Innovative technologies in the Russian construction industry as a factor of economic development

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Abstract. The construction sector is a priority area of the economy, which affects the quality of life of the population. The dynamics of construction is one of the key indicators by which one can judge the economic and social development of the country. At the same time, in recent decades the investment and construction industry of Russia experiences a number of problems that hinder its development. First of all, they include a low proportion of qualified personnel; underdevelopment of the competitive environment due to a relatively low share of small and medium-sized enterprises in the structure of the construction industry; poor legal regulation of the construction sector; low investment efficiency; inconsistency of building codes and regulations with modern requirements for construction projects; the lack of a well-developed mechanism for coordinating inter-firm interactions. The article discusses the main factors influencing the innovative development of enterprises in the construction industry. The system of indicators characterizing the structural components of the innovative potential of the enterprise is presented. The authors have developed an organizational economic mechanism for implementing innovations in the construction sector.

Innovation, being a conductor of promising ideas capable of being implemented in economic systems, causes interval effects aimed at satisfying social and economic needs.

Innovativeness of the economy is the subject and object of many studies [4]. One of the possibilities for enhancing the national innovation processes is optimization of approaches to the use of various resources by economic agents [7]. Under equal economic conditions, resources and their rational consumption provide additional competitive advantages to the companies and strengthen business activities, affect the specifics of innovations and peculiarities of the innovative potential.

In this regard, the nature of innovation and innovative resources of a company, as well as the use of effective mechanisms for managing them predetermine the ability of an economic agent to develop new products, strengthen their competitiveness and respond to the current market changes.

Historically, the characteristics of innovation have been the subject of various scientific disputes and discussions [21]. The term “innovation” appeared in the 19th century in the works by cultural scientists. At the same time, special economic studies of innovation began in the 20th century and their results are reflected in the works by K. Christensen, K. Prahalad, P. Romer, R. Solow, P. Sorokin, G. Hamel, J. Schumpeter. When analyzing various changes in the development of economic systems, J. Schumpeter introduced the economic concept of innovation as new combinations of production methods capable of...
bringing commercial benefits associated with the creation of new goods, the use of new materials and raw materials, and new production methods [9].

It seems possible to define innovation as a complex economic process of developing technology, methods of production and management, new products or services, determined by various conditions of the macro- and microenvironment [11].

The main components (theoretical concept, technical invention, commercial use) and properties (scientific and technical novelty; practical applicability; commercial feasibility) of innovation can be presented in the following form (Figure 1).

Revealing the relationship of properties and components of innovation, it can be noted that the theoretical concept of a new idea as a starting point of innovation must have scientific and technical novelty [13]. The construction sector is no exception.

Taking into account a wide range of factors affecting the efficiency of management of innovative activities, Avramchikov identified factors that influence the innovative development of construction companies [17].

Figure 1. Systematization of factors affecting the innovative development of enterprises in the construction industry.

A special role should be assigned to the infrastructural aspects of the innovative development, a territorial-production model of infrastructural support for innovative entrepreneurial activities.

The result of construction is a building or structure with a set of documents, operating engineering and technological systems and a set of other works that allow the building or structure to acquire a
finished, aesthetic and ennoble appearance [22]. To ensure and reduce the cost and period of construction, improve quality and comfort, various innovations are being implemented into this area. Innovative technologies are a determinant of the modernization process which justifies the relevance of the article.

The modern model of a technologically developed metropolis provides for a high level of well-maintained and comfortable housing as one of the key components of the quality of life. “The Strategy of socio-economic development until 2036” is the conceptual basis for the development of a large city. Infrastructural aspects and any other aspects of innovative development must be taken into account when choosing a development strategy for both a region and a company. In the regional planning practice, there are no universal schemes for strategic planning of regional development [6]. Due to the lack of development targets, each region determines its development strategy, taking into account local specifics and implementing the competitive advantages of the territory [3]. Taking into account the geographical features of Irkutsk region, innovations in the construction sector are extremely important, otherwise the high cost of housing (and a number of other factors) force the population to migrate [20]. According to practitioners’ estimates, even a 1% increase in the housing prices reduces the profit of organization by 10%, exacerbating the difficult situation. One of the reasons for the low profitability of investment and construction activities is low innovative activity of enterprises that are part of the investment and construction industry [1].

Innovation in construction involves the implementation of new construction technologies, and reconstruction and modernization of the existing ones. At the same time, reconstruction and modernization improve the architectural, planning and engineering solutions of these buildings, improve the technical reliability, comfort, environmental safety and economic efficiency, while minimizing energy consumption [2]. The solution to the problems of innovation is the use of flexible housing planning, increasing the width of buildings, building duplex apartments, combining several premises, etc. Flexible housing planning allows you to modify apartments depending on different life situations, and the technology of growing houses makes it possible to create buildings with any layout [5]. The cost of apartments gives information on the saturation of this market, the purchasing power of the population, preferences of buyers, construction costs, socio-economic development of the region and regional economic policies.

