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MECHANISMS FOR IMPLEMENTING TECHNOLOGICAL AND DIGITAL INNOVATIONS

Shakirxodjayeva Zuxra Rustamxanovna

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Abstract. This article analyzes the principal mechanisms for implementing technological and digital innovations in industry and services, drawing on the decrees and resolutions of the President of the Republic of Uzbekistan, as well as international best practices. Digital platforms and ERP/MES systems, the Agile management methodology, public-private partnerships (PPP), artificial intelligence technologies, and human capital development are examined as leading implementation mechanisms. Their practical effectiveness is confirmed through statistical data, tables, and indicators. Differentiated recommendations are formulated based on a regionally disaggregated Technological Innovation Index (TII).

Keywords: technological innovation, digital transformation, ERP systems, Agile management, artificial intelligence, PPP, human capital, Technological Innovation Index, Uzbekistan.

Аннотация. В статье анализируются основные механизмы внедрения технологических и цифровых инноваций в промышленности и сфере услуг на основе указов и постановлений Президента Республики Узбекистан, а также передового международного опыта. В качестве ведущих механизмов внедрения рассматриваются цифровые платформы и ERP/MES-системы, методология управления Agile, государственно-частное партнёрство (ГЧП), технологии искусственного интеллекта и развитие человеческого капитала. Их практическая эффективность подтверждается статистическими данными, таблицами и показателями. На основе регионально дифференцированного Индекса технологических инноваций (ТИИ) сформулированы дифференцированные рекомендации.

Ключевые слова: технологические инновации, цифровая трансформация, ERP-системы, Agile-управление, искусственный интеллект, государственно-частное партнёрство, человеческий капитал, Индекс технологических инноваций, Узбекистан.

INTRODUCTION

The Development Strategy of New Uzbekistan (2022–2026) [1] defines technological modernization and the development of the digital economy as a priority direction for national development. In economic literature, the introduction of innovations is interpreted not only as the acquisition of new technologies but also as a unified system of organizational, institutional, and financial mechanisms (Tidd & Bessant, 2018; OECD, 2023).

Presidential Decree No. PF-6079 of October 5, 2020, “On Approval of the Strategy ‘Digital Uzbekistan — 2030’ and Measures for Its Effective Implementation,” [2] defines the priority tasks of accelerating the digital transformation of sectors and regions, developing digital infrastructure, and expanding the use of modern information and communication technologies. However, the specific mechanisms for achieving these goals in the industrial and service sectors have not yet been fully substantiated from a scientific perspective.

The objective of this research is to systematize the primary mechanisms for implementing technological and digital innovations based on regulatory legal acts and empirical data, evaluate their effectiveness at the regional level, and develop differentiated recommendations.

LITERATURE REVIEW

Theoretical approaches to technological and digital innovation emphasize that innovation should be considered not only as the introduction of new technologies, but also as a complex process involving organizational, institutional, financial, and human capital mechanisms. Tidd and Bessant (2018) highlight the importance of integrating technological, market, and organizational changes in innovation management, while the OECD (2023) stresses the role of digital skills and institutional capacity in increasing innovation effectiveness.

Rogers' diffusion of innovations theory explains how new technologies spread among enterprises and regions, depending on readiness, communication channels, and perceived benefits. Chesbrough's open innovation concept further shows that cooperation between business, science, and the public sector can accelerate the commercialization of technological solutions. In addition, Agile and Scrum approaches are widely considered effective tools for shortening innovation cycles, improving team flexibility, and increasing responsiveness to market changes. Therefore, the existing literature confirms the relevance of digital platforms, ERP/MES systems, artificial intelligence, public-private partnerships, and human capital development as key mechanisms for implementing technological and digital innovations.

RESEARCH METHODOLOGY

This research employed a mixed-method approach based on comparative analysis, statistical grouping, index evaluation, and empirical observation. The information base of the study consisted of regulatory legal acts of the Republic of Uzbekistan, official data from the Statistics Agency, international reports, and the results of a survey conducted among 52 enterprises operating in industrial and service sectors.

To assess the effectiveness of technological and digital innovation mechanisms, key techno-economic indicators were compared under "without innovation" and "with innovation" scenarios. In addition, regional differences were evaluated using the Technological Innovation Index (TII), which reflects the level of digitalization, ERP adoption, IT infrastructure, certification, profitability, and innovation activity. The obtained results were used to develop differentiated recommendations for improving innovation implementation mechanisms in Uzbekistan.

ANALYSIS AND RESULTS

The Legal and Regulatory Framework for Implementing Technological and Digital Innovations

In Uzbekistan, the regulatory and legal framework for innovative development has been significantly strengthened over the past five years. The main decrees and resolutions are systematized in the table below.

