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ANALYSIS OF THE EFFICIENCY OF INNOVATIVE ENTREPRENEURSHIP IN THE SYSTEM OF INDUSTRIAL ENTERPRISES

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Abstract. The article proposes a system of five indicators and an integral index for assessing the efficiency of innovative entrepreneurship in industrial enterprises and tests it on five model enterprises over 2022–2025. According to the Global Innovation Index (GII), Uzbekistan rose from 83rd place in 2024 to 77th place in 2026, but its innovation outputs lag behind its inputs. At the enterprise level, the return on innovation costs increased from 42.0% to 59.4%, and the payback period fell from 2.38 to 1.68 years. The share of innovative products was more closely associated with return than the intensity of spending ($r = 0.84$ and $r = 0.55$), which indicates that spending alone does not guarantee efficiency. The article concludes with practical recommendations for enterprises.

Keywords: innovative entrepreneurship, efficiency, industrial enterprise, integral index, innovative products, Global Innovation Index.

INTRODUCTION

The competitiveness of modern industrial enterprises depends on how quickly and effectively they introduce new products, technologies and management solutions. In economic theory, the concept of innovative entrepreneurship goes back to J. Schumpeter’s idea of “new combinations”: the entrepreneur recombines factors of production in new ways and thereby drives economic development.[1] P. Drucker interprets innovation as the specific instrument of entrepreneurship and as a systematic, purposeful activity.[2] In international statistical practice (the Oslo Manual), an innovation is a new or improved product or business process that differs significantly from the firm’s previous products or processes and has been made available to potential users.[3]

Innovation processes take shape not within a single firm in isolation but within a national innovation system, in which research institutions, education, the financial system and public policy interact.[4] M. Porter links competitiveness to innovative activity in industries and clusters,[5] while H. Chesbrough proposed the

“open innovation” model, which relies on external ideas and technologies.[6]

Contemporary textbooks on innovation management stress that not only creating innovations but also measuring their results is a separate managerial task.[7]The institutional foundations of innovative development in Uzbekistan have been built consistently in recent years: the Ministry of

[1]Schumpeter J.A. The Theory of Economic Development. Cambridge, MA: Harvard University Press, 1934.

[2]Drucker P.F. Innovation and Entrepreneurship: Practice and Principles. New York: Harper & Row, 1985.

[3]OECD/Eurostat. Oslo Manual 2018: Guidelines for Collecting, Reporting and Using Data on Innovation. 4th ed. Paris/Luxembourg: OECD Publishing, 2018.

[4]Freeman C. Technology Policy and Economic Performance: Lessons from Japan. London: Pinter Publishers, 1987.

[5]Porter M.E. The Competitive Advantage of Nations. New York: Free Press, 1990.

[6]Chesbrough H. Open Innovation: The New Imperative for Creating and Profiting from Technology. Boston: Harvard Business School Press, 2003.

[7]Tidd J., Bessant J. Managing Innovation: Integrating Technological, Market and Organizational Change. 5th ed. Chichester: Wiley, 2013.

Innovative Development was established in 2017,[8] the Law "On innovation activity" (No. ZRU-630) was adopted on 24 July 2020,[9] and the innovative development strategy for 2022–2026 was approved.[10] In the Global Innovation Index (GII), the country rose from 83rd place in 2024 to 79th in 2025 and 77th in 2026.[11] However, the index shows that innovation outputs are weaker than inputs, which makes measuring and improving efficiency at the enterprise level a pressing issue.

In practice, enterprises record the volume of innovation costs, but the economic effectiveness of those costs, that is, how quickly and with what profit they are recovered, often remains at the level of separate indicators, and no single integral assessment is formed. This prevents managers from comparing precisely which enterprise or project uses resources efficiently. The resulting research gap defines the topic of this article.

The aim of the study is to propose a system of indicators and an integral index for assessing the efficiency of innovative entrepreneurship in industrial enterprises and to test it on model enterprises. To achieve this aim, the following tasks were set:

1) to form a system of indicators describing the efficiency of innovative entrepreneurship;
2) to analyze Uzbekistan's innovation environment on the basis of GII results;
3) to calculate the 2025 indicators and the 2022–2025 dynamics for five industrial enterprises;
4) to group the enterprises on the basis of the integral index and to develop practical recommendations.

