Strategy for the formation of innovative campuses is the basis for building a smart city in the context of digitalization

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Abstract. The paper is aimed at substantiating strategic alternatives for the formation of a campus functioning model based on an innovative approach, at studying and analyzing the functions of a planned campus as the core of an urban innovation system, an innovation institute and an educational organization of higher education. The paper updates the idea of promoting the smart education paradigm in Russia. The given paradigm is based on self-directed, motivated, flexible, resource-enriched, technological education that brings together smart learners, smart teachers and smart environments, including both formal and non-formal learning. It also involves a personalized approach to learners with the goal of acquiring necessary knowledge, skills, abilities, and competencies. In other words, the arrangement of university complexes should inspire scientists to new promising discoveries, and instill an attentive attitude to the environment in students. The relevance of the study is conditioned by the need of improving the efficiency of innovation cycle subsystems: support and dissemination of knowledge, production of new knowledge, commercialization and practical application. The conclusion that the campus mission is to develop every subject of interaction, create conditions for achieving the aims of the state, society, business, employees and students of the campus is made and justified in the paper.

1 Introduction

A university township with its infrastructure is understood as a campus. The tradition of building campuses originally engendered in Europe, but later spread throughout the globe. “Practical” reasons, in addition to the prestige of organizing university campuses, are, primarily, a necessity, since the formation of infrastructure, the development of technology and the attraction of talented students, including foreign ones, require enough space for their settlement, as well as the creation of conditions for scientific activity.

The idea is that it is required to designate a subject that performs functions of both scientific and educational, infrastructural, entrepreneurial and resource for the knowledge economy, for the formation of an urban innovation system. University campus is a term that we are accustomed to using, speaking mainly about the world’s leading universities, where the presence of a campus is a university symbol, one of the indicators of its prestige.

Universities are active participants in the socio-economic development in the regional innovation system through interaction with industry and public authorities at the regional level [1, 2]. The basis of innovation is knowledge, science, new ideas and the person who creates them. It is obvious that the system of higher education has the potential and advantage for the formation of all other subsystems that ensure the functioning of the innovation cycle. Digital data has an increasing impact on many aspects of contemporary cities and people's lives. The amount of data is growing rapidly, with global data growth projected at 40 % per year. About 90% of the world's digitized data is obtained in just the last few years. Thus, digital data is increasingly seen as a critical resource to support the development and sustainability of smart campuses around the world [3].

The relevance of the development of innovative campuses is currently great, because the presence of similar campuses within a number of countries provides a vivid example of their socio-economic progress. Universities, as centers of social and cultural life of regions, connecting elements between society, government and business, are becoming catalysts for the economic growth of countries. The reasons are varied: desire of governments and municipal authorities to improve the human capital quality and well-being of their population, the desire to develop and implement innovations, the need to invest in the environmental component within territories because strict adherence to environmental regulations becomes a universal rule.

The purpose of the paper is to consider the issues of forming innovative campuses using smart technologies. A smart city is a concept that has gained popularity in developed countries of the world in the last few years. Cities are getting smarter, and this is the merit of technologies and advanced solutions of the 21st century. For many people, a smart city is still limited to ideas about unmanned vehicles. In fact, this is a very broad concept that affects absolutely all aspects of life in contemporary society. Its success lies in the ides that Smart City services are able to respond to every

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demand and need of today's cities, as well as create new business models and value propositions of comfort and safety for both residents and guests. What city can we call smart? It must combine investment in human and social capital, infrastructure and breakthrough technologies that ensure sustainable economic development and a high standard of living through the conscious management of natural resources, infrastructure, and people. The concept of a smart city is almost inextricably linked with the term "digital", and the transition implementation is linked to the digital need.

The main idea of a smart home is to maximize the automation of control systems for technical devices in all areas of a house, apartment or office. The “Smart Home” system allows a person to pre-configure the operating modes of devices when the owners are at home or on vacation, in a standard (family, work) environment or when inviting guests, and to create comfortable conditions for a person.

2 Materials and Methods

The tangibility is that the country’s universities need not only the renovation of buildings and dormitories, but also the development of student and scientific infrastructure in general. Young people, as a rule, expect more diversity from student life, teaching and research activities of the university, as well as a contemporary and involved approach to the educational process organization in general, which influences the choice of an educational institution. Besides, the increasing demand for lifelong learning and the renewed interest in gaining new knowledge and experience make higher education increasingly relevant. The methodological basis of the study is the principles of problem solving based on knowledge, science, new ideas and the person who gives birth to them, and educational organizations have the potential and advantage to form other subsystems that provide the innovation cycle. An urgent strategy for the development of universities as innovation centers is the creation of an interuniversity campus.

