The problem of designing research centers on the example of the Far Eastern Region

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Abstract. This article discusses the problem of architectural planning, spatial and city-forming factors in the formation of the architecture of research institutes, centers and complexes, which in turn are part of science cities, technology parks, technopolises and academic towns. The world and Russian (including the Far East) examples of the formation and development of research centers are considered. The main features of their development are highlighted, which include: the location near the city and scientific institutes / universities, the construction period is no more than 5 years, the multidisciplinarity of workspaces, the flexibility of the planning structure, the economy and energy efficiency of the adapted architecture, etc. Based on the analysis, recommendations are proposed for the development of innovation and infrastructure in the Far East, using the example of the city of Khabarovsk. The problems and possibilities of design and construction in the city are identified, based on regional aspects inherent in the Far East.

1. Introduction

Today, the priority in the socio-economic policy of developed countries is to ensure a high quality of life for the population, which in turn attracts the best professionals from around the world. A special place in this area is occupied by organizations of higher education and science, which include scientific and research centers, universities and institutes, scientific laboratories, business incubators, research and production and information buildings and structures as part of scientific and production complexes, science cities and technoparks. These institutions are the core of the field of education and science, accumulating knowledge and creating innovations. The first scientific research institutes appeared in the 1960s, the development of which gained momentum in the 21st century, when in the USSR, USA, Japan and China, emphasis was placed on the development of new high technologies and the creation of science parks, technopolises and academic towns as an instrument of scientific progress.

As a new typological unit of the scientific and educational complex, the research institute differs from the classical buildings of this sphere of the last century. First, the research institute is a multifunctional structure, which includes various rooms, the combination of which gives a synergistic effect in the process of training and research work. In Russia, the cities of science (science cities) have been developed, however, the practical creation of innovation centers as complexes of science, business and production is still a near-term task for us.
2. The degree of knowledge of the research topic
This study is based on work devoted to various aspects of the formation of research, production and educational complexes of the innovative direction. A significant contribution to the formation of concepts for creating new types of buildings and structures for scientific high-tech activities was made by the theoretical and practical works of architectural professionals such as M. van der Rohe, Le Corbusier, F.-L. Wright, A. Aalto, E. Saarinen, F. Johnson, L. Kahn, M. Breyer, N. Foster, A. V. Zholtovskii. Aspects of development of research territorial complexes, centers, institutes and laboratories, research and development (R&D) management capabilities, as well as rental facilities for innovative purposes are studied in the works of I. V. Dianova-Klokova, D. A. Metanyev and D. A. Khroustalev [1, 2]. The problems of the architectural and planning organization of buildings and building complexes of scientific research institutes and centers were studied in the works of R. K. Gazarian [3], I. Y. Loginov, O. L. Bantserova [4] and A. V. Antonov [5]. It should be noted some scientific works and publications devoted to regional aspects of the formation and design of innovation centers on the example of the Far East of Russia. Studies of modern problems and prospects of interaction between higher education and academic science in the field of training specialists in the Far East were considered in the work of L. I. Galliamova and V. G. Makarenko [6]. The dynamics of the development of innovation infrastructure in the regional innovation systems of the Far Eastern Federal District are studied in the works of V. F. Efremenko and S. M. Bakharev [7]. Thus, taking into account the fact that there are not so many studies and publications in this area as an example of the Russian Far East, the relevance of the research in this article is dictated by the need to consider a number of issues in order to identify the patterns of formation of research institutes on the example of world and Russian experiments.

3. Main design features of research institutes
The traditionally-organizational construction of production is considered as a stable formation, which allows you to design buildings designed for operation for 50–100 years. However, significant changes in the innovation system lead to the fact that within two to five years after the commissioning of the new building, discrepancies arise between the organizational and functional structures. It becomes obvious that the maximum possible reduction in the proportion of unchanged planning and structural elements allows us to increase the adaptability of the planning structure, which determines the design with the option of creating combinations of design solutions. A research institute is one of the components of a whole complex of scientific infrastructure of a technopark, science city or technopolis, and each structure has its own functional orientation, which provide special and general services [8]: the structure of R&D is represented by research centers and laboratories; a business zone is a zone of private innovative companies and units for the production and prototyping of services; the technology services zone includes business incubators that provide territory for the development of startups and the development of advanced technologies; educational structures represented by universities and institutes; also, the provision of general services is represented in the form of electronic libraries, computer rooms, conference rooms, exhibition areas, meeting rooms, cafes and restaurants.

The design of research institutes depends on a number of internal and external factors that form the basis for further design and justify the application of some promising methods for the formation of institutions, or rather the choice of a specific layout system that provides the optimal organization of scientific, educational, scientific, administrative, social information and recreational infrastructures separately and together.