Research hypothesis: the intensity of innovation spending does not by itself guarantee high efficiency; efficiency depends mainly on the share of innovative products and on the ability to convert costs into additional profit.

METHODS

2.1. Research design and data. The study was carried out in two stages. In the first stage, the country's innovation environment was analyzed using secondary data from the WIPO Global Innovation Index. In the second stage, efficiency indicators were calculated for five industrial enterprises from different industries (A: metal products, B: electrical engineering, C: building materials, D: textiles, E: food industry) for 2022–2025. The enterprises were selected deliberately to ensure industry diversity. To demonstrate the methodology, the enterprise data are given as illustrative (model) values; in a real study they would be taken from financial statements, statistical forms on innovation activity and management accounting data.[12] Monetary indicators are expressed in million soums.

2.2. System of efficiency indicators. The efficiency of innovative entrepreneurship is not one-dimensional: it includes resource input, market result, financial return, speed of payback and the contribution of innovation to total profit. The idea of multidimensional assessment is close to the Balanced Scorecard approach.[13] On this basis, five indicators were selected (Table 1).

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[8]Decree of the President of the Republic of Uzbekistan No. PF-5264 of 29 November 2017 "On the establishment of the Ministry of Innovative Development of the Republic of Uzbekistan". https://president.uz/oz/lists/view/1297

[9]Law of the Republic of Uzbekistan No. ZRU-630 of 24 July 2020 "On innovation activity". https://lex.uz/uz/acts/-4910391

[10]Decree of the President of the Republic of Uzbekistan No. PF-165 of 7 July 2022 "On approval of the innovative development strategy of the Republic of Uzbekistan for 2022–2026".

[11]WIPO. Global Innovation Index 2026: Uzbekistan. https://www.wipo.int/edocs/gii-ranking/2026/uz.pdf; WIPO. Global Innovation Index 2025: Uzbekistan. https://www.wipo.int/edocs/gii-ranking/2025/uz.pdf

[12]National Statistics Committee of the Republic of Uzbekistan. Statistical collections "Science and innovation activity in Uzbekistan". https://stat.uz

[13]Kaplan R.S., Norton D.P. The Balanced Scorecard: Translating Strategy into Action. Boston: Harvard Business School Press, 1996.

Table 1. System of indicators of the efficiency of innovative entrepreneurship

Code	Indicator	Formula	Weight (w)
K1	Innovation cost intensity, %	Innovation costs ÷ Net sales × 100	0.15
K2	Share of innovative products, %	Revenue from innovative products ÷ Total revenue × 100	0.25
K3	Return on innovation costs, %	Additional profit from innovation ÷ Innovation costs × 100	0.30
K4	Payback period, years	Innovation costs ÷ Annual additional profit	0.10
K5	Share of innovation in profit, %	Additional profit from innovation ÷ Net profit × 100	0.20

Source: author's development.

Here K1 reflects the level of resources committed, K2 the market result, K3 and K4 the financial return on costs and the speed of payback, and K5 the contribution of innovation to the enterprise's total profit. The higher K1–K3 and K5 and the lower K4, the higher the efficiency.

2.3. Integral index. Because the indicators have different units of measurement, they were brought to the range [0; 1] by min–max normalization:[14]

$Z_{ij} = (x_{ij} - \min x_j) \div (\max x_j - \min x_j)$, for K4: $Z = (\max x - x) \div (\max x - \min x)$

The integral index was calculated as a weighted sum: $I_i = \Sigma\, w_j \cdot Z_{ij}$, $\Sigma\, w_j = 1$

The weights (Table 1) were set by expert judgment: the highest weight was given to the financial return on costs (K3), followed by the market result (K2), because these express the economic meaning of innovation most directly.[15] Enterprises were divided into three groups by index value: high ($I \geq 0.60$), medium ($0.30 \leq I < 0.60$) and low ($I < 0.30$) efficiency.

2.4. Statistical methods. The analysis used comparison, time series (2022–2025) and Pearson's correlation coefficient (r). Because the correlation is based on only five observations, its results were treated as indicating a direction rather than as confirmatory.

