Digitalization of the construction complex of the region as a factor of development RIS

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Abstract. The development of innovative potential of the region through the formation of a regional innovation system, in the context of innovative development of the construction complex of the region, is relevant. The article considers the regions of the North-Western Federal district, analyzes the state of innovation activity, which allowed to determine that high innovation activity is inherent in St. Petersburg, as well as some regions of the Arctic zone of the Russian Federation: Murmansk region, Arkhangelsk region and the Republic of Komi. Also, the list of stages, which must be followed in the innovative development of the construction complex of the region, namely: 1) creation of conditions for increasing the intellectual potential of the construction complex within the existing legislation; 2) creation of information specialized data Bank on patents, advanced technologies, inventions, research organizations, scientists; 3) Association and coordination of activities of enterprises of the construction complex for innovative development; 4) saturation of the labor market with highly qualified specialists in the field of construction. In this connection, the article forms a model of the regional innovation system, where the building complex acts as a factor of innovative development. The model reflects in the context of the micro-level, meso-level and macro-level the points that need to be worked out for the development of the construction complex as a driver of the regional innovation system. In accordance with the model, the integral innovative potential of the construction enterprise is determined, subsystems are identified: organizational and institutional mechanisms; investments; the level of scientific and technical development; factors and conditions of the external and internal environment; human resources. In accordance with the subsystems selected targets and built a strategic map of the integrated innovation potential of the construction complex of the region.

1. Introduction
An important task of the government of the Russian Federation is the modernization of the classical economic system of functioning of enterprises, complexes and regional systems through the transition to a digital economy, which implies the digitalization of key production processes by a cloud management system. It is necessary to distinguish between the concepts of "Digital economy" and "Digitalization". Thus, the digital economy is a communication environment of economic activity on the Internet, as well as forms, methods, tools and results of its implementation [1, 2, 3]. Digitalization, in turn, is the transformation of information into digital form, which in most cases leads to lower costs,
new opportunities, etc. [4]. Therefore, in considering the question of regulation, promotion and implementation of innovative activities and processes of digitalization in the territory of the regions of the Russian Federation it should be noted that it is reinforced by the Strategy of information society development in Russian Federation to 2017–2030 [5], and also by the Program "Digital economy of the Russian Federation" [6].

Currently, it is necessary to form a tool that allows to assess the level of digitalization of the region. Thus, there are a number of national indices, with the help of which it is possible to assess the level of digital development of the economy of the state, they include: 1) Digital Economy and Society Index – DESI [7]; 2) International Digital Economy and Society Index – I-DESI [8]; 3) Digital Evolution Index – DEI [9]; 4) world digital Competitiveness index – WDCI [10]; 5) e-government Development Index – EGDI [11, 12]; 6) global connectivity Index – GCI [13, 14]; 7) ICT Development Index – IDI [15]; 8) Boston Consulting Group economy digitalization index (e-Intensity) [16]. These indices are quite difficult to adapt to the regions of the Russian Federation, as the territorial arrangement of the countries of the index developers (mainly the EU and the USA), differs significantly in its composition, functioning and activities. In this regard, it seems appropriate to form a regional innovation system (RIS), which should be understood as a set of different institutions that together and individually contribute to the creation and dissemination of innovations and determine the innovative development of the economy [17, 18]. As part of the RIS of the region, it is necessary to further develop a methodological assessment of the level of digitalization of the industry. As a driver of innovative development, in the context of the formation of a RIS, it is worth considering the construction industry of a region, namely the construction complex in the context of which it is possible to form a methodology for digital assessment in the future.

The construction complex is a horizontal branch system of the region, which serves other sectors of the national economy of the territory. Also, the construction complex includes the activities of construction enterprises (for various activities), research and design and survey organizations, whose activities are aimed at the implementation of projects related to industrial, non-industrial and linear objects [19].

Analyzing the scientific literature of Russian and foreign authors on the issue of digital development of the construction complex and the construction industry, some features of development are revealed. Thus, the authors in [20-23] analyze automation systems in construction. For example, A. Volkov in [20] considers digital models in construction, forms a scheme of system engineering for digital modeling of activities. N. Safonova, A. Budakov, E. Ivankina, A. Paolini S. Kollmannsbergera, E. Rankab in [24, 25] consider digital technologies as a factor of increasing business activity in the construction industry, as well as additive technologies of construction production. The second part of the paper [26] considers the impact of digitalization on transport systems and assesses its economic consequences within the subjects of the Russian Federation. Therefore, the consideration of the construction complex of the region as a driver of innovative development of the RIS is quite relevant, which is confirmed by research in the field of innovative and digital development of the construction industry.

