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Key factors influencing the mechanisms of formation of the innovative portfolio of gas transportation construction enterprises

High-tech construction companies face the need for continuous implementation of innovative solutions in order to increase production efficiency, reduce costs and increase competitiveness. The mechanisms for selecting and implementing innovative solutions require the formation of effective approaches to an objective assessment of their potential and associated risks. A typical example of a high-tech construction sub-sector is the field of gas transportation construction, whose enterprises are fully affected by the effects of this issue in the current macroeconomic conditions. High-tech enterprises in the gas transmission construction sub-sector are influenced by a complex set of internal and external factors. Solving the scientific problem of organizational and economic modeling of the mechanisms of formation of an innovative portfolio of enterprises involves the need to identify and comprehensively analyze a vast factor space.

As a result of the multi-stage expert analysis conducted by the author, key external and internal factors influencing the mechanisms of formation of the innovative portfolio of gas transmission construction enterprises were identified and classified. The use of a set of identified factors is also possible as part of the assessment of innovations in the production systems of high-tech construction enterprises, which can contribute to the unification of approaches and improve the effectiveness of mechanisms for selecting and implementing innovative solutions, and the formation of an effective innovation portfolio of the enterprise.

Keywords: *innovation, innovation portfolio, high-tech construction, production systems, factors*

Modern construction is characterized by accelerated development of technologies and materials, increased requirements for product quality and shorter project implementation time [1]. Today, in the context of modern macroeconomic conditions and shifts, the domestic investment and construction complex is facing new challenges and an extensive list of tasks to ensure sustainability, efficiency and accelerated development. Their solution requires the search and use of reserves in the production systems of construction enterprises [2].

This modern problem is particularly relevant for high-tech sub-sectors of the construction complex, for which macroeconomic instability, expressed in restrictions on the import of foreign technologies and equipment, as well as a decrease in the inflow of investment resources from abroad, is often extremely high, and in some cases, critical importance [1]. In these conditions, development mechanisms implemented on an innovative basis are becoming highly in demand.

High-tech construction companies face the need for continuous implementation of innovative solutions in order to increase production efficiency, reduce costs and increase competitiveness. The mechanisms for selecting and implementing innovative solutions require the formation of effective approaches to an objective assessment of their potential and associated risks [1].

Within the framework of such mechanisms, the innovative development of high-tech enterprises in the investment and construction sector is based on modern approaches to planning and implementing technical, technological and organizational innovations that enhance the competitiveness, productivity and economic efficiency of production

systems. Modern conditions for the transformation of production systems of enterprises necessitate an adequate restructuring of management systems and processes: the development and implementation of innovative management methods for production systems is the main condition for increasing their competitiveness. Consequently, management innovation solutions that harmonize production process models primarily through the formation, development and optimization of the functioning of organizational and managerial resources and structures of the enterprise are a necessary element ensuring the feasibility of these types of innovations within the framework of a single innovation portfolio of a high-tech construction enterprise [2–7].

A typical example of a high-tech construction sub-sector is the field of gas transportation construction, whose enterprises are fully affected by the effects of all the described issues in the current macroeconomic conditions.

In the proposed paradigm, it is advisable to consider the tasks of forming and implementing a portfolio of innovations of such enterprises in the context of achieving the goals of ensuring their strategic innovative development, including both elements of goal-setting in the field of economic efficiency, competitiveness and growth, as well as the necessary risk management mechanisms and ensuring the strategic sustainability of the enterprise.

Solving the scientific problem of organizational and economic modeling of the mechanisms of forming an innovative portfolio of enterprises involves the need to identify and comprehensively analyze the vast factor space that influences these mechanisms.

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► The subjects of the considered sub-sector — high-tech enterprises of gas transportation construction — in the course of their functioning experience the multidimensional and multidirectional influence of factors of the internal and external environment.

According to the traditional approach, in the most general classification, the factor space can be formed according to the principle of division into two main groups of factors:

- external factors, the sources of which are beyond the influence of the environment of the system.

In the context of the innovative development of the enterprise, the importance of managing transformational changes is increasing, with the main focus on ensuring the ability of the production system to develop, recover, and adapt in accordance with its internal development resources in the context of the dynamics of environmental factors. The result of such development should, among other things, be an increase in the manageability of the system based on its inherent principles of self-organization, flexibility and adaptability [8–10];

- internal factors, the impact of which is due to the causes and prerequisites related to the functioning of the internal environment of the system.