RESULTS

3.1. Innovation environment: GII data. Uzbekistan showed a positive trend in the GII over the last three years (Table 2). In 2024 the country ranked 83rd,[16] In 2025 it rose to 79th among 139 economies, with 69th place in the input sub-index and 92nd place in the output sub-index,[17] and in 2026 it ranked 77th. Table 2. Uzbekistan's position in the Global Innovation Index

[14]OECD/European Commission JRC. Handbook on Constructing Composite Indicators: Methodology and User Guide. Paris: OECD Publishing, 2008.

[15]This rule is consistent with the innovation classification and the principles of recording innovation expenditure in the Oslo Manual: OECD/Eurostat. Oslo Manual 2018. Paris/Luxembourg: OECD Publishing, 2018.

[16]2024 result: Declines outweigh gains: How is Uzbekistan's position changing in international rankings? Kun.uz, 13 June 2025. https://kun.uz/en/news/2025/06/13/declines-outweigh-gains-how-is-uzbekistans-position-changing-in-international-rankings

[17]2025 result: WIPO. Global Innovation Index 2025: Uzbekistan. https://www.wipo.int/edocs/gii-ranking/2025/uz.pdf; input and output sub-indices: Uzbekistan ranks 79th in Global Innovation Index 2025. https://www.xs.uz/en/post/uzbekistan-ranks-79th-in-global-innovation-index-2025

Year	GII rank	Note
2024	83	One place lower than the previous year; index score 24.7
2025	79 (out of 139 economies)	Input sub-index: 69th; output sub-index: 92nd
2026	77	Innovation outputs still lag behind inputs

Source: compiled from WIPO Global Innovation Index reports and Kun.uz data.

By pillar for 2026 (Table 3), institutions (57th) are the strongest area, while business sophistication (81st) and creative outputs (96th) stand out as the weakest.[18] Among selected indicators, entrepreneurship policies and culture (3rd) and the share of science and engineering graduates (2nd) are rated very high, while gross expenditure on R&D (99th) and software spending (117th) rank low.

Table 3. GII 2026: Uzbekistan's rank by pillar and selected indicators

Pillar / indicator	Rank	Assessment
Pillars		
Institutions	57	Relatively strong
Knowledge and technology outputs	62	Average
Market sophistication	69	Average
Human capital and research	70	Average
Infrastructure	71	Average
Business sophistication	81	Weak
Creative outputs	96	Weak
Global Innovation Index (overall)	**77**	—
Selected indicators		
Entrepreneurship policies and culture	3	Very strong
Graduates in science and engineering, %	2	Very strong
Gross expenditure on R&D, % of GDP	99	Weak
Software spending, % of GDP	117	Weak

Source: WIPO, Global Innovation Index 2026, Uzbekistan profile.

[18] WIPO. Global Innovation Index 2026: Uzbekistan. https://www.wipo.int/edocs/gii-ranking/2026/uz.pdf

The calculated indicators are given in Table 4. For the whole sample, innovation cost intensity was 3.63%, the share of innovative products 22.1%, the return on costs 59.4%, the payback period 1.68 years, and the share of innovation in net profit 26.0%.

Table 4. Efficiency indicators of innovative entrepreneurship, 2025

Enterprise	K1, %	K2, %	K3, %	K4, years	K5, %
A	3.00	25.0	66.7	1.50	25.0
B	7.00	35.0	65.0	1.54	50.5
C	2.00	12.0	45.2	2.21	11.3
D	4.00	22.0	53.8	1.86	26.9
E	3.50	22.0	60.3	1.66	23.5
Total sample	**3.63**	**22.1**	**59.4**	**1.68**	**26.0**

Source: author's development.

There are marked differences between the enterprises. Enterprise B has the highest intensity (7.00%) and share of innovative products (35.0%), and innovation accounts for more than half of its net profit (50.5%). Enterprise A, at a comparatively low intensity (3.00%), achieved the highest return (66.7%) and the shortest payback period (1.50 years). By contrast, Enterprise D spent more than A (4.00%) but has a lower return (53.8%). Enterprise C has the lowest values on all indicators: intensity 2.00%, share of innovative products 12.0%, payback period 2.21 years.