The purpose of this study is to form a model of the RIS of the Russian Federation with the inclusion of the construction complex as a factor of innovative development. In accordance with the purpose of the study, it becomes necessary to solve the following tasks: 1) analysis of innovation activity in the context of the North-Western Federal district to determine the nature of innovation activity of the regions; 2) identification of important stages of innovative development of the construction complex as a driver of the RIS; 3) a scheme of integration of the construction complex of the region in the RIS; 4) the definition of the integral of innovation potential of enterprises of the construction complex of the region with allocation of subsystems and targets, build a strategy map. The object of the study are the regions of the North-Western Federal district, and the subject is the integration of the construction complex into the RIS.

2. Methods
The methodological basis of the study is:
1. Quantitative method. It includes the collection, processing, analysis and synthesis of statistical data characterizing the innovation activity of the regions of the North-Western Federal district. The following indicators were taken into consideration: 1) the number of organizations that performed research and development, units; 2) the number of personnel engaged in research and development, people; 3) the number of researchers with academic degrees, people; 4) internal costs for research and development, million rubles; 5) the number of developed advanced production technologies, units.; 6) the number of advanced production technologies used, units; 7) innovative activity of organizations, %; 8) the volume of innovative goods, works and services, %; 9) the index of inventive activity in the region.

2. Qualitative method. It implies the integration of the construction complex of the region into the RIS, with the allocation of the integrated innovative potential of construction enterprises, which is schematically visualized.

3. Results and Discussion
To implement the digital transformation of the construction complex of the region and the formation of RIS, it is necessary to assess the digital potential of the territory. The territories of the North-Western Federal district are quite interesting for the study, as the district includes the regions of the Arctic zone of the Russian Federation. Also, the advantage of the North-Western Federal district is the presence in its composition of the city of St. Petersburg (the second largest urban agglomeration of the Russian Federation), as well as proximity to the developed countries of the European Union and access to the most important sea trade routes. The priority directions of economic development of the North-Western Federal district include [27]: development of transport infrastructure (Baltic, White and Barents seas); development of the pipeline system (including the North European gas pipeline); creation of free economic zones (Leningrad, Kaliningrad, Murmansk regions); development of tourism.

Let's consider the main indicators of innovation activity of the North-Western Federal district, which will determine the nature of innovation activity of the regions and their potential for further development, including in the context of the construction complex. For the analysis, we will make a sample of indicators from the data of state statistics [28], it is worth noting that the indicator of inventive activity in the region will be calculated as the balance between the number of applications for patents for invention, utility model and the number of patents for invention, utility model (table 1).

Table 1. Indicators of innovation activity in the context of the regions of the North-Western Federal district, 2017.

| Indicator                                      | 1   | 2   | 3   | 4   | 5   | 6   | 7   | 8   | 9   | 10  | 11  |
|------------------------------------------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| Number of organizations performing research and development, units | 15  | 26  | 4   | 31  | 19  | 12  | 12  | 30  | 19  | 13  | 295 |
| Number of personnel engaged in research and development, people   | 1168| 1655| 22  | 999 | 464 | 1788| 7265| 2138| 1739| 236 | 77051|
| Number of researchers with academic degrees, people                | 362 | 501 | 2   | 187 | 86  | 163 | 599 | 471 | 59  | 53  | 9673 |
| Internal costs for research and development, million rubles        | 943,2| 2350,0| 21,5| 1522,9| 479,5| 1094,0| 6863,5| 2276,1| 2751,8| 437,7| 120804,0|
| including on technical Sciences                                   | 251,3| 1337,1| - | 895,0| 256,8| 606,8| 4545,0| 397,3| 2589,9| 334,0| 98279,9|
| Number of                                                         | 10  | 1   | -   | 9   | 8   | 1   | 18  | -   | 28  | 1   | 130  |
Developed advanced production technologies, units

|                           | Republic of Karelia | Republic of Komi | Nenets Autonomous Okrug | Arkhangelsk region without NAO | Vologda region | Kaliningrad region | Leningrad region | Murmansk region | Novgorod region | Pskov region | St. Petersburg |
|--------------------------|--------------------|-----------------|-------------------------|--------------------------------|----------------|---------------------|-----------------|----------------|----------------|--------------|---------------|
| Number of advanced production technologies used, units | 660                | 910             | 63                      | 1417                           | 2992           | 859                 | 1879            | 1145           | 1983           | 1363         | 8933          |
| Innovative activity of organizations, % including technological innovations | 5.9                | 3.5             | 4.6                     | 4.4                            | 5.4            | 4.3                 | 9.3             | 8.2             | 8.8            | 7.4          | 16.1          |
| Volume of innovative goods, works and services, % | 0.3                | 0.4             | 0.0                     | 2.8                            | 2.9            | 0.3                 | 2.2             | 1.3             | 4.0            | 2.1          | 9.1           |
| Index of inventive activity in the region | 3                  | 7               | -                       | 38                             | 46             | 44                  | 50              | 5               | 7              | 11           | 317           |

