smart cities and find common features that characterize smart cities and regarding the role of innovation and technology, environmental requirements and social development.

Despite many definitions, from our point of view, it is most appropriate to understand a smart city as a system of the urban environment based on the use of digital technologies as a means of maintaining economic, social, environmental balance, as well as improving efficiency in six areas of urban development: economy, management, urban mobility, environment, living conditions, human capital. It is also worth noting that, due to different conditions for the development of cities, internal and external factors, climatic, political, cultural and other features, the development directions of smart cities may vary [11].

In the conditions of the formation of a smart space of the urban environment, the priorities of urban development become interrelated and require the creation of a common information space and a data management system to provide intellectual services to urban entities. In such circumstances, one of the main approaches to managing increasing flows of information resources is the concept

of big data, which is a powerful tool for smart city applications. Current trends in the development of digital systems show how difficult it is to collect, manage, store and analyze big data [12]. However, the large volume and variety of data provides an excellent opportunity for creating intelligent applications that respond effectively to current changes and offer accurate decision-making tools. Thanks to this technology, many countries of the world, such as South Korea, the USA and the United Arab Emirates strive to create and support smart cities [13].

As cities tend to have large amounts of heterogeneous data, good data processing practices are key factors in determining reengineering, linking, formalizing, and using data [14].

In the context of digitalization, data play a decisive role in the planning of urban space and receive more and more significant attention from researchers. The key question in exploring the impact of big data on urban development is how and for whom data is collected, how it is used and managed. A significant amount of data is accumulated from new systems of electronic interaction, in connection with this there are questions related to the functionality, usefulness and ethical consequences of using this data. As part of addressing these issues, new forms of organizing interactions are developing in the form of shared economy models, crowdsourcing, crowdfunding. Studies of these processes are often associated with data research. The question of how to manage data that directly meets the needs of users is one of the key in modern conditions [15].

Public sector organizations have begun exploring ways to use big data to provide better solutions for citizens. In such circumstances, many public sector organizations found themselves in a new situation, trying to deploy and integrate work with big data into another rapidly changing and relatively new concept of a smart city. The results revealed a number of steps related to the research and use of big data in the framework of the initiatives of the "smart city": (a) search for knowledge; (b) rethinking knowledge; (c) interorganizational collaboration; and (d) subsequent evaluations [16].

One of the tools for creating an open data space is Living Labs, which act as an intermediary in innovation and promote collaboration between various participants in network interactions. By creating an environment for data exchange, they stimulate the use of open data and the further development of smart cities. New tools can take full advantage of modern market channels and a changing business environment, creating a new industry around open data. By creating a space in which benefits are most tangible, a living lab promotes smart urban planning and the development of a digital environment. Geographic and cultural externalities are enhanced by strengthening ties between firms, various government organizations, and all other participants in network relationships. The development of mobile Internet, open data, new channels for the provision of services and a growing number of owners of digital devices opens up opportunities for startups. By demonstrating the benefits of network collaboration, Living Labs, as innovative intermediaries, can support the interests of diverse stakeholders. The future development of the digital environment depends on the collaboration of innovative firms, the government, the infrastructure control organizations and the users themselves. All of these different actors collaborate around the Living Lab, creating value for themselves and each other [17].

In modern conditions, it is not enough just to consider the impact of digitalization on urban development. It is imperative to offer smart solutions for smart cities that will improve the quality

of life of their citizens. Thus, the main task is to bring innovative opportunities to cities in order to use their digital potential. Well-known solutions for smart cities are not necessarily suitable for all cities, because they have very individual characteristics and require a specific innovation process to solve various problems and specific needs. Therefore, the innovation process must take into account the local context, local stakeholders and smart solutions as factors that correct problems. Smart cities can use an open innovation approach to identify appropriate solutions. Moreover, the results of modern research confirm the need for further research that digital technology is becoming more and more vital for business and society as a whole [18]. While the concept of a smart city is designed to solve a complex of problems, it should also be remembered that there are serious risks that require discussion of the pros and cons of digitalization of urban space.