The influence of internal factors should be considered in at least two aspects [11–14]. On the one hand, internal factors in their quality and combination determine the possibilities of developing the production and economic system of an enterprise, its economic potential in the broadest sense, thereby forming the prerequisites for the adoption of certain management strategies. On the other hand, the analysis of internal factors should help identify areas of inefficiency that hinder the effective development of the enterprise's production and economic system and, as a result, reserves of economic development that can be implemented on an innovative basis.

It is advisable to base the further grouping of factors on the nature of their impact on the production and economic system of the enterprise.

As a result of the multi-stage expert analysis conducted by the author, key external (Table 1) and internal (Table 2) factors

influencing the mechanisms of formation of the innovative portfolio of gas transmission construction enterprises were identified and classified.

The complex process of strategic planning of innovative development of a high-tech construction enterprise requires algorithmization with the allocation of key process blocks that ensure the synchronous solution of the tasks of evaluation and selection of innovative solutions, depending on the results of the analysis of the elements of the presented factor space. The central element in this case should be a portfolio of innovations, which in turn is characterized by an internal hierarchy and includes managerial, organizational, technological and technical innovative solutions selected as a result of a multi-criteria assessment of all influencing factors, taking into account their mutual influence.

The key analyzed characteristics of the considered innovative solutions should include the following in accordance with the provisions of current regulatory and scientific and methodological sources¹ [1]:

1. Scientific and technical novelty of the innovative solution.
2. The high-tech nature of the innovative solution.
3. Technical and economic effects resulting from the implementation of an innovative solution.
4. The integral economic effect resulting from the implementation of an innovative solution.

Thus, the proposed approach to developing effective mechanisms for forming an innovation portfolio in gas transmission construction enterprises requires the implementation of diagnostic procedures based on the identified factor framework. These procedures are aimed, among other things, at identifying problematic areas of production activity and determining the causes of deviations from planned (optimal) development parameters. This, in turn, enables the selection of optimal management solutions at the final stage,

¹ On approval of criteria for classifying goods, works, and services as innovative products and (or) high-tech products for the purposes of forming a procurement plan for such products : Order of the Ministry of Energy of the Russian Federation dated December 25, 2015, No. 1026. URL: <http://publication.pravo.gov.ru/document/0001201603010009> (rus).

Table 1. Factorial space for the formation of an innovative portfolio of gas transportation construction enterprises. External factors

Groups of factors	Direction of influence on the innovation portfolio	Factors	
Technical and regulatory	Pressure and need for changes from various regulators	R-F19	Dynamics and volume of changes in industry standards (ecology, industrial safety, technical standards and requirements) that require a review of approaches in the innovation portfolio
		R-F20	The degree of dependence on imported technologies, hardware, and software, and the associated risks to innovation
Macro- and mesoeconomic	External economic conditions	M-F21	Volatility of the cost of key resources (pipes, equipment, energy, machinery) and currency risks affecting the financial model of the portfolio
		M-F22	Availability and cost of credit resources to finance a capital-intensive portfolio of projects
		M-F23	Investment attractiveness and budgetary opportunities of the regions for laying gas transmission systems for PPP or other forms
Political and geopolitical	Strategic risks and opportunities	P-F24	The degree of influence of international political risks on supply chains and technology transfer for the portfolio
		P-F25	The level of support and priority of gas transportation construction projects in state strategic programs
Natural, climatic and ecological	External environmental constraints	EN-F26	The degree to which the portfolio takes into account the specifics of work in various natural and climatic zones (permafrost, seismic, swampiness)
		EN-F27	The level of stricter environmental requirements (for emissions, land use, etc.) affecting project decisions across the portfolio

Table 2. Factorial space for the formation of an innovative portfolio of gas transportation construction enterprises. Internal factors

