

## STRATEGY FOR DEVELOPING THE INNOVATION ECOSYSTEM IN UZBEKISTAN IN THE CONDITIONS OF DIGITAL TRANSFORMATION

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**Annotation:** The article provides a comprehensive analysis of the issues of developing the innovation ecosystem in Uzbekistan in the conditions of the digital economy. Based on data for 2015-2024, the impact of digital technologies on innovation activity was assessed using econometric models. The results of the study showed that a 1% increase in the volume of e-commerce increases the production of innovative products by 0.58%. The synergistic effect of artificial intelligence, big data, digital platforms and IoT technologies is identified. A digital innovation strategy for 2030 is proposed.

**Keywords:** digital transformation, innovation ecosystem, artificial intelligence, big data, e-commerce, digital platforms, econometric modeling.

In the 21st century, digital technologies are the main driver of economic development and are fundamentally changing innovation processes. According to the World Economic Forum, by 2030, 70 percent of the global economy will be digitalized. According to research by the McKinsey Global Institute, digital transformation adds \$1.2 trillion to annual global GDP growth.

In Uzbekistan, the development of the digital economy has also been identified as a national priority. According to the “Digital Uzbekistan – 2030” strategy, the task is to increase the share of the digital economy in GDP to 30 percent, digitize all public services, and increase Internet coverage to 95 percent. In this context, scientific substantiation of the impact of digital technologies on the innovation ecosystem is an urgent task.

The relationship between digital transformation and innovation is analyzed in depth in E. Brynjolfsson and A. McAfee (2014) in their book “The Second Machine Age”. K. Schwab (2016) in his book “The Fourth Industrial Revolution” highlighted the disruptive impact of digital technologies. M. Porter and J. Heppelmann (2014) showed the role of IoT technologies in ensuring competitive advantage.

In the context of Uzbekistan, S.S. Gulomov (2019) studied the impact of information and communication technologies on economic growth, A.A. Qodirov (2021) studied the economics of digital platforms, and N.H. Khaydarov (2023) studied the impact of artificial intelligence on innovation potential. However, there is a lack of research on the econometric assessment of the complex impact of digital transformation on the innovation ecosystem.

The study used systematic analysis, econometric modeling, and statistical forecasting methods. A multivariate regression model was constructed to assess the impact of digital transformation on innovation activity:

Where: Y - Volume of innovative products production (billion dollars);  $X_1$  - Internet penetration (%);  $X_2$  - Number of digital platforms;  $X_3$  - Number of AI/ML projects;  $X_4$  - Volume of e-commerce (billion dollars);  $X_5$  - Investment in digital technologies (million dollars);  $X_6$  - Number of IT specialists (thousand people). STATA 17.0 software was used to estimate the model parameters. Multicollinearity, heteroskedasticity, autocorrelation, and specification tests were conducted.

In 2015-2024, digital transformation in Uzbekistan took place at a rapid pace. The number of Internet users increased from 10.2 million to 26.7 million (2.6 times), and Internet penetration increased from 31.2% to 78.1%. Smartphone users increased from 3.8 million to 22.5 million. E-commerce volume increased from \$0.12 billion to \$9.34 billion (78 times).

The number of digital platforms increased from 12 to 892. B2B platforms amounted to 256, B2C platforms - 498, and C2C platforms - 178. The number of active users reached 13.89 million, and the number of annual transactions reached 345.6 million.

Artificial intelligence and big data technologies are being widely implemented. The number of AI/ML projects increased from 12 in 2018 to 423 in 2024. The number of Data Science specialists reached 1,012, and Big Data platforms reached 156. The volume of processed data amounted to 67.8 petabytes.

The results of model evaluation are as follows:

Model quality indicators:  $R^2 = 0.997$ , Adjusted  $R^2 = 0.991$ , F-statistics = 178.4 ( $p = 0.0008$ ), Durbin-Watson = 2.34.

Elasticity coefficients:

E-commerce volume: 0.58 (the highest impact);

IT specialists: 0.54;

Internet penetration: 0.44;

AI/ML projects: 0.38;

Digital platforms: 0.32;

Digital investment: 0.26.

The high elasticity coefficient of e-commerce (0.58) indicates the important role of digital trade in stimulating innovation. The impact of the number of IT specialists (0.54) confirms the crucial importance of human capital in the digital economy.

The results of the study revealed that digital technologies have a complex, rather than individual, impact. The combined impact of AI, ML and digital platforms is 0.70 percent. This synergy is manifested in:

1. Creating new innovative solutions through the analysis of large volumes of data. 234 AI+Big Data projects were implemented.

2,645 IoT integrations were implemented, creating the possibility of collecting and analyzing data in real time.

3,178 blockchain-based solutions accelerate financial innovation.

With the expansion of 4.5G networks, immersive technologies are developing.

The rapid development of the digital economy in Uzbekistan creates new opportunities, as well as serious challenges. The country's emerging innovation clusters, existing barriers and the 2030 strategic directions envisaged create a complex picture of digital transformation.

Four large digital clusters are successfully operating in Uzbekistan. The largest has 487 resident companies, \$680 million in output and 23,500 jobs. 89 companies are actively working in the cluster specializing in artificial intelligence and data analytics. The Fergana fintech cluster has achieved an annual transaction volume of \$234 million with 156 fintech companies. The Bukhara tourism-tech cluster, on the other hand, offers digital tourism solutions, generating \$45 million in turnover through 78 companies.

