Construction sector enterprise product quality as a result of strategic innovation management

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Abstract. The article examined the role of construction products quality in ensuring the operational reliability of buildings and structures constructed with their use. The issues of complexity and feasibility of introducing innovations into construction were raised, construction manufacturing was evaluated as a multistage, sequential process. An example was given to demonstrate the results of introducing innovative methods into the production process of an enterprise for the production of reinforced concrete products.

Introduction
In the modern market of construction products, the issue of their performance improving and maintaining is very relevant. The main component of buildings and materials quality is performance. Their quality is influenced by many internal and external factors. These are the level of research, both scientific and technical, technological solutions, quality of the source material, the level of organizational and production process, staff qualification, product quality control at all stages of research and development work [1].

Improving production efficiency and construction quality is possible when introducing timely innovation processes in the construction industry, which helps save resources, reduce the cost of building maintenance and solve social problems of the population, primarily due to the provision of housing [2].

However, for the widespread introduction of innovations there is no unified assessment system that would allow to take into account all the advantages possible through the introduction of innovative programmes, and thereby to motivate participants in the construction industry to invest [3].

Problem analysis, goals and objectives
The final products of construction manufacturing are the completed and commissioned construction projects, the quality of which is predetermined by regulatory documents, design solutions, being ensured at all stages of the production process and manifesting itself during the operation of facilities. The sphere of construction manufacturing covers a production complex: extraction of raw materials, manufacture of materials, products, structures, construction of building projects. At each of these stages, specific products are produced, which, in relation to the completed object, are initial or intermediate. Thus, the manufacturer’s products are intermediate for the construction process as a whole, and for the manufacturer itself it will be conditionally final, since the manufacturer reports for the production of this product and delivers it to the consumer. The quality requirements of this product
are determined by the consumer, who is the next link in the production in which the product is to be used. For example, for a perlite manufacturer, the quality of this conditionally final product (perlite sand and crushed stone) is determined by the requirement imposed by the consumer of the product, in this case - by the wall materials plant. But, since the chain of the production cycle ends with the end product of construction manufacturing - the building, then the quality of all types of intermediate products determines the quality of the final product. However, there is no direct relationship here. In some cases, the reduction in the quality of the intermediate product is compensated at one of the subsequent stages of the production cycle and does not affect the quality of the building or structure. For example, if lower grade cement entered the precast concrete plant, the plant continues to produce products with the required concrete strength class, i.e. retains consumer properties of products through the implementation of effective technological solutions or, in extreme cases, due to cement overspending.

As a result, a certain relationship can be traced, which unites the quality of the final and intermediate products of construction manufacturing into a common whole. This integration should be considered as common whole, and internal interdependencies are established when examining the quality mechanism of buildings and structures under construction.

At the present development stage of production and market relations, this is achievable only with the widespread introduction of technological innovations into the production process. In general, technological innovations are present in all areas of the modern market but they have a different character. Each of these areas, both for innovators and for innovations themselves, is risky and can slow down or completely eliminate the introduction of efficient technologies.

And, perhaps, one of the most important factors constraining the massive introduction of innovative technologies in the construction industry is the end result (buildings, constructions, structures) estimated by durability and reliability for the entire period of operation. Since for most building materials this period is calculated for dozens of years, being confident of a positive result would be a serious risk, especially since a new product (product, design, technology) initially has no regulatory and other technical documentation, which complicates the introduction of innovative products or technologies and proper monitoring of their implementation in the construction industry.

This is happening against the background of foreign trade restrictions removal, which opened all borders for imported products and reduced domestic consumption of domestic products and government orders. All these factors determined the decline in production and overall decline in product quality of the construction sector enterprises in Russia. A return to the domestic consumer market of domestic building materials and technologies is possible only if they are brought to the next level of quality that can satisfy real consumer demand, or to one step higher level compared with the quality of incoming construction products from the external market.

As a result, the issues of attracting the necessary volumes of external investment and the most efficient implementation of innovations by Russian construction sector industrial enterprises are becoming top priority issues, since the most promising strategic management of innovative development programmes based on long-term competition can only be achieved by further improving the technical and technological level of these projects [4].

Construction industry enterprises of the Russian Federation are not always competitive with respect to foreign enterprises on the principle of "the lowest cost - the best quality." Therefore, the best way for their development is product manufacturing according to the "distinctive feature" principle. The production of a similar product is being replaced by the production of a specialized and unique product. As a result, construction industry should be as close as possible to the project model of a business enterprise.