Where: 1) Republic of Karelia; 2) Republic of Komi; 3) Nenets Autonomous Okrug; 4) Arkhangelsk region without NAO; 5) Vologda region; 6) Kaliningrad region; 7) Leningrad region; 8) Murmansk region; 9) Novgorod region; 10) Pskov region; 11) St. Petersburg.

Analyzing the indicators table 1, we can say that the level of innovative development of the regions of the North-Western Federal district is divided into three groups, namely: a group with high innovation activity (St. Petersburg), a group with medium innovation activity (Leningrad region, Novgorod region, Murmansk region, Komi Republic, Republic of Karelia, Kaliningrad region and Arkhangelsk region), a group with low innovation activity (Nenets Autonomous district, Vologda region, Pskov region). Considering the group of regions of the Arctic zone of the Russian Federation separately (Republic of Karelia, Komi Republic, Nenets Autonomous Okrug, Arkhangelsk oblast and Murmansk oblast), we can say that innovative leaders are Arkhangelsk oblast, Murmansk oblast and Republic of Komi.

Considering the construction complex as a driver of innovative development of the region, it is necessary to understand that the organizational structure of innovation management in the construction complex should guarantee the functioning of such interrelated stages as: 1) strategic (development of scientific and technical potential of the industry); 2) tactical (implementation of the existing scientific and technical potential of the industry). Therefore, using program-target approaches in the framework of innovative development of the construction complex, it is necessary to develop and implement projects, focusing on [29]:

1) creation of conditions for increasing the intellectual potential of the construction complex within the framework of the existing legislation;
2) creation of information specialized data Bank on patents, advanced technologies, inventions, research organizations, scientists, etc.;
3) Association and coordination of activity of the enterprises of a construction complex on innovative development;
4) saturation of the labor market with highly qualified specialists in the field of construction, etc.

Shaping the process of integration of the construction complex of the region in the RIS, is becoming necessary at the micro-level to take into account the integral of innovation potential of construction enterprises, at the meso-level to form the innovative infrastructure of the region and to develop a regional strategy of innovation management in the construction industry at the macro-level to ensure a link with the national innovation system (NIS) government. In this regard, we present the integration process in fig. 1.
Figure 1. The process of integration of the construction complex of the region in the RIS.

For the innovative development of construction complex and building companies belonging to it, consider the integral of innovation potential, which is shown in fig.1. Considering it in detail, it follows that each subsystem should include specific targets with which it is possible to implement the selection of control indicators. Therefore, to assess the integrated innovative potential of a construction company, it is possible to build a strategic map, where each identified subsystem will act as its component [30] (fig. 2).

Figure 2. Strategic map of integrated innovative potential of enterprises of the construction complex of the region.
On the basis of fig. 2, it follows that the selected targets in accordance with the identified subsystems of integrated innovation potential for the development of the enterprise of the construction complex meet the key stages that are necessary for the innovative development of the construction complex of the region.

4. Conclusions
The analysis of the main indicators of innovative development of the North-Western Federal district revealed the region-leader, which has a good potential for innovative development-St. Petersburg. If we consider the territory of the Arctic zone of the Russian Federation within the North-Western Federal district, the highest level of innovative development was noted in the Arkhangelsk region, the Murmansk region and the Komi Republic. Therefore, in the future it seems appropriate to consider the formation of a RIS in these territories.

The study allowed to determine the importance of innovative development of the construction complex as a key factor of the RIS. It is the construction enterprises in the conditions of innovative development that are actively developing, the production process is digitalized thanks to the cloud systems of BIM technologies. Considering the development of the construction complex as a key link of the RIS, it is worth noting that there is a list of stages that were described in the study and in the digital development of the construction complex of the region they must be taken into account. Also, due to the described process of integration of the construction complex into the RIS, it seems appropriate: 1) formation of the strategy of innovation management in the construction complex; 2) description of the process of formation of the innovation infrastructure of the region; 3) formation of methodology for assessing the innovative potential of the industry in the context of the RIS; 4) assessment of the possible formation of industrial and construction cluster in the regions of the North-Western Federal district using the localization coefficient. The described integrated innovative potential of the enterprise, through the identified subsystems and targets, is visualized by means of a strategic map. The strategic map can be further supplemented with control indicators.

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