



Article

Development of Innovative Infrastructure in The Regional Higher Education System

Mardonova Go'zal Mamatqul qizi*¹

1. Doctoral student of Karshi State University, Senior Teacher at Karshi International University
- * Correspondence: guzalardonova398@gmail.com

Abstract: This study examines the development of innovative infrastructure in regional higher education systems and its role in enhancing the efficiency of knowledge transfer, research commercialization, and human capital formation. The paper analyzes key components of innovation infrastructure, including technology parks, business incubators, digital platforms, and research centers. Special attention is given to the challenges faced by developing countries, particularly in the context of limited financial resources and institutional capacity. The research employs a mixed-method approach, combining statistical analysis and comparative international experience. The findings indicate that the integration of digital technologies and public-private partnerships significantly improves the performance of higher education institutions. Furthermore, the study proposes a model for developing an integrated innovation ecosystem at the regional level. The results can be used by policymakers and university administrators to design effective strategies for strengthening innovation infrastructure.

Keywords: Innovation Infrastructure, Higher Education, Regional Development, Digital Economy, University-Industry Collaboration, Technology Transfer

1. Introduction

In the context of globalization and the rapid development of the digital economy, higher education institutions play a crucial role in promoting innovation and regional economic growth. The success of universities is now increasingly dependent on the presence of a well-developed innovation infrastructure.

In the context of globalization and the rapid development of the digital economy, higher education institutions are increasingly acknowledged as a key driver of innovation and regional economic growth. According to the Organisation for Economic Co-operation and Development, countries that have a well-developed system of collaboration between universities and industries exhibit significantly higher levels of productivity, innovation output, and competitiveness[1].

The theoretical foundation of innovation ecosystems is based on the Triple Helix model proposed by Henry Etzkowitz, where the interaction between universities, industry, and government is a key factor. This model has also been successfully implemented in the leading innovation ecosystems like Silicon Valley, where universities like Stanford and Massachusetts Institute of Technology have played a crucial role in producing thousands of startups and developing high-tech industries. As per reports published by the World Bank, it has been stated that regions with well-developed innovation ecosystems can experience a growth rate up to 20-30% higher than other regions[2].

Citation: Mamatqul qizi, M. G. Development of Innovative Infrastructure in The Regional Higher Education System. Central Asian Journal of Innovations on Tourism Management and Finance 2026, 7(2), 323-328.

Received: 30th Jan 2025

Revised: 25th Feb 2026

Accepted: 15th Mar 2026

Published: 29th Mar 2026



Copyright: © 2026 by the authors. Submitted for open access publication under the terms and conditions of the Creative Commons Attribution (CC BY) license (<https://creativecommons.org/licenses/by/4.0/>)

For example, in Asia, countries like South Korea have shown the success story of innovation clusters supported by the government. For example, Daedeok Innopolis, where there are more than 40 institutions and over 18,000 researchers, is one example of successful regional innovation development. Innovation-driven policies supported by the European Commission are another example[3].

Uzbekistan has carried out significant reform processes in recent years to modernize its higher education system and develop its innovation capacities. For example, according to the Ministry of Higher Education, Science, and Innovation of Uzbekistan, the total number of higher education institutions increased from 72 in 2017 to more than 200 in 2024, and the total enrollment in higher education institutions exceeded 1.7 million. The higher education coverage rate is estimated at around 47.7%[4].

At the same time, new elements of innovation infrastructure have been introduced. These elements include engineering schools, technology parks, and digital platforms. For instance, the HighEd platform has made it possible to facilitate international student mobility and gain access to global educational opportunities. In addition, universities such as Tashkent State Technical University are making efforts to integrate digital technologies in the process. Despite all these successes, there are many challenges that need to be addressed. The innovation infrastructure in the regions remains underdeveloped compared to major urban centers such as Tashkent. Challenges such as limited financial resources, digital infrastructure, and university-industry links remain an obstacle to the functioning of innovation systems[5].

Thus, the aim of the present study is to examine the current state of innovative infrastructure in the regional higher education systems and suggest the mechanisms for its development, both in the context of international practice and with regard to national specifics[6].

Literature Review

The idea of innovation infrastructure in higher education has been widely researched in the context of the theory of innovation systems and knowledge-based economic development. Among the most popular approaches in this area, the Triple Helix model advanced by Henry Etzkowitz and Loet Leydesdorff focuses on the dynamic interaction between universities, industry, and government as a factor in innovation. In this model, the role of higher education institutions extends beyond their traditional roles in teaching and research to include their contribution to economic development in the form of knowledge commercialization.

