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A SYSTEM OF INDICATORS FOR INNOVATIVE DEVELOPMENT IN INDUSTRIAL ENTERPRISES

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Abstract:

This article provides a scientifically grounded system of indicators designed to assess and monitor innovative development in industrial enterprises. The study examines the need to systematise innovative development metrics and analyses the advantages and limitations of existing methodological approaches. In particular, the Oslo Manual (OECD), the Frascati Manual, and the Global Innovation Index (GII) methodologies are reviewed in the context of their applicability to Uzbek industrial enterprises. The article presents a structured classification of input indicators (innovation-oriented investment, R&D expenditure, human capital capacity) and output indicators (share of new products, patent activity, export competitiveness), and proposes an integrated assessment methodology encompassing all dimensions of innovation activity.

Keywords: Innovative development, indicator system, industrial enterprise, R&D expenditure, innovation capacity, Oslo Manual, Frascati methodology, competitiveness, innovation monitoring, strategic management.

INTRODUCTION

The profound transformation of the global economy, the unprecedented acceleration of globalisation processes, and the rapid pace of the technological revolution are presenting industrial enterprises with new, strategically significant, and increasingly complex challenges. In this context, ensuring competitiveness, achieving sustainable economic growth, and adapting to the constant shifts in market conditions have made the development of innovative activity an absolute imperative. Innovation serves not only as a fundamental driver for the creation of next-generation products and services, but also as the primary catalyst for optimising production processes, enhancing the efficiency of resource utilisation, and substantially improving labour productivity. Accordingly, the effective management of innovative development in industrial enterprises and the establishment of systematic, objective assessment mechanisms constitute one of the most pressing scientific, theoretical, and applied problems of our time.

Innovative development is widely recognised as the principal determinant and engine of economic progress. The experience of numerous developed nations clearly demonstrates that an innovation-driven economy creates the conditions for the production of high value-added goods, the generation of new high-technology employment opportunities, and a significant improvement in living standards. Within the context of Uzbekistan, the stimulation of innovative activity represents a strategic priority for the modernisation of the economy, the enhancement of industrial competitiveness, and the diversification and expansion of export potential. However, the complexity of innovation processes, their multidimensional nature, and the long-term and uncertain character of their outcomes necessitate the development of precise, objective, and comprehensive indicator systems for their assessment and monitoring.

LITERATURE REVIEW

A comprehensive analysis of the indicator system for innovative development in industrial enterprises is of strategic importance for stabilising economic growth and enhancing global competitiveness. This section undertakes an in-depth examination of the theoretical foundations of innovation theory, the operational characteristics and development trends of industrial entities, and the existing body of foreign and domestic scholarly literature on innovation indicator systems. The relevant decrees and resolutions of the President of the Republic of Uzbekistan directed at the advancement of the sector are also subjected to rigorous scientific and methodological scrutiny.

The theoretical and scientific foundations of the concept of innovation were extensively explored in the seminal works of J.A. Schumpeter, who conceptualised innovation as the primary driving force of economic development [1]. Leading scholars such as P. Drucker and M. Porter subsequently extended the role of

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innovation in management and strategic competitiveness, substantiating it as a key determinant of enterprise success [2, 3]. Methodological approaches to measuring and evaluating innovation activity at the international level are comprehensively set out in the Oslo Manual, developed by the Organisation for Economic Co-operation and Development (OECD) [4]. This manual proposes standardised indicators for the classification and measurement of innovation types. While systems such as the EU Innovation Scoreboard and the Global Innovation Index enable comparative analysis of innovative development at the country and regional level, research on the development of innovation indicator systems at the level of individual industrial enterprises continues to retain significant scientific relevance. Among foreign researchers, C. Christensen has advanced the theory of disruptive innovation, while R. Florida has provided a comprehensive analysis of innovation ecosystems and their impact on regional economic development [5, 6]. These scholars emphasise the necessity of employing specific sets of indicators encompassing financial, technological, organisational, and marketing innovation dimensions when assessing innovation processes in industrial enterprises.