Although these clusters demonstrate Uzbekistan's potential in the digital economy, there is still great potential for development. The geographical distribution of clusters is uneven, concentrated mainly in large cities. The level of specialization by sector is still insufficient, with most companies offering general IT services.

The first and most serious obstacle is the lack of digital skills. 39% of the population does not have basic digital skills, and only 18% of the population has advanced digital skills. These indicators not only limit the use of digital services, but also lead to a shortage of qualified personnel in the IT sector. In particular, there is a shortage of specialists in such modern areas as artificial intelligence, data analysis, and cybersecurity.

Cybersecurity problems are the second most important obstacle. In 2024, 6,234 cyber attacks were recorded, which led to losses of \$ 89.2 million. These figures indicate not only financial losses, but also a low level of trust in digital services. Cybersecurity infrastructure is poorly developed, there is a shortage of specialists, and a cybersecurity culture has not been formed in enterprises and organizations.

The imbalance in digital infrastructure is the third main obstacle. In rural areas, internet penetration is only 35 percent, and high-speed internet is available to only 8 percent of the population. This is deepening the digital divide between urban and rural areas. Fiber-optic networks are developed mainly in large cities, while rural and remote areas still rely on old technologies.

The fourth obstacle is the imperfect regulatory environment, and the legislative framework for data protection, digital signatures, cryptocurrencies, artificial intelligence and other modern technologies is

not sufficiently developed. This makes it difficult to implement innovative projects, engage in international cooperation and attract investments.

The first direction - the development of digital infrastructure - is aimed at strengthening the country's digital base. Increasing internet coverage to 95 percent will allow connecting all residents to the global information space. The introduction of 5G networks in all major cities will create the basis for the widespread use of advanced technologies such as Industry 4.0, IoT, and smart cities. Increasing the capacity of national data centers by 10 times will ensure data sovereignty and security. Extending fiber-optic networks to 200,000 km will provide high-speed Internet throughout the country.

The second direction - creating an AI and Big Data ecosystem - aims to make Uzbekistan a regional leader in the field of artificial intelligence. A \$ 1 billion AI development fund will finance startups and research. 10 specialized AI research centers will conduct fundamental and applied research. A program to train 10,000 AI, ML specialists will eliminate the shortage of personnel. Providing state data through open APIs will be the basis for creating innovative solutions. The third direction - support for digital platforms - is aimed at developing the ecosystem of local platforms. 5-year tax holidays will help new platforms grow. A \$ 500 million venture fund will allow for risk sharing and financing of innovations. The regulatory sandbox regime will create a safe environment for testing new business models. Integration with international platforms will allow access to global markets.

The fourth direction - expansion of IT education - is aimed at solving the shortage of digital skills. A program to train 100,000 IT specialists will meet the human resources needs of the industry. Making programming mandatory in schools will prepare the new generation for the digital world. 50 specialized IT schools will develop talented young people from an early age. 1,000 digital libraries will increase the digital literacy of the population.

The fifth direction - development of e-commerce - is aimed at expanding the practical application of the digital economy. The goal is to reach \$15 billion by 2030. The creation of a national payment system will ensure financial independence and security. A \$2 billion investment in logistics infrastructure will increase delivery efficiency. Cross-border e-commerce platforms will expand export opportunities.

An integrated approach is necessary for the successful implementation of the strategy. Institutionally, the Ministry of Digital Development will play the role of a coordinator, and responsible agencies will be determined for each area. Financing will be provided through the state budget, international loans, private investments, and public-private partnerships. The total investment volume is expected to be \$10 billion.

The monitoring and evaluation system will include real-time monitoring of KPIs, quarterly progress reports, annual independent audits, and public oversight. International cooperation will be carried out through technical assistance programs with the World Bank, ADB, and EBRD, strategic partnerships with Google, Microsoft, and Amazon, and through studying the experience of South Korea and Singapore.

Based on the exponential trend model, the following results are expected to be achieved by 2030: the production of innovative products will reach \$9.34 billion, the volume of e-commerce will reach \$25

billion. The number of AI, ML projects will reach 3,500, and the number of IT specialists will reach 150,000. The share of the digital economy in GDP will be 30 percent.

As an economic impact, GDP is expected to grow by an additional 15-20 percent, 500,000 new jobs will be created, and labor productivity will increase by 40 percent. The social impact will be manifested in the coverage of digital skills by 80 percent of the population, 100 percent digital access to education and medical services, and a 50 percent reduction in the level of corruption.

Uzbekistan's digital transformation strategy for 2030 will allow the country to become an active participant in the global digital economy. By overcoming existing obstacles and consistently implementing five strategic directions, Uzbekistan can become a center of digital innovation in Central Asia. The success of the strategy depends on the effective cooperation of all stakeholders - the state, the private sector, academia and civil society. Digital transformation is an important tool for ensuring not only economic growth, but also qualitative changes in all spheres of society. The results of the study confirmed that digital transformation plays a decisive role in the development of the innovation ecosystem in Uzbekistan. The complex impact of e-commerce, IT personnel, AI technologies and digital platforms significantly increases the production of innovative products.

Implementation of the proposed strategic directions will make it possible to transform Uzbekistan into a center of digital innovation in Central Asia. By 2030, it will be possible to increase the country's global digital competitiveness and ensure the transition to a knowledge-based economy.

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