Another significant theoretical contribution in the field is the concept of national and regional innovation systems by Bengt-Åke Lundvall. He highlights the fact that innovation is a systemic process and that it depends upon the institutional framework and interactions between all the key stakeholders. This concept has also been supported by the Organisation for Economic Co-operation and Development, which highlights the fact that innovation systems are critical for enhancing productivity. The role of regional clusters in fostering innovation has been widely discussed by Michael Porter, who introduced the cluster theory. According to Porter, geographically concentrated networks of interconnected firms, universities, and institutions improve competitiveness and stimulate innovation. Empirical evidence from regions such as Silicon Valley demonstrates that strong linkages between universities like Stanford University and industry actors contribute to the creation of high-value industries and technological advancement.

Additionally, the idea of the “entrepreneurial university” proposed by Burton Clark emphasizes the role of universities as active economic actors. Burton Clark argues that there are five main dimensions of entrepreneurial universities, which include a strong steering core, diverse funding sources, and a unified entrepreneurial culture. These concepts are also supported by the World Bank, which argues that universities with good innovation infrastructure are likely to lead to new ventures and regional development.

Recent studies also point to the rising role of digitalization in innovation infrastructure. According to the European Commission, digitalization allows universities to improve collaboration in research, knowledge transfer, and education access. Digital platforms, innovation hubs, and technology parks are now increasingly acknowledged as critical elements in innovation systems.

In the case of developing countries such as Uzbekistan, several studies have been undertaken on the challenges in building innovation infrastructure in these countries. Studies undertaken by the Ministry of Higher Education, Science and Innovation in Uzbekistan indicate that while there has been significant growth in higher education institutions in the country, there are still challenges in infrastructure, research, and university-industry collaboration.

For example, studies conducted in Uzbekistan have found that the development of digital technology in higher education in this country has made progress, albeit in a non-uniform manner. In this respect, it has been found that higher education institutions in major regions, such as the city of Tashkent, have better access to innovation resources than those in other regions. However, the development of platforms such as the HighEd platform indicates the potential of digital technology in improving access to global education and enhancing innovation potential. Although there has been significant research in this area, there has been a lack of comprehensive studies conducted in the development of integrated innovation infrastructure in regions, especially in the development of sector-specific innovations in the agriculture and food sectors.

2. Methodology

The study is based on the use of a combination of quantitative and qualitative approaches. Comparative analysis of the international practices was done, with special attention to the USA, Germany, and South Korea. Statistical data was analyzed to assess the effectiveness of the elements of the innovation infrastructure.

3. Results and Discussion

The results indicate that regions with well-developed infrastructure for innovation support exhibit higher levels of research productivity and start-up activity. For example, the integration of digital platforms in university systems significantly improves knowledge transfer[7].

The comparative analysis of the innovation infrastructure in higher education in developed countries and Uzbekistan shows that there are significant differences. According to the data from the World Intellectual Property Organization, Uzbekistan ranked 79th in the Global Innovation Index 2025. This shows that there are some positive trends in the development of innovation in Uzbekistan, but there is still a significant gap in comparison to developed countries such as the USA and South Korea. These countries are always in the top 20 in the Global Innovation Index. This is due to the fact that these countries have highly developed innovation infrastructure, significant R&D expenses as a percentage of GDP (2-4%), and highly developed collaboration between universities and industry. In contrast, in Uzbekistan, the R&D expenses are at a low level, about 0.2-0.3% of GDP[8].

There are a number of structural and institutional factors that account for the disparity in innovation infrastructure between Uzbekistan and other major economies like the United States and South Korea. One of the major factors that account for the disparity in innovation infrastructure is the lack of adequate investment in research and development activities in Uzbekistan. While South Korea invests more than 4% of its GDP in research and development activities through organizations like Samsung Electronics, Uzbekistan spends less than 0.3%, thereby limiting scientific research and innovation activities[9].

The other major factor that accounts for the disparity in innovation infrastructure is the lack of adequate interaction between universities and industries in Uzbekistan. While universities in the United States like Stanford University partner with industries in Silicon Valley, resulting in the formation of companies like Google, universities in Uzbekistan lack adequate interaction with private sector enterprises[10].