Groups of factors	Direction of influence on the innovation portfolio	Factors	
Organizational and managerial	Ability to systematically implement new management methods	O-F1	The degree of maturity of corporate project and portfolio management systems (availability of methodologies, templates, digital platforms, and passports)
		O-F2	Availability and quality of knowledge base (solutions, metrics, templates) from completed gas transportation construction projects for replication of innovations
		O-F3	The degree of adaptability of the company's project office to various types of projects in the portfolio (new construction, reconstruction, modernization of facilities)
		O-F4	The portfolio team's proficiency in strategic analysis, risk management, and engineering tools
		O-F5	The degree of elaboration and standardization of contract models for typical scenarios of gas transportation construction
Technological and production	Influence of technological features on the choice of innovations	T-F6	The share of using standard and modular technological solutions in the portfolio of projects that allow for scaling innovation
		T-F7	The degree of loading and wear of the fleet of specialized equipment for the conditions of the Far North, swamps, difficult terrain, etc.
		T-F8	The level of concentration of competencies in critical technologies (welding, automation, energy supply and heavy machinery in remote areas)
		T-F9	The degree of readiness for the use of BIM technologies and digital twins at all objects of the portfolio
Logistics	Constraints and opportunities of logistics for innovation	L-F10	The level of dependence of the project portfolio on the remoteness of facilities from mobilization bases, transport arteries, and the impact of seasonal restrictions
		L-F11	The degree of development of own or partner logistics infrastructure in key construction regions
Economic and financial	Financial opportunities and constraints for the selection, implementation and implementation of innovations	E-F12	The degree of capital intensity and synchronization of financial flows for portfolio projects
		E-F13	The volume and flexibility of the company's reserve funds for testing risky management innovations
		E-F14	The quality of the system for monitoring economic indicators and cost dynamics of projects in the portfolio in real time
		E-F15	The degree of elaboration of methods for assessing the economic impact of the introduction of management innovations
Human resources and social	Human capital for the implementation of innovations	C-F16	The level of accessibility and qualification of personnel for the implementation of innovative projects in the portfolio, including in remote regions
		C-F17	The degree to which the company's management and administration perceive the need for constant managerial innovation and readiness for change
		C-F18	The level of industrial discipline and work experience in conditions of increased industrial safety requirements

aimed at overcoming these deviations through innovation-driven development. The results of diagnostic checks of the production system can also be used by the company's management to make managerial decisions in connection with the development and implementation of investment and innovation projects, the formation of business plans and production programs, the improvement of the organizational structure and reengineering of the corporate model of the enterprise, as well as the comprehensive restructuring of the company.

The implementation of this approach can contribute to improving the effectiveness of both innovation management mechanisms and the strategic planning and management system of a high-tech construction enterprise as a whole based on the justification of rational innovation priorities and optimization of organizational and managerial processes for the formation and management of the enterprise's innovation portfolio.

The use of a set of identified factors is also possible as part of the assessment of innovations in the production systems of high-tech construction enterprises, which can contribute to the unification of approaches and improve the effectiveness of mechanisms

for selecting and implementing innovative solutions, and the formation of an effective innovation portfolio of the enterprise.

Thus, within the framework of the performed research, the factor space for the formation of an innovative portfolio of gas transportation construction enterprises has been formed and systematized, as well as the directions of its use in the context of solving the tasks of innovative development of industrial and economic systems of enterprises have been identified. At the same time, there is a significant problem in practice that makes it difficult to apply the results of factor analysis in order to model the organizational and economic mechanisms of forming an innovation portfolio, which is the subject of further research by the author. Overcoming this issue will contribute to solving the urgent and significant task of providing high-tech construction enterprises with the necessary tools to make strategic decisions aimed at improving quality, reducing costs and increasing labor productivity on an innovative basis, and, in turn, creating conditions for sustainable economic growth and strengthening the position of the Russian investment and construction complex.

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Ключевые факторы, оказывающие влияние на механизмы формирования инновационного портфеля предприятий газотранспортного строительства

Высокотехнологичные строительные предприятия сталкиваются с необходимостью постоянного внедрения инновационных решений в целях повышения эффективности производства, снижения затрат и повышения конкурентоспособности. Механизмы выбора и внедрения инновационных решений требуют формирования результативных подходов к объективной оценке их потенциала и сопутствующих рисков. Характерным примером высокотехнологичной подотрасли строительства является сфера газотранспортного строительства, предприятия которой в текущих макроэкономических условиях в полной мере испытывают на себе воздействие эффектов данной проблематики. Субъекты рассматриваемой подотрасли — высокотехнологичные предприятия газотранспортного строительства — в процессе своего функционирования испытывают многоаспектное и разнонаправленное влияние факторов внутренней и внешней среды. Решение научной задачи организационно-экономического моделирования механизмов формирования инновационного портфеля предприятий сопряжено с необходимостью выявления и всеобъемлющего анализа обширного факторного пространства.