In the near future, apparently, real-time models of urban environment management will become a reality in many cities. It is worth noting that such changes carry potential risks of technocratic management, corporate governance of the city, technological blocking capabilities, and system vulnerabilities. Other ethical issues arise related to the supervision, observation and control of data, as well as problems related to data quality, reliability, safety, and reliability of analytics [19]. Recently, ideas about the role of technology in social change, the convergence of the technological and social factors and the formation of sociotechnical innovations on this basis have been heard more and more often. Modern smart cities are a prime example of such innovations in modern conditions and are increasingly being analyzed from the point of view of the socio-technical processes taking place within them. One of the main problems in this case is the institutionalization and coordination of various stakeholders who participate and interact in these social and technical processes. In this regard, strategies for the development of smart cities are increasingly being created that contribute to solving the problems of institutionalization and coordination.

The Internet of Things (IoT) plays an important role in the development of a smart city through monitoring, data collection, analysis and personalized service delivery methods [20]. The Internet of Things is already improving the quality of many services, including transport, housing and communal services, management, education and healthcare [21]. Other digitalization tools for the urban environment are cloud technologies, digital platforms, a sharing economy toolkit, as well as business models and forms of organizing economic activities based on crowdsourcing, crowdfunding and other elements of a digital society.

One of the important principles for the development of smart cities is that any smart city project needs to be evaluated in terms of local cultural values [22].

For example, a suitable offer of “smart cities” for Moscow (a Russian city known for its entrepreneurial, competitive and cosmopolitan bias) may be completely unsuitable for residents of Sochi (another Russian city whose strong values are connected with the contemplation of nature and balance between work and personal life). Therefore, there should be reservations regarding proposals for the replication of successful projects imported from other cultures and regions, even if they are in the same country. Thus, planning to turn any territory into a smart city may require more than just introducing best practices. To establish a real understanding of the place, the cooperation of all interested parties that really understand the history and values of the community (including its future) is necessary. As a result of such discussions, opportunities arise to determine what is relevant and useful, as well as secondary or undesirable for the community and the city as

a whole. In addition to the continuous nature of the transformation process, it is assumed that potentially in the long term, the most successful smart city projects will be those created by the residents themselves.

A study of urban communities shows that in smart cities, citizens play numerous roles and implement different behaviors when participating in the formation of an urban environment. The development of tools for involving citizens in the decision-making process for comparing and evaluating various projects from the point of view of a citizen is an important factor in the development of modern cities. Modern tools include the practice of involving and participating citizens in smart city projects, thanks to which scientists and stakeholders can better understand who is involved and in what capacity in any existing and future initiatives of the smart city. Such tools provide a basis for formulating new research directions, for example, in relation to a comparative analysis of various institutional structures and the scale of implementation of smart city projects, and the conditions for their implementation. In such conditions, it is necessary to create tools to engage citizens in the management of the urban environment [23].

Different types of cities have constantly evolved into more complex ecosystems that are able to offer more intelligent services and provide technological embeddedness as the ability of technology to integrate into social systems to provide intelligent services. During the development of smart cities, the level of technological embeddedness ranged from simple information delivery (low level) to the implementation of an intelligent system (functionality), then to systems that deal with social and human problems (quality of life) and environmental systems (sustainability).

The rapid growth of smart cities created the conditions for their classification and systematization. One approach is the classification in accordance with the project organization and the business model for the development of the urban environment. The following options are possible: a private company is engaged in the development of a smart city, respectively, independently financing this project; smart city is developing on the basis of public-private partnership; a lot of independent companies and other interested parties take part in the smart city project, with virtually no integration; a smart city is created and managed by the state with the involvement of a limited number of companies.

Another classification of the urban environment is based on the functionality that is offered to users: information sites, navigation, online chats (virtual city); fiber optic internet connection (broadband city); databases, knowledge bases (city of knowledge); wireless Internet, mobile Internet (wireless city); infrastructure based on digital technologies, human capital (smart city).

The development of a smart city occurs due to a change in its characteristics, which leads to the transition of the urban environment from one class to another. The reasons for this development are not yet clear, but it can be assumed that a number of factors of an economic, technological, and social nature influence this process. The authorities are forced to increase urban competitiveness, the quality of the urban environment, which pushes them to introduce new technologies. The urban population is also making increasing demands on the quality of life. An important factor is technological development, as well as the economic situation.

A fundamental moment in the development of a smart city is the design and development of the architecture of a digital system, which is used as the basis for the entire system, describes the functional aspects and structure of the system, characterizes the intra-system and intersystem relationships. The definition of the architecture of an information system is directly related to the collection of information and understanding of the needs of all interested parties, as well as environmental constraints that affect the operation of the system. The architecture of a smart city describes and defines the structure of the environment in which business systems operate.

