

**IMPROVING MECHANISMS FOR THE COMMERCIALIZATION OF APPLIED
RESEARCH BASED ON THE “ENTERPRISE–UNIVERSITY–RESEARCH
INSTITUTION” CLUSTER MODEL IN UZBEKISTAN**

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Abstract: This article examines issues related to improving the mechanisms for the commercialization of applied research results based on the “enterprise–higher education institution–research organization” cluster model, in line with the priority areas of innovative development defined in the “Uzbekistan – 2030” Strategy. The Strategy identifies enhancing the competitiveness of the national economy through strengthening the integration of science, education and the real sector as a key objective and this study is specifically devoted to the scientific and practical solutions addressing these tasks. Within the scope of the research, both theoretical and practical aspects of integrating scientific developments into production processes in the context of an innovation-driven economy are analyzed. The institutional structure of the cluster model, interaction mechanisms among stakeholders and their impact on the effectiveness of innovation activities are assessed.

In accordance with the objectives of the “Uzbekistan – 2030” Strategy, the article proposes practical recommendations aimed at developing technology transfer offices, strengthening public–private partnerships within cluster structures and improving financing mechanisms for startups and innovative projects. The research results have significant scientific and practical relevance for enhancing innovation policy, ensuring the effective utilization of scientific potential and increasing the competitiveness of the national economy.

Keywords: “Uzbekistan – 2030” Strategy, innovative development, “enterprise–higher education institution–research organization” cluster model, applied research, technology transfer, public–private partnership.

Annotatsiya: Mazkur maqolada “O‘zbekiston – 2030” strategiyasida belgilangan innovatsion rivojlanish ustuvor yo‘nalishlaridan kelib chiqqan holda, “korxonalar–oliygo‘h–ilmiy tashkilot” klaster modeli asosida amaliy tadqiqotlar natijalarini tijoratlashtirish mexanizmlarini takomillashtirish masalalari tadqiq etilgan. Strategiyada ilm-fan, ta‘lim va real sektor integratsiyasini kuchaytirish orqali iqtisodiyotning raqobatbardoshligini oshirish asosiy maqsad sifatida belgilangan bo‘lib, ushbu maqola aynan shu vazifalarning ilmiy-amaliy yechimlariga bag‘ishlangan. Tadqiqot doirasida innovatsion iqtisodiyot sharoitida ilmiy ishlanmalarni ishlab chiqarish jarayoniga joriy etishning nazariy va amaliy jihatlari o‘rganilgan. Maqolada klaster modelining institutsional tuzilmasi, manfaatdor tomonlar o‘rtasidagi o‘zaro hamkorlik mexanizmlari hamda ularning innovatsion faoliyat samaradorligiga ta‘siri baholangan.

Maqolada “O‘zbekiston – 2030” strategiyasi maqsadlariga mos ravishda texnologiya transfer ofislarini rivojlantirish, klasterlar doirasida davlat–xususiy sheriklikni kuchaytirish, startup va innovatsion loyihalarni moliyalashtirish mexanizmlarini takomillashtirish bo‘yicha amaliy taklif va tavsiyalar ishlab chiqilgan. Tadqiqot natijalari innovatsion siyosatni takomillashtirish, ilmiy salohiyatdan samarali foydalanish hamda milliy iqtisodiyotning raqobatbardoshligini oshirishda ilmiy-amaliy ahamiyatga ega

Kalit so‘zlar: “O‘zbekiston-2030” strategiyasi, innovatsion rivojlanish, “korxonalar–oliygoh–ilmiy tashkilot” klasteri modeli, amaliy tadqiqotlar, texnologiya transferi, davlat-xususiy sheriklik.