В результате проведенного автором многоэтапного экспертного анализа были выявлены и классифицированы ключевые внешние и внутренние факторы, оказывающие влияние на механизмы формирования инновационного портфеля предприятий газотранспортного строительства. Применение комплекса выявленных факторов также возможно в рамках оценки инноваций в производственных системах высокотехнологичных строительных предприятий, что может способствовать унификации подходов и повышению результативности механизмов выбора и внедрения инновационных решений, формирования эффективного портфеля инноваций предприятия.

Ключевые слова: инновации, инновационный портфель, высокотехнологичное строительство, производственные системы, факторы

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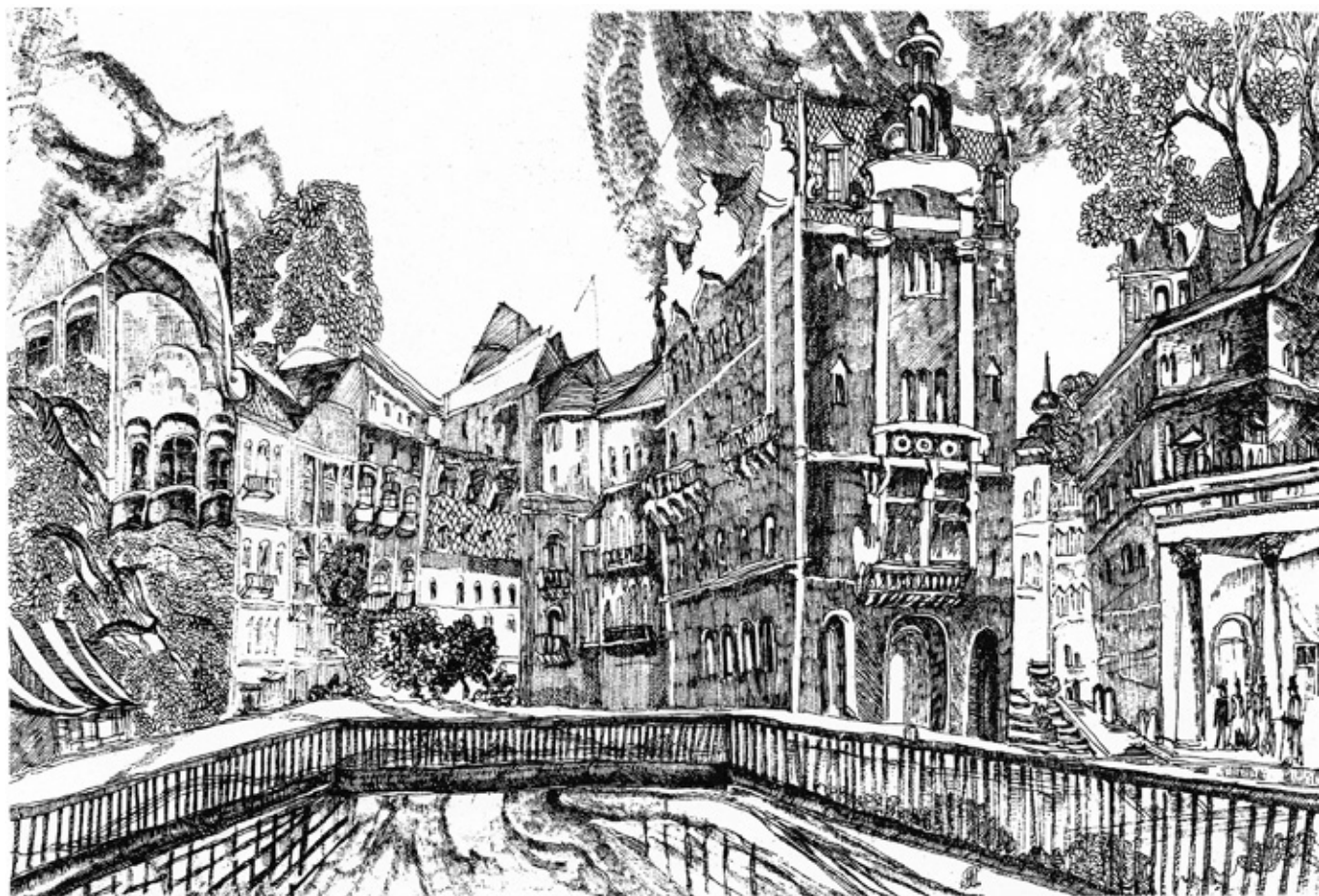
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