4. World experience in designing research institutes
The end of the twentieth century was the time when mass creation of innovative complexes in the countries with advanced economies began (the USA, Great Britain, Germany, France, Canada, Japan, China, etc.). The design and construction of integrated scientific and industrial formations is gaining prominence throughout the world. USA Leader in Innovation [9]. This is due to the continued focused
attention of the state and educational apparatus to the development of research processes, and as a result, the high efficiency of the country’s national innovation system as a whole. This was facilitated by the focus of the policy on self-development of companies in fierce competition, on the introduction of innovations in industrial production and in the consumption process. Numerous US research institutes occupy leading positions in the ranking of the best institutes in the world as part of science cities. Among them, Oxford, Stanford, Harvard universities, which include a number of research institutes, Massachusetts (MIT) and California (Caltech) institutes and others. And also “Silicon Valley” on the basis of Stanford University, a unique metropolitan area, following the example of which Russia in the mid–20th century tried to create its own innovative platform in the form of Academgorodoks.

From an analysis of the world experience in creating innovative infrastructure in the form of complexes of technoparks, science cities and technopolises, in which the research institute occupies a leading role, we can single out the main architectural planning, spatial and urban planning factors for the successful formation of a scientific platform:

- the territory of the research institute should be located near the city or in the structure of the city with a developed research and educational base to provide the institute with highly qualified scientific personnel and near universities / institutes for joint research, technology development and for the exchange of scientific information;
- accommodation in a territory with favorable conditions for life and scientific activity, with well-developed transport and pedestrian access;
- the construction period of the complex should not exceed 3.5 years from the time of design to commissioning, as the innovative focus is variable;
- growing requirements for engineering infrastructure, for reorganization and transformation;
- development of a tool base for “box” typing, which allows you to abandon complex construction techniques for creating isolated work areas;
- increase in the share of computer rooms and a decrease in the proportion of hall spaces;
- increasing the importance of informal communication and recreation areas, conference rooms, coworking, exhibitions and educational facilities: classes, classrooms and lecture halls;
- development of shared and cooperative use services;
- tendency to increase the share of temporary use areas by risky jobs.

Russia is trying to keep up with global successes in the field of innovation, however, there is still a lack of infrastructure supporting small venture enterprises, insufficient efficiency of business incubators and a shortage of universal companies whose services affect the innovative activity of enterprises. The world experience of the research institute makes it possible to choose a more effective direction in the development of innovative activity of Russian institutions.

5. Research institutes of Russia

In the late 1960s, urban planning and social experiment is being set up in the USSR - a large-scale project to create an Academgorodok near Novosibirsk [10]. Its active development was accompanied by the development of new advanced approaches to the formation of innovative activity, ahead of even world analogues, such as MIT and Stanford. In the years 1962–1968, academic towns were created in Pushchino, Troitsk, Moscow Region, as well as in Krasnoyarsk, Irkutsk and Zelenogorsk [11]. The formation of the first wave of Russian innovation centers as part of technology parks begins in the early 1990s [12]. And the very first real technology park in Russia was the Tomsk Science and Technology Park. In subsequent years, technology parks began to appear everywhere.

The direct transfer of successful world practice in designing research and production facilities to Russian soil was hardly acceptable, because science abroad was concentrated in large universities and was inextricably linked with education. In our country, on the contrary, research centers developed on an independent basis, industry-specific. And so, the scientific centers of the USSR Academy of Sciences were formed in Novosibirsk, the Far East, the Urals, etc. This influenced the fact that high-
tech enterprises were not prepared for a market, competitive struggle with other companies due to the inability to quickly reorganize. A study of the Soviet experience in the construction of research institutes allows us to draw conclusions that will help in creating a new design methodology based on adaptive architecture.

In Russia, there are a lot of examples of modern research institutes of various fields of activity as part of technoparks in many regions, the number of which is about 1.8 thousand, but most of all research institutes are concentrated in Moscow [13]. The list of parks of the highest level of efficiency included: Nanotechnology Center “Technospark” and Technopark “Strogino” in Moscow; “Sigma Nanotechnology Center” in Novosibirsk; “Ulyanovsk Technology Transfer Center” in Ulyanovsk; Technopark of Novosibirsk Academgorodok JSC in Novosibirsk and others. Currently, the field of innovation is one of the priorities. The coordination center of the Ministry of Communications of Russia in the spring of 2020 launched a program for the strategic development of Russian science cities [14]. A competition for financing innovative projects among science cities was held at the Russian Ministry of Education and Science, the cities of Reutov, Obninsk, Protvino and Koltsovo were recognized as winners [15]. From the analysis of the Russian experience in the formation of the innovative infrastructure of research institutes, the main principles can be distinguished: multifunctionality—combining various functional zones into a single structure, built on the principle of multidisciplinarity; reservation—the possibility of transformations that require the availability of reserves of the territory, space, engineering capacity, service and structural resources; flexibility—the ability to quickly respond to changing market priorities; social engineering—the development of exhibition areas, educational facilities, informal communication zones; security—ensuring the protection of intellectual and physical property; economy and energy efficiency—reducing operating costs, improving the quality of the environment and improving employee productivity; quality of architectural solutions—a high level of planning, engineering, constructive, artistic solutions for exteriors and especially interiors.