Аннотация: В данной статье на основе приоритетных направлений инновационного развития, определённых в стратегии «Узбекистан – 2030», исследуются вопросы совершенствования механизмов коммерциализации результатов прикладных исследований на основе кластерной модели «предприятие – высшее учебное заведение – научная организация». В стратегии в качестве ключевой цели обозначено повышение конкурентоспособности экономики за счёт усиления интеграции науки, образования и реального сектора, и настоящая статья посвящена научно-практическим решениям именно этих задач. В рамках исследования изучены теоретические и практические аспекты внедрения научных разработок в производственные процессы в условиях инновационной экономики. Проанализированы институциональная структура кластерной модели, механизмы взаимодействия заинтересованных сторон, а также их влияние на эффективность инновационной деятельности.

В статье, в соответствии с целями стратегии «Узбекистан – 2030», разработаны практические предложения и рекомендации по развитию офисов трансфера технологий, усилению государственно-частного партнёрства в рамках кластеров, а также совершенствованию механизмов финансирования стартапов и инновационных проектов. Полученные результаты имеют научно-практическое значение для совершенствования инновационной политики, эффективного использования научного потенциала и повышения конкурентоспособности национальной экономики.

Ключевые слова: стратегия «Узбекистан – 2030», инновационное развитие, кластерная модель «предприятие – высшее учебное заведение – научная организация», прикладные исследования, трансфер технологий, государственно-частное партнёрство.

INTRODUCTION

In the context of contemporary globalization and digital transformation, innovation has increasingly emerged as one of the key driving forces of economic growth. Transforming new knowledge into economic value through the close integration of science, education, and enterprises constitutes a fundamental component of modern development models. From this perspective, improving mechanisms for the implementation and commercialization of research outcomes has become a highly relevant issue on a global scale.

In the Republic of Uzbekistan, enhancing the competitiveness of the national economy, expanding the production of high value-added goods, and accelerating innovative activity have been identified as priority directions of state policy. In particular, the “Uzbekistan–2030” Strategy emphasizes strengthening the integration of science, education, and the real sector, supporting applied and innovative research, and ensuring sustainable economic growth through the introduction of research results into various sectors of the economy. This strategic document places special emphasis on the development of innovation infrastructure, the promotion of technology transfer, and the expansion of private sector participation.

In achieving these objectives, the “enterprise–university–research institution” cluster model serves as a key institutional mechanism. This model facilitates effective collaboration among stakeholders in the processes of generating scientific knowledge, advancing it through

applied research, and creating market-oriented innovative products. The experience of developed countries demonstrates that systems organized on the basis of a cluster approach enable a high level of efficiency in the commercialization of research results.

However, despite the gradual formation of certain institutional and organizational foundations for this model in Uzbekistan, a number of challenges persist in the commercialization of applied research outcomes. These include the insufficient development of technology transfer mechanisms, limited private sector involvement in scientific activities, and constraints related to financing and market infrastructure. Such conditions hinder the full utilization of the potential of scientific developments.

In this regard, based on the objectives of the “Uzbekistan–2030” Strategy, providing a scientific justification for improving mechanisms for the commercialization of applied research within the framework of the “enterprise–university–research institution” cluster model represents a pressing scientific and practical task. This article is dedicated to analyzing these issues, examining advanced international experience, and developing practical recommendations tailored to national conditions.

LITERATURE REVIEW AND METHODS

Issues related to innovative development and the integration of science, education, and industry have been extensively examined in both global and domestic research. The “enterprise–university–research institution” model (Triple Helix), developed by Henry Etzkowitz and Loet Leydesdorff, is widely recognized as a theoretical foundation for scientific research and technology transfer [2]. This model was initially implemented at the Massachusetts Institute of Technology [3] and subsequently applied successfully in Switzerland and other developed countries. Research findings indicate that effective collaboration between science and industry contributes significantly to enhancing a country’s innovative capacity.

In the context of Uzbekistan, studies have analyzed innovation development strategies, R&D expenditures, and the application of scientific developments in production. In addition, comparative analyses have been conducted on public–private partnerships, cluster-based approaches, and the activities of technology transfer offices, drawing on both U.S. experience and domestic practices. This approach enables the integration of the processes of creating, evaluating, financing, and commercializing scientific results within a unified system.