The stages of digitalization of the urban environment usually includes the following components: “soft” infrastructure (people, knowledge, communities, business processes); “hard” infrastructure (buildings, urban facilities and utilities); innovations based on digital technologies, that is, hardware and software solutions that can be embedded in the aforementioned “hard” infrastructure; innovations not based on digital technologies, that is, innovations that cover other aspects of a smart city; physical environment and natural features of the city (for example, land, forests, rivers).

Modeling the architecture of a smart city is also possible on the basis of a modular approach, and it should be noted that the modular structure is more difficult to implement, since it requires taking into account the type of city and the features of its infrastructure. The soft infrastructure of a smart city (people, data and applications) is flexible, extensible, scalable. On the contrary, hard infrastructure and physical features of the environment impose many restrictions on modular design.

The result of the modular architecture of a smart city is a structure consisting of the following components:

1. Network infrastructure and communication protocol. Smart City forms the necessary network infrastructure (telecommunication networks and IoT) to deploy intelligent services and improve living standards in the city.
2. Applications that are available in the smart city ecosystem. These applications can be classified into 6 components of a smart city (smart people, smart mobility, smart government, smart economy, smart environment and smart living).
3. Business. This module applies to all business groups that are available in the smart city ecosystem and use smart applications. The module is devoted to the following issues of information management: user information for recognizing consumer behavior; business analytics for statistical and feasibility studies; industry information for monitoring market demand; business information for commercial and financial analysis; information about business activity.
4. Management. This module contains all the rules and procedures for managing a smart city. The main elements of this module are: information management; process management; personnel management; resource management.
5. Data. Data is crucial in smart cities and can be used or produced while it can be stored centrally or in a distributed manner (locally). The module includes data sets such as: data about people; process data; documents.

Note that there are other smart city models that highlight components such as smart city services, organizational, technological and social factors, as well as components such as infrastructure,

environment, institutions, communications and business models, which are the basis for analysis various directions of the smart city, including the transport system, the education system and other directions [24].

One of the challenges in exploring a smart city is that the real impact of digital technology on the economy and life of the city is extremely difficult to assess. The literature reflects a separation between a way that focuses on urban systems affected by digital technologies (economy, people, government, mobility, environment, living) and a way that focuses on planning efforts to improve urban environments. Both directions require a huge amount of data collection and processing. The first direction also requires a good modeling of the urban system to separate the impact of digital technology from the effects caused by other factors. In the process of digitalization of the urban environment, qualitative improvements such as the ability to respond more quickly to adverse events, the ability to complete transactions online, and the ability to pay for goods and services via the Internet are achieved. These fragmented results are part of the process of developing systems and applications through decentralized bottom-up actions without integrated planning.

Developing approaches to creating data-driven innovations requires a comprehensive understanding of various aspects of data, including standards, collection, analysis, management, ownership, accessibility and security. Building capacity to use data is also important when developing appropriate indexes and indicators to measure progress towards smart city development. Based on a solid foundation of data-based approaches, it is expected that the scientific community will develop the necessary skills and perspectives that contribute to the acquisition of knowledge that is not only academically accurate, but also applicable in practice [25]. Urban development planning is complicated by the lack of data on the impact of digital innovation on the sustainable development of the city. In some cases, this data is collected by government services, another source of quantitative data and metrics is global rankings such as Alexa and Google Page Rank, which indicate the widespread use of electronic services and the expansion of the audience, but do not describe the impact of electronic services on innovation efficiency and sustainable development cities.

Qualitative changes in the urban environment in the context of digitalization are characterized by higher information potential, support for companies from the digital technology sector and the creation of new jobs. Interactions in the real world are replaced by online transactions in the relationship of citizens with government agencies and firms, as more and more goods and services are offered on the Internet. In addition, more friendly image of the city is created as most of the information about the city and its characteristics, monuments, places of recreation and cultural resources becomes available on the Internet. These changes come from bottom-up initiatives, such as the expansion of broadband networks by telecommunications companies, progress in mobile communications, and the large number of applications created by small companies and individual developers [26]. Future research may contribute to a deeper understanding of bottom-up communities in terms of their problems, motives, organization, and life cycle [27].

METHODOLOGY

The object of research is the processes of formation of smart cities. The research method is a logical system analysis of previous studies with the identification of the stages of the formation of smart cities and the involvement of author's results on the modeling of economic activity.