“Today the goal of any university is to be a “magnet” for talented youth in the regions. And the creation of a modern infrastructure that will combine education, science, innovation and provide comfortable living for students is extremely significant. To this end, on behalf of the Russian President Vladimir Putin, a large-scale program for building a network of world-class campuses has been launched, and comprehensive work continues to develop the infrastructure of existing campuses,” said Valery Falkov, the Minister of Science and Higher Education of the Russian Federation [4]

Contemporary universities are actively involved in the process of applying recreational areas, creating public spaces, integrating the achievements of science and practice, using innovative technologies for sustainable development, creating business incubators and start-up sites, museums, stadiums and concert halls, places for physical education and sports, security of the territory and social comfort, as well as the formation of university cultural traditions. Digital data is the basis for efficient functioning of the given components. [5]

The significance of universities in the innovative development of their region, the country as a whole, integration groups and sometimes world economy is growing rapidly. Models of architecture correspond to the university idea as a center of intellectual activity and a generator of scientific discoveries in the field of modern technologies. Experience has proven that, the effectiveness of used data in various socio-economic systems depends on the tools for handling data, in particular in matters of data collection, transmission, storage, and application. The spread of huge data flows contributes to the transformation of modern cities [6]. The data application contributes to the creation of useful content for various stakeholders, including citizens, local governments and private companies [7]. Classification according to urban planning features of the of the university campus formation is shown in Fig. 1.

In our country, the Decree of the Government of the Russian Federation on the project implementation to create an innovative educational environment (campuses) applying PPP mechanisms within the framework of the federal project “Development of infrastructure for scientific research and training of personnel” of the national project “Science and Universities” was adopted at the Federal level last year [8].

The Decree provides for the implementation of investment projects for the university campuses creation (reconstruction) intended for accommodation, independent work, leisure and sports for students, scientific and pedagogical workers, researchers and other categories of employees of educational institutions of higher education and scientific organizations (“students and employees”) by concluding concession contracts and PPP agreements.

In 2021, the Government of the Russian Federation has selected eight projects for the construction of world-class university campuses in different cities of Russia. They plan to build campuses in Tomsk, Moscow, Novosibirsk, Nizhny Novgorod, Ufa, Yekaterinburg, Kaliningrad and Chelyabinsk. About what is known about these projects and how much money will be required for their implementation? Modern approaches based on the application of a large amount of digital data are increasingly being used in urban development, in particular in the formation of smart cities (Smart City). Generally, such changes are aimed at creating conditions for sustainable development, improving the quality of governance, improved quality of life and prudent management of natural resources and urban facilities [9].

The opportunity to apply digital data in ways that can enhance civic participation and help citizens and consumers in their daily lives is expanding as the use of digital technologies in various aspects of socio-economic activity increases [10].