**Research part, recommendations to manufacturing enterprises**

Research conducted at industrial facilities in one of the regions showed that the range of development strategy implementation appeared to be quite wide: from minimizing costs and concentrating on a specific segment to marketing and product innovations. Among the features of the process...
management strategy of innovative programs for the development of domestic industrial enterprises in
the construction segment of the market, the availability of various financing channels can be noted -
from the own funds of enterprises, external investments and budgetary sources within the framework
of federal and regional target programmes to modern market instruments (issue of securities). An
example of budget financing is the Federal Target Program of Research and Development in Priority
Areas for the Development of the Scientific and Technological Complex of Russia for 2014-2020.
Nevertheless, experts argue that financial resources allocated from the budget are not enough for the
full development of areas, so enterprises are forced to consider other extra-budgetary sources of
funding. A feature of the implementation of innovation programmes for development of domestic
industrial enterprises is, among other things, the maintenance of the own R & D and technical centers
that have their own network of contractors, in manufacturing enterprises [5]. A similar structure
existed in domestic production earlier and I must pay tribute, yielded positive results both for the
development of construction science in general and for the research areas that were at the peak of the
demand for the definite period of time.

Such areas have always been the use of local building materials in the production of building
materials, products and structures, on the one hand, and improving or expanding consumer properties
of products (typical for the region of product use), on the other hand.

The first area has always been attractive for middle-level consumers, as it allowed, practically on a
budget (social) basis, to satisfy consumer demand in construction products. At the same time, the use
of local building materials has often had a positive effect on improving the environmental situation in
the region [6].

The second area is more attractive when it comes to meeting the needs of a more demanding
consumer.

Solving problems of both the first and second areas can become a real process only with close
cooperation of science and industry. For more effective implementation of innovation processes, it
makes sense to analyze the specifics of strategic management of innovations in construction sector
enterprises as representatives of industrial organizations in general [7, 8, 9].

The classification of industrial organizations (including those producing construction products)
taking into account the specifics of the strategic management of innovative processes is presented in
Table 1.

**Table 1. Classification of organizations for the strategic management of innovation**

| Parametric data, P₁ | Value of parametric data, P₁p |
|---------------------|-------------------------------|
| Production profile  | P₁₁  P₁₂  P₁₃ -             |
| R & D costs        | P₂₁  P₂₂  P₂₃  P₂₄ -        |
| R & D type         | P₃₁  P₃₂  P₃₃  P₃₄ -        |
| Number of key technological processes | P₄₁  P₄₂ -               |
| Assortment composition and choice of products | P₅₁  P₅₂  P₅₃ -             |
| Product renewability | P₆₁  P₆₂ -                |
| Number of links with counterparties | P₇₁  P₇₂  P₇₃  P₇₄  P₇₅ - |

P₁₁, P₁₂, P₁₃ - mass production (standard construction products), specialized (mass, but non-
standard products) or experimental;
P₂₁, P₂₂, P₂₃, P₂₄ - research costs are high, medium, low or no costs;
P₃₁, P₃₂, P₃₃, P₃₄ - the type of scientific research is breakthrough, improving, adaptable, is not
present;
P₄₁, P₄₂ - one basic technology, two or more;
P₅₁, P₅₂, P₅₃ - assortment composition and choice of products: mass, medium, piece;
\( P_{61}, P_{62} \) - range update regular, rare;
\( P_{71} \) - interaction with one company-counterparty;
\( P_{72} \) - interaction with several counterparties for one thematic purpose;
\( P_{73} \) - interaction with several counterparties for all thematic purposes;
\( P_{74} \) - interaction with international counterparties;
\( P_{75} \) - there are no permanent contacts.

The above classification makes it possible to identify the features of the development and implementation of the process in organizations, which should be taken into account when managing innovative processes of industrial organizations. In the conditions of modern market relations, domestic industrial enterprises face many challenges of the most diverse and complex nature. The analysis of situation data in the construction sector, as well as the research of strategic management in high-tech production, made it possible to reveal the most pressing issues of management in the current Russian conditions. These include:

- **Violation of binding elements in the process in the manufacture of the final product.** This issue is associated with the loss of both technological, financial, and industrial relations between industrial enterprises of the former Soviet Union for the entire period of the formation of new interstate and intersectoral relations, as well as relations between economic entities in the transition period of the economy with increasing competition. This situation is well seen when it becomes necessary to analyze the possibilities of the construction complex for production, and even more when assessing its quality parameters. For a long time, the available measuring instruments working on the principles of non-destructive testing methods were devices, the result reliability of which was in doubt. Today, a sufficiently large list of test equipment and measuring instruments are in the available price range, have been entered into the State Register of Measurement Tools of the Russian Federation, have certified methods for performing measurements, allowing you to control not only the quality of the finished product, but also simultaneously carry out continuous monitoring of the operating parameters of the process equipment and trace the process of phased formation of product quality parameters throughout the entire cycle of its production.