3.2. Dynamics of efficiency (2022–2025). The dynamics for the whole sample are given in Table 5. Between 2022 and 2025 revenue grew 1.39 times and innovation costs 1.94 times. Although costs grew faster than revenue, the return rose from 42.0% to 59.4% and the payback period fell from 2.38 to 1.68 years. Thus the additional costs did not reduce the average return; on the contrary, they raised it.

Table 5. Dynamics of efficiency in the sample, 2022–2025

Year	Revenue, million soums	Innovation costs, million soums	K1, %	K2, %	K3, %	K4, years
2022	1,420,000	36,900	2.60	15.0	42.0	2.38
2023	1,610,000	48,300	3.00	18.5	50.0	2.00
2024	1,790,000	59,600	3.33	21.0	56.0	1.78
2025	1,970,000	71,550	3.63	22.1	59.4	1.68
2025/2022	**×1.39**	**×1.94**	**+1.03 p.p.**	**+7.1 p.p.**	**+17.4 p.p.**	**−0.70 years**

Source: author's development.

DISCUSSION

4.1. Interpretation of the results.

First, the results show that the volume of innovation costs and their efficiency are not the same thing. A comparison of Enterprises A and D illustrates this clearly: D spent more but lags behind A in converting costs into additional profit. This suggests that choosing innovative products to match market demand, testing projects and bringing them to market determine efficiency. In this respect the research hypothesis was confirmed.

Second, the leadership of Enterprise B is explained by a combination of factors: a high share of innovative products, a high return on costs and a large contribution of innovation to profit. In Enterprise C, the share of innovative products is low (12.0%), so costs are recovered slowly. Third, the enterprise-level conclusions are consistent with the macro picture. In the GII, Uzbekistan is strong in institutions and entrepreneurship policy and ranks high in the share of science and engineering graduates, but it lags in business sophistication, creative outputs and R&D expenditure. In other words, opportunities and human capital exist, but the link that turns them into commercial results is weak. At the enterprise level this is visible precisely through the share of innovative products and the conversion of costs into profit.

4.2. Practical recommendations. On the basis of the analysis, the recommendations in Table 6 were developed for industrial enterprises.

Table 6. Findings and practical recommendations

No.	Finding	Recommendation	Expected effect
1	Low share of innovative products (Enterprise C)	Renew the product portfolio; test developments on the market before launch	Higher K2 and K3
2	High costs, average return (Enterprise D)	Select projects by expected return; finance them in stages	Shorter payback period
3	High-performing enterprises (A, B)	Transfer successful practice to other divisions; cooperate with technology transfer centers	Economies of scale
4	Strong human capital, low business sophistication	Strengthen university–industry cooperation; involve young engineers in applied projects	More innovation outputs
5	Low expenditure on R&D	Form an in-house R&D budget; use state support and grant opportunities	Smaller gap between inputs and outputs
6	Efficiency is not measured systematically	Include the integral index in annual monitoring and the KPI system	Better-grounded management decisions

Source: author's development.

4.3. Limitations. The study has several limitations.

First, the enterprise data are illustrative, so the results serve to demonstrate the methodology. Second, the sample is small (n = 5); the correlation results indicate a direction and are not sufficient for statistical generalization. Third, the index weights were set by expert judgment; future studies should test how stable the ranking remains when the weights change (sensitivity analysis). Fourth, isolating the additional profit attributable to innovation is methodologically difficult and may not be calculated in the same way across enterprises.

CONCLUSION

1. A system of five indicators (intensity, share of innovative products, return, payback period and share in profit) and an integral index were proposed for assessing the efficiency of innovative entrepreneurship in industrial enterprises.

2. Uzbekistan rose in the GII from 83rd place in 2024 to 77th place in 2026, but it lags in business sophistication and creative outputs; this points to the need to strengthen innovation results at the enterprise level.

3. For the model enterprises, the return on innovation costs rose from 42.0% to 59.4% and the payback period fell from 2.38 to 1.68 years over 2022–2025.

4. Efficiency depends more on the share of innovative products and the ability to convert costs into profit than on the volume of costs ($r = 0.84$ and $r = 0.55$); enterprises should therefore select projects by their results rather than simply increase innovation funding.

5. The proposed integral index can serve as a practical tool for comparing enterprises, screening projects and annual monitoring; supplementing it with real enterprise data and sensitivity analysis is the direction for further research.

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