Analyzing the world and Russian experience, we can conclude that Russia is currently moving to a global model for the development and formation of the infrastructure of innovation. Prospect programs are aimed at increasing the digital development index, establishing communication and interaction between ICT companies and foreign partners, as well as developing the material and technical base of educational organizations.

6. Research Institute of the Far East of Russia

The successes of world scientific and technological leaders are determined by the effectiveness of the integration of science, education and business. At the same time, Russian, and, in particular, Far Eastern examples are characterized by poor development of the quality of innovation. The Far Eastern Branch of the Russian Academy of Sciences (RAS) is a regional association of research, development, production organizations, centers and institutes located in the Far East [16]. In the cities of Vladivostok, Khabarovsk, Blagoveschensk, Petropavlovsk-Kamchatsky, Yuzhno-Sakhalinsk and others, there are about 50 organizations that influence innovative infrastructure throughout the Far Eastern Federal District. Integrated development of innovation infrastructure is carried out in the Far Eastern Federal University and the Russky Technopark (Primorsky Territory) [17] and the Yakutia Technopark (Republic of Sakha) [18]. Seaside scientific infrastructure consists of: the Joint Center for Collective Use, digital science laboratories and departments, the center for project activities, innovative business incubators and other production and technical units. The infrastructure of the Yakutia Technopark is represented by the State Budgetary Institution GBU “Business Incubator”, ten laboratories, the center of intellectual property and marketing, and the student business incubator “OREH”.

From the analysis of some works on the example of the Far East, it can be noted that the strategic goals of the government are: the formation of world-class institutions that can have a significant impact on the innovative development of Russia and the Far Eastern Federal District; enhancing national security and competitiveness in global knowledge and technology markets; creation of
successful cooperation with business representatives and entrepreneurs and the development of a system of promoting highly qualified personnel for research in various fields of science [19].

Common urban features of these objects include: location outside the urban structure; convenient connection with it and between separate zones of the research institute complex; interesting volumetric and spatial composition of technology parks; the presence of industrial and residential facilities, areas of resident companies, public, trade and business infrastructures; arrangement of educational, working laboratory, recreational, entertainment and sports spaces; good landscaping of on-site territories. Architectural and planning features include: multi-storey, steppedness and small width of buildings with architectural dominants, and good horizontal and vertical connections between the corridor and tower building zones.

Russian Far East has the potential for innovative industrial development. There are practically no publications and studies in the field of architectural-planning and spatial-spatial solutions of the Research Institute of the Far East. But this does not hinder the conclusion that the active interaction of the intellectual, technical, scientific and educational potentials of the Far Eastern Branch of the RAS and a number of Far Eastern research institutes and universities is leading innovative progress along the path of many leading Russian and world institutions.

7. Prospects for the development of research institutes in the Russian Far East using the example of Khabarovsk

Scientific activity in the Khabarovsk Territory is an integral part of science in the Far East. It contains about 20 research institutes which include all the necessary facilities, zones and spaces for scientific activity [20]. An undeveloped area near the Pacific National University (PNU) can be chosen as a promising site for the design of an industrial park with a research institute in accordance with the current master plan of the city. Such a choice is determined by the following factors: proximity to higher and secondary educational institutions and being in the structure of the city; convenient walking and transport accessibility; developed infrastructure of the district and favorable conditions for life and scientific activity. The area of the projected site in red lines is about 15 ha. It is advisable to include: research institute area; living area for scientific and administrative staff of research institutes; business area for the design and research activities of business companies; hotel zone for visiting guests and employees of resident companies; industrial area for laboratories with special requirements; recreation area.

The research institute itself and the adjacent landscaped area should be included in the zone of the research institute. The designed building of the institute should be widely hull and low-rise, which contributes to energy efficiency and low wind production, with several atrium spaces for lighting interior rooms with different levels of platforms for different types of activities. Due to the fact that the territory has a relief with different slopes, it is proposed to deepen part of the building, which is also due to regional climatic conditions. For a more effective development of scientific and educational activities, the project proposes to place in one building zones of laboratories and business incubators with classrooms. Also, the object may include: a sports part with a pool and halls for various sports; administrative part; areas of conference rooms, exhibitions, coworking and informal communication; underground parking for all guests and employees of the research institute and other auxiliary facilities.

The city of Khabarovsk is one of the strategic areas in the Far East for the development of innovative research activities [21]. And in order to prevent the process of “decay” of the innovation infrastructure in Khabarovsk and the Far East as a whole, it is necessary to strengthen the organizational activation, material condition and work of all the structures of research institutes and technology parks.

8. Conclusion

In the analysis of world and Russian experience, one can identify the main problems and their solutions to the organization and formation of scientific and innovative activities for the further design
of the buildings of the research institute. Their observance will increase the efficiency of the work and production environment, creating better conditions for research, development, communication, work, generation and development of ideas, and create structures that will be adapted to transformations and changes in the process.

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