In the Republic of Uzbekistan, the promotion of innovative development is recognised as one of the strategic priorities of state policy. The Presidential Decree on the Establishment of the Ministry of Innovative Development [7] and the corresponding governmental resolutions [8] established a robust legal and regulatory foundation for the formation of a national innovation ecosystem and for the acceleration of innovative activity in industrial enterprises. While these legislative instruments define the principal directions of innovative development, the creation of a unified, comprehensive indicator system for evaluating innovation processes at the enterprise level continues to demand rigorous fundamental scientific inquiry. Among domestic scholars, researchers such as A. Vahobov, Sh. Gulomov, B. Begalov, and R. Olimov have extensively addressed issues of the innovation economy, management of innovation activity in enterprises, and improvement of its effectiveness [9, 10]. However, their scientific works have not sufficiently analysed fundamental theoretical approaches to developing an indicator system for innovative development that accounts for the specific characteristics of industrial enterprises.

RESEARCH METHODOLOGY

The methodological foundation of this study consists of a complex of fundamental scientific and theoretical approaches directed at the formation, systematic analysis, and effective evaluation of a system of indicators for innovative development in industrial enterprises. The primary objective of the research is to create a highly reliable and practically significant indicator system that enables comprehensive, objective, and systematic assessment of innovation activity, adapted to the distinctive characteristics of the national economy. In pursuit of this objective, a range of scientific methods is applied in a synergistic and integrated manner, including rigorous statistical analysis, advanced computer modelling, and expert evaluation techniques.

ANALYSIS AND DISCUSSION OF RESULTS

The assessment of the level of innovative development in industrial enterprises constitutes one of the strategic priorities of contemporary economic policy. Within the framework of this study, the existing methodological approaches and indicator systems directed at the quantitative measurement of innovation activity were first subjected to a rigorous critical analysis. International normative documents and standards — including the Oslo Manual and the Global Innovation Index (GII) — were thoroughly reviewed, alongside the conceptual approaches advanced in the research of local scholars such as A.A. Karimov [1] and M.S. Yuldosheva [2].

The analysis conducted clearly demonstrated that the majority of existing systems operate primarily with input indicators of innovation activity (such as R&D expenditure and the number of employees engaged in innovation processes) and output indicators (including the number of patents received and the volume of new products manufactured). At the same time, it was established that these approaches are insufficiently capable of revealing the complex internal mechanisms of the innovation process, its transformational potential, or its direct impact on the competitiveness of the enterprise. In particular, the specific characteristics of the national industrial sector, inter-sectoral diversification, and the dynamic nature of technological change are inadequately reflected in the existing evaluation systems [3].

On the basis of the foregoing analytical conclusions, the necessity arose to develop an improved indicator system capable of providing a comprehensive assessment of the level of innovative development in industrial enterprises. The significant scientific novelty of the proposed system lies in the fact that, unlike traditional assessment approaches, it incorporates a four-block hierarchical structure, which enables systematic analysis of the various stages of the innovation process. The proposed system comprises the following four blocks:

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1. **Block 1 — Resources and Capacity:** This block is designed to evaluate the existing foundation and capabilities of the enterprise for carrying out innovation activity. Relevant indicators include the share of R&D expenditure in total costs, the composition of highly qualified engineering and technical personnel, and the level of digital infrastructure provision.
2. **Block 2 — Innovation Process:** This block is directed at monitoring the degree of activity in the transformation of innovative ideas into commercially viable products or services. Key parameters include the number of new projects initiated, the implementation of rationalisation proposals, collaboration agreements concluded with higher education institutions and scientific centres, and technology transfer indicators.
3. **Block 3 — Performance and Output:** This block encompasses indicators that directly reflect the economic effectiveness of innovation activity. These include the share of new or substantially improved products in total sales volume, cost optimisation achieved through innovative solutions, and the volume of high-technology product exports.
4. **Block 4 — Efficiency and Competitiveness:** This concluding block is directed at evaluating the strategic impact of innovation activity on the enterprise's market position, its overall efficiency, and its competitiveness. Key indicators analysed in this block include the rate of labour productivity growth, the expansion of market share, and the product competitiveness index.