The study employs a combination of quantitative and qualitative research methods. Quantitative analysis is based on data from the State Committee of Statistics, R&D expenditure indicators, and figures related to the production of innovative products. Qualitative methods include literature analysis, case studies, and expert assessments. The case study approach facilitated an examination of cooperation projects between Uzbekistan’s innovation-oriented educational and production technoparks and higher education institutions, while expert assessments enabled an evaluation of the effectiveness of cluster structures and technology transfer mechanisms.

RESULTS AND DISCUSSION

In the “Uzbekistan–2030” Strategy, innovative development is identified as a priority direction for ensuring sustainable growth of the national economy, with particular emphasis

placed on strengthening the integration between science, education, and the real sector. The strategy envisages the allocation of 4 million soums from the state budget for applied research, the production of approximately 850 thousand types of innovative products, and the development of more than 2.5 thousand new scientific innovations. In addition, the establishment of eight scientific and industrial clusters is set as a key strategic objective [1].

The model that envisages cooperation among science, enterprises, and the state was developed in the 1990s by Henry Etzkowitz and Loet Leydesdorff [2]. Although it was initially implemented in the United States by the Massachusetts Institute of Technology [3], this model has since been widely applied in Switzerland. As a result, Switzerland ranked first among 139 countries in the Global Innovation Index compiled by the World Intellectual Property Organization (WIPO) in 2025, maintaining this leading position consistently over a long period. The indicators of this ranking reflect the effectiveness of active collaboration among universities, research institutions, and enterprises in the fields of science, technology, and industry [4].

Switzerland's sustained high level of innovative capacity is based on an integrated system formed through close cooperation between universities, research institutions, and industry. Consequently, the country also demonstrates one of the highest performances in indicators related to university–research center–industry collaboration. These results confirm the strong engagement of universities and research centers with industry and their active role in transferring newly generated knowledge into the economy.

According to statistical analysis based on data from the State Committee of Statistics of the Republic of Uzbekistan, expenditures on research and development (R&D) in 2024 amounted to approximately 1,574.1 billion soums.



Figure 1. Research and Development (R&D) Expenditures in Uzbekistan, 2020–2024 (billion soums) [5]

The obtained results make it possible to draw important scientific and practical conclusions in the context of Uzbekistan. Within the framework of the innovation development priorities outlined in the “Uzbekistan–2030” Strategy, it is necessary to further develop enterprise–university–research institution clusters, institutionally strengthen technology transfer offices, and expand financing mechanisms for startups and innovative projects. In particular, supporting R&D projects based on public–private partnerships and stimulating private sector participation in scientific activities contribute to enhancing the efficiency of the national innovation system.

From an international perspective, the United States has established deeply institutionalized technology transfer mechanisms aimed at strengthening university–industry–government collaboration. The primary objective of technology transfer is to commercialize research outcomes and integrate them into industrial needs. As a result of U.S. legislation—most

notably the Bayh–Dole Act—universities and research institutions were granted the right to retain patent ownership and license inventions arising from publicly funded research. This legislation significantly improved the market applicability of academic research, increased the number of patents and startups, and facilitated the transformation of scientific outputs into tangible economic outcomes [6].

In addition, organizations such as the Federal Laboratory Consortium (FLC) operate in the United States, serving as platforms that accelerate the commercialization of scientific and technological achievements between federal laboratories and the private sector. These organizations develop technology commercialization strategies and provide methodological support to overcome barriers in the transfer process [7].

Collaborative Research and Development Agreements (CRADAs) are also widely applied in the U.S. context [8]. These agreements enable joint scientific, educational, and innovation-oriented projects between government laboratories, universities, and private enterprises, optimize resource utilization, and ensure the protection of intellectual property rights.

As a result of these policies, the efficiency of technology transfer in the United States has significantly increased, patenting activity within universities and research institutions has intensified, and a growing number of startups and innovation-driven businesses have emerged beyond traditional academic pathways. Consequently, collaboration among enterprises, universities, and research institutions has been further strengthened.