**Table 1.** The system of indicators characterizing the structural components of the innovative potential of the enterprise.

| Indicator                              | Formula                   | Designations                      |
|----------------------------------------|---------------------------|-----------------------------------|
| **Intelligent component**              |                           |                                   |
| Staff innovativeness coefficient       | \( K_{si} = \frac{N_{si}}{N_s} \) | \( N_{si} \) – total number of staff involved in the development of innovations, people |
|                                        |                           | \( N_{s} \) – the average number of staff, people |
| Share of scientific and technical      | \( K_{sts} = \frac{N_{sts}}{N_{st}} \) | \( N_{sts} \) – total number of scientific and technical specialists involved in innovation activities, people |
| specialists in the total number of     |                           |                                   |
| staff involved in innovative activities|                           |                                   |
| Share of employees with a scientific   | \( K_{sd} = \frac{N_{sdC}}{N_e} \) | \( N_{sdC} \) – number of employees with a scientific degree, people |
| degree                                 |                           | \( N_e \) – number of employees |
| Staff training ratio                   | \( K_{t} = \frac{N_{t}}{N_s} \) | \( N_{t} \) – number of trained staff, people |
|                                        |                           |                                   |
| **Research component**                 |                           |                                   |
| Intellectual property ratio            | \( K_{ip} = \frac{IA}{N_{ca}} \) | \( IA \) – intangible assets, rub |
|                                        |                           | \( N_{ca} \) – non-current assets, rub |
| Indicator                              | Formula                                      | Designations                                                                 |
|---------------------------------------|----------------------------------------------|------------------------------------------------------------------------------|
| Product innovation ratio              | $K_{pi} = \frac{C_{RD}}{C_t}$                | $C_{rd}$ - amount of investments in research and development, rub.             |
|                                       |                                              | $C_t$ - total costs of the enterprise, rub.                                   |
| Innovation implementation effectiveness ratio | $P_{it} = \frac{N_{it}}{N_{dev}}$            | $N_{it}$ – number of implemented innovations for a certain period, pcs.       |
|                                       |                                              | $N_{dev}$ - number of developed innovations for a certain period, pcs.        |

The limit values of these indicators have not been established, however, they should tend to the maximum and, when implementing the innovative strategy, they should increase [19]. The negative dynamics of these indicators will indicate a decrease in the innovative potential of the enterprise.

In terms of its focus, the innovation potential can be classified into production and organizational; in terms of size, the innovation potential can be divided into high (constant innovative activity at the enterprise) or low (characterized by inconsistency and episodicity) [15]. The qualitative and quantitative characteristics of the innovative potential affect the type of the strategy chosen by the enterprise - Table 2.

**Table 2.** Correspondence of the innovation strategy of the enterprise to the characteristics of its innovation potential.

| Manufacturing innovation potential | Organizational innovation potential |
|-----------------------------------|------------------------------------|
| high                              | high                               |
| Offensive innovation strategy     | Offensive innovation strategy      |
| low                               | low                                |
| Integration innovation strategy   | Integration innovation strategy   |
| Residual innovation strategy      | Residual innovation strategy      |

Summarizing information about the principles, approaches and foundations of the development of innovative strategies, the following stages of development and implementation of an innovative strategy can be identified (Fig. 2).

**Figure 2.** Stages of development and implementation of the innovative strategy.

The success of strategy development and implementation depends on the ability of an enterprise to perform innovative activities, rationally combining and combining them with each other and resource components [16].

Taking into account the nature of the innovation process, the authors have developed the following organizational and economic mechanism for implementing the innovative technologies in the construction industry - Figure 3. The main criteria for the effectiveness of this mechanism is the systematic approach that allows us to manage the innovation process and the principle of integrity [10].
At the first stage, the main task is to create an effective system of interaction between domestic construction companies and research organizations that develop innovations [13]. It is necessary to create a single information space, an open information field for identifying the need for innovative developments and searching for organizations capable of creating these innovations.

In addition, it is necessary to use various measures of state regulation and stimulation of the innovation process, increasing the degree of innovativeness of the economy as a whole.

**Figure 3.** The organizational economic mechanism for implementing innovations in the construction industry.

At the first stage of innovative project implementation, it is necessary to reduce administrative barriers [8].

Of particular importance is the involvement of small businesses in the innovative project whose task is to test innovations and determine their effectiveness [14].

According to the author, the most effective mechanism for attracting investment resources are venture financing, factoring and franchising.

At the second stage, the innovative idea formed as a result of determining the needs of the real sector of the Russian economy is transformed and the mechanism for the project implementation is created [12]. To do this, the scientific fund that concentrates main resources necessary for implementing
innovative projects creates an innovative project team, forms a resource base and controls the innovative
development.

At the third stage, the innovative development is implemented into practical activities of the
construction enterprise. Small businesses are more mobile than large enterprises, so it is easier for them
to change production processes. The innovation implementation period is shorter, and changes in the
production process are less painful in the event the project is not efficient. In the conditions of limited
financial resources, small businesses gain access to the latest achievements of science and technology.

At the fourth stage, the return on investment can be obtained by implementing the innovative
development in large and medium-sized enterprises of the construction industry. The figure shows a
direct return on investment, which includes the purchase of the innovative development from the
scientific fund, and the return of invested resources to the scientific funds - government authorities.
Indirect return is increasing tax revenues as a result of increasing companies’ incomes.

At this stage, it is important to track the effectiveness of innovative development, taking into account
economies of scale. Innovations in construction occupy a special place in the general classification,
since they create positive synergistic effects at the stages of the life cycle of a building or structure, and
in many related sectors of the economy.

Thus, the presented organizational and economic mechanism covers the full cycle of the innovation
process, takes into account the principles of consistency and integrity, determines the functions and tasks
of each participant.

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