Another important factor in this regard is the disparities in digital infrastructure. While developed countries provide their citizens with access to high-speed internet and digital technologies, regional universities in Uzbekistan are not equipped with such facilities. Moreover, technoparks and venture capital are also more developed in developed countries compared to Uzbekistan, as the startup scene in Uzbekistan is at a very early stage[11].

Table 1. Digital infrastructure comparison.

Indicator	Developed countries	Uzbekistan
LMS usage	~90–100%	~75%
Advanced digital tools	Widely spreaded	Limited
Infrastructure equality	High	Uneven
Digital literacy	High	Moderate

This implies that although there is a process of digitalization in Uzbekistan, it is still in a transitional phase.[12]

On another note, Uzbekistan has experienced rapid growth in terms of higher education. Based on information from the Ministry of Higher Education, Science, and Innovation of Uzbekistan, there was an increase in the number of institutions offering higher education from 72 in 2017 to more than 200 by 2025. Moreover, there was an increase in student enrollment to 1.7 million. Consequently, the rate of higher education coverage increased to 47.7%. This implies that the government has been undertaking impressive initiatives to promote higher education. However, such growth has been more quantitative than qualitative. In developed nations, more emphasis is given to research output, innovation commercialization, and global competitiveness in terms of higher education. However, infrastructure quality and research output are still low[13].

The prevalence of quantitative development over qualitative development in the higher education system in Uzbekistan can be attributed to several factors. Firstly, the government's efforts to increase access to education have been a priority in social policy. In other words, the government has been striving to increase the number of higher education institutions and enrollment in higher education to meet the needs of the increasing *molod* population. Although this has been successful in increasing access to higher education to the level of 47.7%, it has also posed challenges in sustaining high standards in higher education. In contrast, in developed countries such as the USA or Germany, the government does not focus only on increasing access to higher education but also strives to support quality assurance in higher education[14].

Another key reason is the low level of integration between research, industry, and innovation centers. In developed countries, universities earn revenues from patents, start-ups, and collaboration with industry, which in turn helps to achieve quality research. For example, universities like Stanford are involved in commercializing research output in innovation centers like Silicon Valley. However, in Uzbekistan, universities lack industry collaboration, which affects the ability of universities to engage in quality research. Moreover, academic staff are mostly involved in teaching, which affects the time spent on research activities. Besides, universities lack access to international research networks,

which affects qualitative growth. This creates a gap between access and quality in terms of higher education[15].

Another significant aspect of innovation infrastructure is digitalization. According to studies carried out at Tashkent State Technical University, 83% of respondents believe that the impact of digital technologies on the quality of education is positive, and approximately 75% of faculty members use digital learning platforms. However, it has also been found that around 30% of educational institutions face a lack of digital infrastructure, especially in rural areas. This, in turn, reveals the presence of a digital divide between urban centers like Tashkent and other regional universities. In contrast, in developed countries, the use of digital technologies is widespread, ensuring equal access to innovation infrastructure throughout the country.

Several key barriers hinder the effective digitalization of higher education and innovation infrastructure in Uzbekistan, despite ongoing reforms and growing adoption of digital tools.

1. Firstly, infrastructure limitations continue to present a major hindrance. While urban centers such as Tashkent enjoy well-developed infrastructure in terms of internet connectivity, rural universities continue to struggle with unreliable broadband connectivity, slow internet speed, and obsolete technology. This creates unequal access to online platforms, which affects the efficiency of online learning platforms.
2. Secondly, there are financial constraints that limit digital transformation on a larger scale. There are universities that lack the necessary finance to invest in digital technologies such as IT infrastructure and cloud computing. Funding mechanisms in Uzbekistan are still in the process of being established, unlike in other developed countries where the government and other organizations are actively investing in digital technologies.
3. Third, the digital competencies of the faculty and staff are another challenge. While around 75% of educators use digital platforms, their level of competency may be limited to basic digital tools. However, advanced digital competencies in data analytics, AI, and digital content creation are in development.
4. Fourth, there are institutional and organizational factors. The coordination between universities, industry, and government agencies also affects the speed at which digital strategies are implemented. In most instances, there is fragmentation in digital strategies as opposed to systemic integration.

Lastly, cybersecurity and data management are emerging issues. This is an issue that will become more important as digitalization continues to increase.