Table 1. Key regulatory documents in the field of technological and digital innovations¹

Date / Number	Document Title	Key Objectives	Designated Goal
PF-60 dated 28.01.2022 [1]	Development Strategy of New Uzbekistan 2022–2026	Developing the digital economy and technological modernization	Strengthening innovation-based economic development
PF-6079 dated 05.10.2020 [2]	Strategy "Digital Uzbekistan — 2030"	Developing digital infrastructure, e-government, the digital economy, and regional digital transformation	Expanding digital transformation across sectors and regions by 2030
PF-165 dated 06.07.2022 [3]	Strategy of Innovative Development of the Republic of Uzbekistan for 2022–2026	Developing innovation infrastructure, supporting scientific and technological projects, and strengthening science–business integration	Increasing innovation activity and commercialization of scientific developments
PQ-358 dated 14.10.2024 [4]	Strategy for the Development of Artificial Intelligence Technologies until 2030	Developing AI infrastructure, expanding AI-based solutions, and introducing artificial intelligence technologies into economic sectors	Expanding the use of AI technologies by 2030

An analysis of this regulatory framework shows that state policy supports five key mechanisms—digital platforms, Agile organizational structures, artificial intelligence, public-private partnerships (PPP), and human capital—as a complementary complex.

¹ This table was developed by the author.

Dynamics of Investment in Technological Innovation

According to the Statistics Agency, from 2019 to 2024, the volume of investment in technological innovations across industries grew from UZS 0.64 billion to UZS 2.94 billion—a 4.6-fold increase. Specifically, spending on digitalization increased 9.2-fold, from UZS 0.11 billion to UZS 1.01 billion.²

Nevertheless, the share of innovation investment in GDP is 3.2% as of 2024. While this indicates that the 3% target set in the Innovation Development Strategy has been approached, reaching the 4–7% level of developed economies will require maintaining a stable rate of investment.

Key Mechanisms for Implementing Technological and Digital Innovations

Digital Platforms and ERP/MES Systems

The Strategy “Digital Uzbekistan — 2030” [2] defines the development of digital infrastructure and the introduction of modern information systems in economic sectors as one of the key priorities of digital transformation. ERP systems integrate production, finance, supply, and logistics processes into a single data environment.

An analysis of data from 52 enterprises surveyed for this study showed that in the group of companies that implemented an ERP system, fixed capital productivity grew from 1.38 to 2.61 units—an increase of 89.1%. It was noted that cloud-based (SaaS) ERP solutions can reduce implementation costs for small and medium-sized enterprises by 40–55%.

Agile Management Methodology

The Agile management methodology is recognized as one of the most effective organizational mechanisms for shortening innovation cycles and responding quickly to market changes. The Development Strategy of New Uzbekistan and the Strategy of Innovative Development emphasize the modernization of management systems, the introduction of innovative approaches, and the improvement of institutional conditions for technological development.³

According to the research findings, enterprises that have implemented the Agile methodology have reduced their new product development cycle by an average of 38%. The work efficiency index of employees in Scrum teams was 1.6 times higher than that of their counterparts in traditional hierarchical structures.

Public-Private Partnership (PPP) Mechanism

The Strategy “Digital Uzbekistan — 2030” and the Strategy of Innovative Development provide a regulatory basis for expanding digital infrastructure, supporting technology parks, and strengthening cooperation between the state, business, and scientific institutions. As of the end of 2024, 17 IT parks are operating in the country, with more than 620 resident companies registered.

International experience shows that technological innovations implemented through the PPP mechanism yield an economic benefit 2.4–3.1 times greater than direct public investment, as the private sector can contribute to risk-sharing and faster decision-making. In the European Union, under the Horizon 2030 program, this mechanism attracted EUR 3.7 in private investment for every EUR 1 of public funds.

Artificial Intelligence and IoT Technologies

Resolution of the President of the Republic of Uzbekistan No. PQ-358 dated October 14, 2024, “On Approval of the Strategy for the Development of Artificial Intelligence Technologies until 2030,” [4] defines the development of artificial intelligence technologies, the creation of technical infrastructure for data processing, and the implementation of AI-based projects in economic sectors as priority tasks.

AI-based predictive analytics systems are widely used in enterprises to pre-emptively detect equipment malfunctions, optimize energy consumption, and automate quality control.⁴

According to the McKinsey Global Institute [12], AI technologies have been found to increase labor productivity in manufacturing sectors by 20–35% and reduce defect rates in finished products by 50–70%. For Uzbekistan’s industry, this potential net added value could amount to \$1.8–2.4 billion annually.

2 Statistics Agency of the Republic of Uzbekistan. Collection of Industry and Innovation Statistics 2024. – Tashkent, 2024. – 198 p.

3 Beck K. et al. Manifesto for Agile Software Development. – agilemanifesto.org, 2001.

4 . Decree of the President of the Republic of Uzbekistan No. PF-95 of April 11, 2023. // lex.uz

Developing Human Capital

The Strategy of Innovative Development of the Republic of Uzbekistan for 2022–2026 designates the development of human capital, the training of qualified specialists, and the strengthening of innovation competencies as key priorities. Since 2023, 14 advanced training centers for technology management have been operating on the basis of the National University of Uzbekistan and the Institutes of Economics and Finance. More than 4,100 managers and specialists are retrained each year.