This indicator system was successfully subjected to empirical validation using data from 15 leading machine-building and chemical industry enterprises of the Republic of Uzbekistan. The results obtained indicate that, while the majority of enterprises demonstrate relatively satisfactory performance under Block 1 — Resources and Capacity (with average R&D expenditure constituting 1.2% of total costs) — significant deficiencies and gaps were identified under Block 2 — Innovation Process and Block 4 — Efficiency and Competitiveness. In particular, it was noted that only 20 percent of the enterprises analysed had established systematic cooperation with research institutions, and that the average time-to-market for new products was 2–3 years, representing a considerable lag relative to international standards and best practices.

Table 1. Four-Block System of Innovative Development Indicators for Industrial Enterprises and Empirical Results

No.	Block Name	Key Indicators	Empirical Results (15 Enterprises)
1	**Resources & Capacity**	R&D expenditure share in total costs; proportion of qualified engineering-technical staff; level of digital infrastructure provision	Average R&D expenditure: 1.2% of total costs (satisfactory level)
2	**Innovation Process**	Number of new projects initiated; implementation of rationalisation proposals; collaboration agreements with universities and research centres; technology transfer indicators	Only 20% of enterprises have established systematic cooperation with research institutions

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No.	Block Name	Key Indicators	Empirical Results (15 Enterprises)
3	**Performance & Output**	Share of new/improved products in total sales; cost optimisation resulting from innovation; volume of high-technology exports	Average time-to-market for new products: 2–3 years (significantly behind international benchmarks)
4	**Efficiency & Competitiveness**	Labour productivity growth rate; expansion of market share; product competitiveness index	Significant deficiencies identified — critical weak point in strategic management

Source: Compiled by the author based on analysis of the performance of Uzbek industrial enterprises.

As is evident from the table, the proposed four-block indicator system provides not merely an evaluation of the final results of innovation activity, but rather a comprehensive analysis of the entire innovation chain — from the mobilisation of resources through to the achievement of market competitiveness for products. As a result, this system serves as a valuable analytical instrument enabling enterprise management to identify "weak points" in the innovation strategy and to direct managerial decisions in a more targeted and effective manner. The practical significance of the research lies in the fact that the proposed system can serve as a robust methodological foundation both for the regular monitoring of the innovation condition of national industrial enterprises and for the development of targeted measures to stimulate innovation activity at the national policy level.

5. CONCLUSIONS AND RECOMMENDATIONS

The in-depth theoretical analysis conducted in this study has demonstrated that the existing traditional methodologies for evaluating innovation activity — such as approaches relying solely on financial indicators or narrow criteria such as the number of patents — are incapable of fully capturing the complex and multidimensional innovative potential of contemporary industrial enterprises. These approaches frequently devote excessive attention to the final outcomes of the innovation process, overlooking the early and intermediate phases of the innovation cycle — including idea generation, research and experimental development (R&ED), prototyping, and the formation of intellectual capital.

The fundamental scientific novelty of this research is represented by the comprehensive indicator system developed for assessing the innovative development of industrial enterprises, designed with due regard for the specific characteristics of the national economy and the context of individual industrial sectors. The proposed system possesses the following significant advantages:

5. **Integrative Approach (Comprehensiveness):** The system departs from one-dimensional approaches to evaluating innovation activity and instead integrates a diverse range of multidimensional indicators encompassing performance (volume of innovative products sold, net profit), resource capacity (innovation-oriented investment, highly qualified personnel), process efficiency (rate of adoption of new technologies, duration of the R&ED cycle), and market position (market share, level of competitiveness).
6. **Adaptability (Flexibility):** The proposed indicator system possesses the capacity to be configured and adapted in accordance with the institutional scale of the enterprise, the industrial sector in which it operates, and its strategic priorities.
7. **Diagnostic Potential:** The system serves not only as a comprehensive assessment tool for the overall innovative condition of an enterprise, but also as a solid analytical

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foundation for identifying critical weak points in innovation processes and for making effective strategic management decisions.

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