The research algorithm was as follows: we analyzed a set of studies on the development of smart cities, identified successive stages in the formation of urban households in a digital economy, identified a hierarchy of priorities for the development of smart cities, and when discussing the results, we identified the possibilities for institutional modeling of the selected stages, as well as examples of the application of these stages in real urban conditions.

RESULTS AND DISCUSSION

As a result of the study, the following results were obtained on highlighting the priorities for the formation of smart cities (Table 1).

Table 1. Priorities for the formation of smart cities (7I).

Priority	Content	Directions for evaluation
1. Formation of urban engineering infrastructure (Infrastructure)	Urban infrastructure (utilities, roads, transportation) are the basis for the development of smart cities.	<ul style="list-style-type: none"> - electricity metering; - city lighting; - garbage collection; - sensors and surveillance cameras;
2. Institutional support for the development of the city (Institutions)	The development of a smart city is associated with formal institutions embodied in the form of strategies, projects, programs of a smart city, as well as informal institutions in the form of a cultural component.	<ul style="list-style-type: none"> - the number of documents adopted in the field of the development of smart cities (strategies, action plans, regulations)
3. Communication systems (Intranet)	This level directly indicates the ability to support innovative infrastructure and telecommunications to bring people and technical devices together to provide high-speed network access throughout the city.	<ul style="list-style-type: none"> - Internet of things; - the speed of fixed broadband Internet in the private and corporate segments; - network bandwidth; - The density of the urban Wi-Fi network;
4. Data Integration on Common Digital Platforms (Integration)	Real-time data availability is an integral part of smart cities that connect the physical world with the information world, and is a hallmark that justifies the term "rationality". A key success factor for smart environments is the provision of an open and distributed storage of information for all systems implemented on different technology platforms.	<ul style="list-style-type: none"> - open data; - the number of data sets on city portals;
5. Tools for user interaction and technical systems (Interfaces)	At the interface level, web solutions are implemented that provide intelligent capabilities and optimize the use of resources when processing data streams in real time.	<ul style="list-style-type: none"> - services in electronic form; - mobile applications for interacting with city services; - electronic and mobile payments; - electronic document management system;
6. Innovation development (Innovations)	Smart cities create a favorable innovative environment for new opportunities. For this, firstly, it is necessary to change the quality and effectiveness of state structures. Secondly, a smart city should be an attractive place to do business.	<ul style="list-style-type: none"> - innovation and research centers; - educational centers, institutes of urban informatics; - "living labs" (smart labs) - analytical centers;
7. The use of innovation in various areas of the smart city (Implementation)	Modern theories of urbanization pay considerable attention to environmental issues and environmental protection, transport, energy, as well as social issues such as education, healthcare.	<ul style="list-style-type: none"> - the number of users of smart medicine; - online courses; - users of public services in an online form;

In general, studying the issues of digitalization of the urban environment in leading cities such as Barcelona, Singapore, London, Copenhagen, Stockholm, Moscow, we can conclude that the processes of digitalization of these cities began with the creation of the basic infrastructure, digitalization of the transport system, and creation of systems of interagency interaction. Similar processes can now be observed on the example of Ekaterinburg.

The main goal of the transformation of Ekaterinburg into a smart city is to achieve the most important indicators of human capital development, improve the quality of life and increase the competitiveness of the economy through the introduction of services and solutions based on the most modern achievements in the field of digital technologies, which allow solving the most urgent problems of population.

The following principles underlie the concept of developing the intellectual capital of a smart city:

- openness of the authorities and ensuring the rights of citizens to access information;
- coordination of actions of various departments and divisions;
- effective interaction of the state with civil society institutions;
- maximum consideration of geographical, economic, socio-cultural, environmental and other features of municipalities, focusing on the interests of local residents and companies;
- support for newly created enterprises in the digital economy, the active involvement of manufacturers and suppliers in ongoing projects;
- reliance on the best world and Russian practices, interregional and international cooperation in the implementation of smart city projects;
- use of the project approach;
- openness to change.

Consider the basic directions of institutional modeling of the intellectual capital of smart cities on the example of Ekaterinburg. We have identified four key areas for the development of a smart city (regulation, digital infrastructure, personnel and education, information security).