Overall, these barriers suggest that, although digitalization in Uzbekistan is a work in progress, it still has a long way to go to become fully effective.

Besides, based on the results of the analysis presented above, it would be possible to make a conclusion that the level of innovation in Uzbekistan is relatively low. Indeed, only 14.2% of the country's enterprises are considered to be innovation-active. Moreover, the density of researchers per million people equals 534, whereas this indicator exceeds the average level in the world, as presented by UNESCO. This means that there are no close relationships between universities, enterprises, and government. In developed countries, innovation centers are known to have close relationships. Therefore, based on the results of the analysis presented above, it would be possible to make a suggestion that Uzbekistan needs to make a transition from extensive to intensive development.

4. Conclusion

Thus, in conclusion, it is evident that the role of the development of innovation infrastructure in higher education is one of the key factors influencing regional economic growth. The comparative analysis of the current state of higher education in Uzbekistan and other world leaders in the sphere, such as the United States and South Korea, shows

significant differences in the levels of research, digitalization, and university-business collaboration. Although significant progress has been made in increasing access to higher education in Uzbekistan, as reflected in the increase in the number of higher education institutions from 72 in 2017 to more than 200 in 2025, as well as enrollment reaching 1.7 million, the sector is yet to see significant qualitative rather than quantitative growth.

The results point to several key challenges, including a lack of investment in research and development, a lack of digital infrastructure in the regions, and poor integration among universities, industries, and government. Such challenges impede the development of a fully functional innovation ecosystem. On the contrary, developed countries enjoy robust institutional environments, high R&D investments, and digital infrastructure provided by organizations like Stanford University and digital innovations like Silicon Valley.

It is, therefore, critical for Uzbekistan to transition from expansion to quality-based strategies by improving its innovation infrastructure, digital transformation, and integration among key stakeholders. The proposed model of the digital innovation platform in the regions can provide a solution to the existing challenges and promote efficiency in development and sustainability.

REFERENCES

- [1] H. Etzkowitz and L. Leydesdorff, "The dynamics of innovation: From national systems and 'Mode 2' to a Triple Helix of university–industry–government relations," *Research Policy*, vol. 29, no. 2, pp. 109–123, 2000.
- [2] B.-Å. Lundvall, Ed., *National Systems of Innovation: Towards a Theory of Innovation and Interactive Learning*. London, UK: Pinter Publishers, 1992.
- [3] M. E. Porter, "Clusters and the new economics of competition," *Harvard Business Review*, vol. 76, no. 6, pp. 77–90, 1998.
- [4] B. R. Clark, *Creating Entrepreneurial Universities: Organizational Pathways of Transformation*. Oxford, UK: Pergamon Press, 1998.
- [5] World Intellectual Property Organization, *Global Innovation Index 2025*. Geneva, Switzerland: WIPO, 2025. [Online]. Available: https://www.wipo.int/global_innovation_index/en/
- [6] Organisation for Economic Co-operation and Development, *Main Science and Technology Indicators*. Paris, France: OECD Publishing, 2023. [Online]. Available: <https://www.oecd.org/sti/msti.htm>
- [7] Ministry of Higher Education, Science and Innovation of Uzbekistan, *Higher Education Development Statistics of Uzbekistan*. Tashkent, Uzbekistan, 2025. [Online]. Available: <https://edu.uz>
- [8] H. Etzkowitz, *The Triple Helix: University–Industry–Government Innovation in Action*. New York, NY, USA: Routledge, 2008.
- [9] L. Leydesdorff, "The knowledge-based economy and the Triple Helix model," *Scientometrics*, vol. 58, no. 2, pp. 445–467, 2003.
- [10] M. E. Porter, *The Competitive Advantage of Nations*. New York, NY, USA: Free Press, 1990.
- [11] OECD, *Innovation Policy Platform*. Paris, France: OECD, 2022. [Online]. Available: <https://www.oecd.org/innovation/>
- [12] World Bank, *World Development Report 2021: Data for Better Lives*. Washington, DC, USA: World Bank, 2021.
- [13] UNESCO, *Science Report: The Race Against Time for Smarter Development*. Paris, France: UNESCO Publishing, 2021.
- [14] Asian Development Bank, *Innovation in Asia: Advancing Development and Competitiveness*. Manila, Philippines: ADB, 2020.
- [15] European Commission, *European Innovation Scoreboard 2023*. Brussels, Belgium: European Commission, 2023.