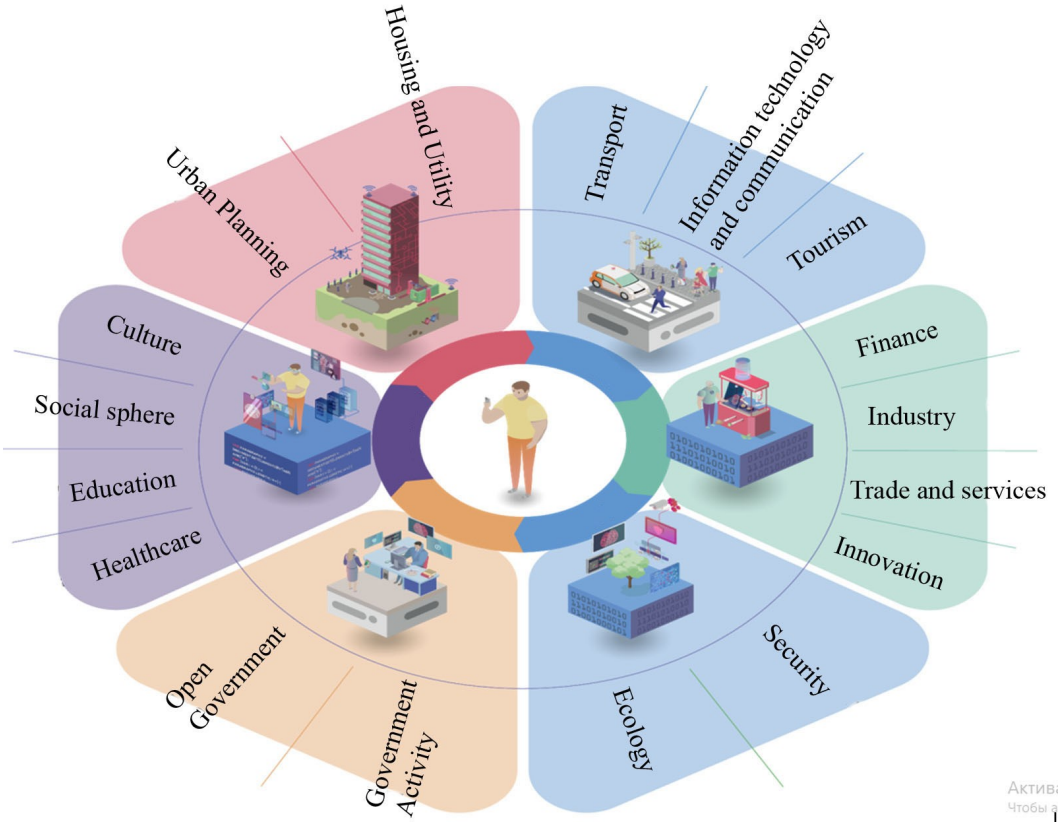

Fig. 1. Model of the campus architecture "University in the center of intellectual activity and generator of scientific discoveries in the field of modern technologies".

The formation strategy of innovative campuses is the basis for building a smart city in a digital economy. The use of digital technologies in the development of cities should be aimed at creating conditions for the use of digital technologies by the population, ensuring the region competitiveness and the implementation of national programs, as well as allowing enterprises to establish mutually beneficial cooperation regardless of the territorial location.

The urban economy digitalization has a positive effect on various areas of society: improving the quality of life, improving the well-being of the population, receiving education remotely, which is especially essential for hard-to-reach regions. Moreover, in the process of digitalization, the availability of technical means and the level of digital literacy of the population are substantial [11].

3 Results and Discussion

One of the major planning ideas of a modern campus is to form a single architectural and spatial environment with predominantly pedestrian accessibility of objects of the main functional, social, industrial, and residential profiles [3]. On campuses, public and social space forms the environment for the objects' existence. The spatial physical characteristics and quality of campus architecture are determined not only by the included buildings and structures, their appearance and style, but to a greater extent by open space and its configurations. The basic campus space is emblematic, it can expand a sense of "unity and identity" and also influence the nature of people interactions on campus, increasing or decreasing the likelihood of a chance meeting or consciously organized activity of campus residents.

On the scale of the country's territorial planning, urban modelling of the new territories' development, the creation of regional centers-enclaves based on "campus" models, included in the national strategic development scheme, is becoming an efficient tool for managing territorial and other resources. Adaptation of general concepts and their localization within the framework of specific activities in the territories can be carried out using a system of regional modelling and strategic planning.

The development of innovations in the university (information technology is the basis of innovation in the management and organization of the educational process) is the key to solving the issue of ensuring high competitiveness of the university. To a large extent, the successes achieved in the given direction are due to the fact that the university staff can trust the decisions that are made by the administration and implemented by the IT service together with university staff.

According to the authors of the study, considering the opinions of Russian and foreign scientists and practicians, the main issues that society faces on the way to creating smart cities are:

1. Lack of qualified personnel. According to the Smart City project, it is planned to develop and implement the Active Citizen digital platform at the first stage in order to involve citizens in solving the city problems. The platform assumes that citizens are aware of the repair work, tourists - about the sights. However, further development of the platform faces a shortage of qualified personnel because of low wages. According to the site https://russia.trud.com/, the average salary of IT specialists in Russia is 40,793 rubles per month. As of July 14, 2020, 615 vacancies of IT

specialists were opened in Russia, and only 16.4% with a salary of 30 thousand rubles or more. The highest salary level is in Moscow (71,201), followed by Nizhny Novgorod (64,667) and Krasnodar (48,929) (https://russia.trud.com/).

2. Information security in the implementation of an intelligent system of intelligent video surveillance. The use of an intelligent video surveillance system, on the one hand, ensures safety and allows monitoring of emergencies, which makes it possible to warn the population about an impending natural disaster. On the other hand, the issue of respect for human rights, guaranteed by the Constitution, arises, because such systems involve an invasion of a person's privacy.