Regulatory environment. The development of intellectual capital, the introduction of certain smart solutions depends on the existing regulatory and legal environment. The work is important in two areas: 1) improving the regulatory framework of the regional level 2) initiating the preparation of federal regulations and discussing them. The latter is critical for the development of smart technologies in such areas as energy and transport. At the first stage of increasing the intellectual capital of smart cities, regulatory legal acts should be developed and adopted that stimulate the introduction of digital solutions in all spheres of socio-economic and spatial development, support the emergence and growth of digital companies, determine the principles for selecting and financing projects, regulate access of citizens and enterprises to the data of state information systems. Normative legal acts should also establish uniform standards and protocols ensuring the creation of a single data and services space.

Information infrastructure. The central tasks in this direction are:

- openness to change;
- the elimination of digital inequality, the increasing penetration of broadband Internet access (including mobile);
- development of fifth generation cellular networks;

- development of the digital infrastructure of organizations of education, health care, culture, social services, public transport, as well as public authorities and local governments;
- development of a network of public access points using wi-fi technology;
- an increase in the volume of open state and municipal data available to the public, companies and researchers;
- development of data storage and processing systems.

Personnel and education. The institutional modeling of the intellectual capital of smart cities is inextricably linked with the modernization of social development. In this regard, identified areas that need to be developed among the population:

- information literacy (data query generation, critical assessment of reliability);
- communication and cooperation (the exchange of data, information, digital content);
- creation of digital content (creation and editing of digital content in different formats, recognition of intellectual property);
- information security (protection of devices and digital content, identification of risks and threats in digital environments);
- digital development (setting up the digital environment, setting up the digital environment in accordance with personal needs);

To prepare specialists in such rapidly developing and interdisciplinary areas as the smart city, it is necessary to create an educational environment based on:

- open educational resources;
- active use of project training;
- a system of external evaluation of the results of achievements;
- participation of high-tech companies in the formation of strategies for the development of institutions that train specialists for the digital economy.

Information security. Consumers of smart city services must be sure that their data will be used only for their intended purpose, and the mutual exchange is safe and guarantees the accuracy of the information transmitted. Also, consumers must be confident in the relevance, integrity, adequacy of the information that is provided to them. The security of digital services is a key factor that provides confidence in services and loyalty to the idea of a smart city, high speed of implementation and dissemination of new services and innovations.

As planned, the implementation of digitalization measures in Ekaterinburg will become a factor in the development and implementation of smart services, the development of centers of smart competencies, the creation of a regional brand and the formation of a digital environment. Planned development indicators by 2024 include the implementation of more than 100 start-ups per year, 50 existing smart services, the provision of 100% of government services in electronic form, the registration of 100 patents per year, the transition to the 5G communication standard, and the reduction in the share of foreign software to 10%.

It can be noted that the development of an urban environment based on digital technologies organically fits into the processes of digitalization of the economy of countries as a whole and meets

the interests of states in the formation of a digital society and ensures life safety in the context of the widespread dissemination of digital technologies [28].

CONCLUSIONS

The rapid development of digital technologies, their widespread introduction into everyday life, radically changes the principles of urban development. In modern conditions, when the number of challenges is growing rapidly, one of the possible answers to increasing challenges is the development based on the concept of a smart city. The most important factor in such conditions are modern digital technologies.

As a result of identifying the priorities for the formation of smart cities, the following theoretical and practical results were obtained:

First, the main components of the concept of a smart city (environmental, social, economic, institutional) are considered in the article, it is shown that the formation of smart cities is directly related to the use of modern digital technologies. Modern approaches to the formation of smart cities in modern conditions are presented.

Thirdly, the author's model for the formation of levels of a smart city was developed. Priorities for the development of smart cities such as engineering infrastructure, institutional support, communication systems, data integration on digital platforms, tools for user and technical systems interaction, innovative activities, the use of innovations in various spheres of a smart city are highlighted. The proposed model is called "7I".

Fourth, the areas for assessing the development of smart cities within each level of the 7I model are identified. The proposed approach can be further used as part of a comparison of the development levels of smart cities, while developing methodological approaches to assessing the development of the urban environment.

In conclusion, we note that the multidimensional and multifaceted concept of smart cities requires the development of a number of goals that must be achieved in the process of socio-economic development, while all interested parties should be included in the design process of smart cities. To monitor the effectiveness of projects and initiatives, all goals must be measurable. Citizens should participate in all stages of creating a smart city, starting with discussion and ending with testing specific solutions.

CONCLUSIONS

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