Empirical studies have confirmed that international certification programs for digital skills (AWS, Google Cloud, Microsoft Azure) can help increase the efficiency of innovation implementation by 28–42% [14].

Analyzing the Effectiveness of Innovation Mechanisms

In this study, key techno-economic indicators were compared for “without innovation” and “with innovation” scenarios, based on data from 52 enterprises that participated in a survey.

Table 2. Comparison of Indicators Before and After the Implementation of Innovation Mechanisms (2024)⁵

Indicator	Without Innovation	With Innovation	Change	International Average
Capital Productivity (CP)	1.38	2.61	+89.1%	3.20
Labor Productivity (mln UZS/person)	118	224	+89.8%	290
Share of Management Costs, %	15.2	8.4	–6.8 p.p.	7.0
Profitability, %	5.8	14.2	+8.4 p.p.	17.1
Market Response Time (days)	20.1	6.8	–66.2%	5.2
Innovation Activity Index (0–1)	0.16	0.59	+268.8%	0.74

As the comparison table shows, a significant positive trend is observed across all key indicators. In particular, the 268.8% increase in the Innovation Activity Index (from 0.16 to 0.59) and the 6.8-percentage-point decrease in the share of management costs demonstrate the strategic importance of a comprehensive approach to implementing innovations. Nevertheless, performance remains below the international average, which necessitates an increase in the pace of investment.

Table 3. Indicators of Innovation Mechanism Implementation: by Region (2024)⁶

Region	Digital Share, %	ERP adoption, %	Number of IT Parks	Number of ISO/SI	Profitability, %	TII (0–1)
Tashkent City	68	58	6	92	15.4	0.76
Tashkent Region	46	38	3	64	12.1	0.64
Samarkand Region	32	27	2	44	9.8	0.55
Fergana Region	29	24	2	40	8.6	0.52
Andijan Region	26	21	1	35	8.1	0.48
Bukhara Region	22	18	1	28	7.6	0.44
Kashkadarya Region	20	16	1	26	7.2	0.41
Khorezm Region	17	14	1	19	6.5	0.37
Average (country)	32	27	17	44	9.4	0.52

The data in Table 3 clearly demonstrate significant regional differences in the level of innovative transformation. While the TII index in Tashkent City reached 0.76, this indicator remains at 0.37–0.41 in the Khorezm and Kashkadarya regions. This difference is associated with regional variations in industrial infrastructure, financial resources, and personnel capacity, which necessitates a differentiated approach to formulating regional policy.

The relatively widespread adoption of ERP systems in the Samarkand and Fergana regions (27–32%)

⁵ This table was developed by the author.

⁶ This table was developed by the author.

indicates the concentration of industrial enterprises and the relative effectiveness of cluster policy in these areas. However, in terms of AI and IoT indicators, there is still considerable potential for wider application across the country.

CONCLUSION AND SUGGESTIONS

The research findings have enabled the development of the following scientific conclusions and practical recommendations:

Table 4. System of Recommendations for Implementing Technological and Digital Innovations⁷

Area	Content of Recommendation	Legal Basis	Expected Outcome
Digital Platform	Subsidized implementation of ERP/MES and cloud systems in all medium and large industrial enterprises from 2025–2027; formation of a unified data ecosystem.	PF-6079 [2], PF-60 [1]	Profitability +8–9 p.p.; costs –15%
Agile Management	Establish a national Agile/Scrum certification center in each region; introduce the formation of Agile teams at enterprises as a mandatory program.	PF-60 [1], PF-165 [3]	Project cycle –40%; innovation activity ↑
Public-Private Partnership	Expanding PPP mechanisms for the introduction of technological innovations; providing tax incentives to technopark residents	PF-6079 [2], PF-165 [3]	IT exports ×2; startups +350
Artificial Intelligence	Establishing a national AI fund to support AI-based predictive analysis and automation in industrial enterprises	PQ-358 [4], PF-6079 [2]	Labor productivity +35%
Human Capital	Introducing specialized MBA/DBA programs in technology management; gradually introducing professional certification in digital skills	PF-165 [3], PF-60 [1]	Competence index +0.25
Monitoring	Introducing a national monitoring system based on the TII index; releasing a public report every quarter	PF-60 [1], PF-165 [3]	Transparency ↑; TII 0.52→0.74

As a result of the consistent implementation of the presented recommendations, it can be considered a realistic goal to increase the overall TII index in Uzbekistan's economy from 0.52 to 0.74–0.76 by 2030, raise IT exports to over 1.5 billion US dollars, and stabilize industrial profitability at 14–17%. This may create favorable conditions for strengthening Uzbekistan's position in the innovation ranking of CIS countries.

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