- **Weak intensity of innovation in production processes.** This issue is associated with a lack of technical and technological equipment of Russian industrial-type organizations, high equipment wear and tear, and an extremely weak feedback efficiency at the “development-production” stage. The above reasons should also include the extremely low use of management methods in the development and implementation of innovations. It is an extremely urgent problem of construction companies: the majority of industries working in the construction industry were designed and equipped twenty or more years ago. Hence the difficulty of introducing modern innovative technologies associated with serious initial investments and the instability of the consumer market for construction products from large performers. This leads to inefficiency and a long payback period, which in turn casts doubt on investment expediency.

- **Low maturity of enterprises and organizations of industrial type in the management of innovative development processes.** The main problem is the lack of use of tools and methods for managing innovation processes, as well as the lack of highly qualified specialists in this area. As a result, a fairly low level of financial performance of many Russian industrial enterprises and low competitive positions. This situation is most clearly seen at the construction sector industrial enterprises. When there are no advanced production technologies, then expediency is questioned in terms of focusing on management issues, using and implementing advanced and promising methods of strategic management, training effective specialists in the field of strategic planning and developing innovative processes in the industry.

- **Extremely low results of methods for using working capital of enterprises and organizations in the implementation of investment projects and development programmes are** due to the deficiencies in tax policy, accounting system and control, as well as the lack of methodological foundations of innovative development under financial constraints [10].
The low activity of government orders and insufficient state financial support for promising developments severely limits the ability of domestic enterprises and organizations to conduct full-scale research and development in the framework of promising areas.

As a result of these issues consideration, it is necessary to note the insufficiency of financing innovative projects, which negatively affects the development and implementation of innovative programmes and results in lagging behind competitors. And this problem “hits” the construction industry more than any other industry. Any funding starts with the calculation of efficiency and payback period, that is, when the invested financial resource begins to give the result in the form of profit. But this indicator in the construction industry is delayed for a sufficiently long period of time, even with a very intensive process, which is alarming to promising investors, and, accordingly, postpones the massive introduction of innovative technologies in the construction industry.

The above list is not complete, however, it considers the main problem points of managing the innovation processes of industrial enterprises at this stage of the Russian Federation economy development.

As a result of the research and identification of problems in the management of innovative processes in industrial enterprises, as well as analysis of the consequences and causes of their occurrence, it can be stated that the key factors in the growth of innovation efficiency and investment activities of enterprises and organizations are the use of modern approaches to the strategic management of innovative development processes in industrial enterprises and the their maturity increase in the construction industry by solving organizational and economic issues.

As an example of a positive outcome from the introduction of innovative technologies in the process of manufacturing concrete products and structures, you can consider the following. Increasingly, the newly created construction sector enterprises are aimed not at the product quality assessment, but at programming the required quality of manufactured products for construction purposes. To this end, the entire technological process is united by an automatic control system. It is known that in the organization of the technological process for manufacturing reinforced concrete products and structures, each subsequent technological conversion is adjusted so that the results of the previous one can be taken into account. Thus, when the initial humidity of inert materials changes (precipitation moistening) estimated in storage bins using probe sensors of universal moisture meters (type VIMC-2.2), the signal is given to a computer with software for adjusting the volume of mixing water depending on the aggregates’ humidity. After dosing and mixing the concrete mix, the express control of the concrete mix workability is carried out in the concrete paver bunker. Depending on the expected characteristics of the concrete mix, workability can be monitored by one of the measuring instruments - C187 K flow tester, C188 roller consistometer, C189 electric plastometer or C190 manual plastometer. The measurement result is fed to the electronic vibro-platform control panel, where the mode of compacting the concrete mix in the form is automatically or manually adjusted, depending on the type of products. Then the products arrive at the heat treatment station, where the mode of thermal unit operation is controlled using a multichannel control system for concrete heat and moisture treatment. This multichannel system can vary heat treatment mode of reinforced concrete products, depending on the characteristics and workability of the concrete mixture on the basis of which they were made.

Summary
Thus, using a comprehensive innovative system for controlling the technological line equipment operation parameters, it is possible to consistently ensure the quality of mass-produced products. At the same time, by adjusting the operating parameters of the main process equipment, you can get a production with a flexible approach to the product nomenclature, which can be divided into groups according to similar features, with the greatest compatibility of operations during molding and heat treatment. Such methods of production organization can provide new construction products with the required quality parameters at the lowest labor, material and energy costs.
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