3. Lack of financial resources. Many cities face the issue of lack of financial resources, some have gone bankrupt owing to the crisis broke out in 2000. Companies' resources are limited, and investors do not haste to invest in such projects, banks do not push on to give loans. In search of funds to continue construction, prices for goods and services are increasing, which leads to the population outflow.

For example, in 2008, IBM developed the "Smart Planet" system to improve the standard of the population living in a highly urbanized environment. The first city to implement the "Smart City" concept was South Korean city of Songdo. The project implementation started back in 2001 and amounted to $35 billion. The first objects in the city were commissioned in 2009, and it is planned to complete the creation of the "smart city" by 2025. Despite such ambitious goals, today about 70 thousand people live in the city and over time this number will only decrease, and the city risks turning into a "ghost town."

The main problem is the funding deficiency and the high cost of services for local population.

Masdar in the UAE is another city that was supposed to represent the eco-city of the future with the application of digital technologies. The city was to become an example of the world's first city, which could be provided with energy through renewable energy, minimal carbon dioxide emissions into the atmosphere and recycling of all human waste [12] It was planned that the city would be environmentally friendly, "green" technologies would be developed here, and only environmental technologies would be in production and ordinary life. The car would become a rarity, and the population would move with the help of automatic transport. There would be a complete rejection of harmful technologies that cause environmental damage. According to various estimates, the cost of creating such a city is more than $ 22 billion, the implementation began in 2006, and the completion date is 2030. Nowadays, students live in the city, several shopping centers have been opened. The future city formation faces a number of issues: the financial crisis and the impossibility of zero carbon emissions into environment [13]. Other cities are also in the planning stage: "The Great City" in China, which should solve the problem of environmental pollution; "Floating Green" in Japan, which involves the creation of six islands with low seismic levels; "Cloud Resident" in China with the use of innovative technologies, where the towers will be interconnected using a special technology; "Earth scraper" in Mexico - the city will go underground and be provided by geothermal energy sources; "Ocean Spiral" in Japan will be first underwater city completed by 2035 [14].

In Russia, Innopolis in the Republic of Tatarstan is an example of a successful city of the future. The city covers an area of 1,200 hectares with a population of 3,800. A Special Economic Zone has been created on the city territory, which provides high-tech companies with preferential business conditions. Besides, there is a university and kindergartens on the territory. It is expected that by 2030 the number of inhabitants will reach 155 thousand people. A classification that structures the majority directions of data use in smart cities is required to promote the development of new projects for the urban space digitalization [15].

The main task in the process of forming a "smart city" is to apply digital technologies for creating comfortable urban environment. The standard infrastructure facilities of a smart city include urban management, smart housing and communal services, intelligent city management systems, smart transport, and tourism.

Digitization of urban environment implies the creation of digital platforms ("Active Citizen"), the application of intelligent systems for public utilities management, the creation of an urban Wi-Fi network and smart lighting, intelligent management of urban transport and emergency monitoring.

The concentration of students, teachers, scientists within a large campus, especially if it is a powerful scientific and educational complex, opens up new opportunities for implementing the policy of education internationalization. However, the campus separation from the city and the creation of the "from scratch" project on the outskirts does not only lead to the construction of a new type of creative environment, but also limit the student's involvement in the city, which negatively affects the economic development of the latter and the possibility of using its cultural potential by students, teachers and researchers. The question also arises of creating a safe campus for students, especially foreign ones, for whom its presence can become an essential criterion for choosing a Russian university and city for studying. Although the creation of compact campuses looks less realistic in large cities with dense buildings, however, the removal of at least a complex of student dormitories in a separate area of the city or out of the city seems to be one of the feasible solutions to the safety issue, since such a campus is isolated and easier to protect [16].

4 Conclusion

The research experience has shown that the existing types of campuses in the world and in Russia represent an effective structure that is unique for each particular university, considering historical features of the university development, as well as the location. The decision to choose the campus form depends on the aims, opportunities, and free space at the university. The suburban campus is gaining popularity today. However, it is required to develop a system of indicators for the competent management of such a university campus for its effective organization.

The developed strategy advantages for the interuniversity campus formation are in overcoming barriers and solving the main issue required for innovation: sustainable interaction of subjects based on the principles of openness and transparency. A special role in these conditions is played by the creation and improvement of infrastructure, especially transport. Another significant point

that requires attention when creating and modernizing Russian campuses is the need to ensure security, which can be achieved, among other things, with the help of spatial solutions. Therefore, mutually beneficial cooperation between the city and universities is of paramount importance.

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