The U.S. experience demonstrates that the effectiveness of innovative cooperation based on the enterprise–university–research institution model is shaped not only by government policy but also by strong institutions, well-developed technology transfer mechanisms, and active private sector participation. By adapting these principles to national conditions, Uzbekistan can reduce existing gaps between science, education, and production, foster technology transfer, and strengthen its innovation-driven economy.

In recent years, reforms aimed at implementing the enterprise–university–research institution cluster model in the Republic of Uzbekistan have intensified significantly. These measures primarily focus on integrating science and education with production, translating innovative ideas into practice, and strengthening the system for utilizing research outcomes in business and economic activities.

Similarly, applied cooperation projects between research institutions and enterprises are being actively established. For example, joint cooperation memoranda have been signed between the INNO Innovative Educational and Production Technopark under the Ministry of Higher Education, Science and Innovations of the Republic of Uzbekistan and several higher education institutions. Strategic negotiations have been conducted on student internships, the development of innovative projects, and the advancement of technology transfer. In particular, the INNO Innovative Educational and Production Technopark has signed memoranda with Tashkent State Technical University, the Tashkent Tractor Plant, and UzAuto Motors Powertrain [9]. This cooperation contributes to the formation of an innovation cluster that integrates industrial enterprises, higher education institutions, and research centers in Uzbekistan, enabling the rapid development and implementation of innovation solutions aligned with industrial needs.

Research conducted by scientific experts indicates that the effectiveness of integration between scientific and industrial sectors has not yet reached an optimal level. According to data from the Institute for Strategic and Interregional Studies, even large industrial enterprises demonstrate relatively low levels of collaborative research with scientific institutions, while there remains significant untapped potential for studying and applying active research outcomes in practice. Therefore, cluster linkages between enterprises and research centers should be further deepened [10].

Within the framework of this study, an integrated author-developed model aimed at enhancing the efficiency of commercializing research results in Uzbekistan has been proposed. This model is designed to institutionally develop technology transfer offices, strengthen public–private partnerships within cluster frameworks, and integrate financing mechanisms for startups and innovative projects into a unified system. The model has been formulated based on the author’s independent conceptual approach.

The proposed model conceptualizes the commercialization of research outcomes not as a set of isolated mechanisms, but as an interconnected institutional ecosystem. The core idea of the model is that the stages of creating scientific results, evaluating them, financing them, and introducing them to the market should be implemented through a unified governance and coordination mechanism.

As the central element of the model, an Integrated Technology Transfer Office Network (ITTOT) is proposed. Unlike traditional technology transfer structures, these offices are not limited to patenting or licensing activities. Instead, they assess the commercial potential of research outcomes from the early stages, analyze market demand, and jointly develop innovation projects in collaboration with enterprises. The ITTOT functions as a coordinating hub that manages flows of knowledge, technology, and financial resources among research institutions, higher education institutions, and production entities.

The second key component of the author-developed model consists of innovation clusters based on public–private partnerships. Within these clusters, higher education institutions and research organizations act as generators of scientific ideas, while the private sector functions as the determinant of market demand and a source of investment. The state provides infrastructural support, shapes the regulatory environment, and ensures financial incentive mechanisms. This approach enables a direct linkage between scientific activity and production needs, thereby increasing the market relevance of research outputs.

The third fundamental element of the model is a hybrid financing mechanism for startups and innovative projects. This mechanism is based on the integration of public grants, private investment, and venture financing instruments. At the initial stage, research developments are supported through state grants, while at subsequent stages, projects with high commercial potential are offered to private sector actors and investors. This approach not only ensures the financial sustainability of innovation projects but also accelerates their development.

The principal distinction of the proposed model from existing approaches lies in the consideration of private sector interests at the earliest stages of scientific research, with commercialization occurring throughout the entire innovation cycle rather than only at the final stage. Moreover, technology transfer, cluster cooperation, and financing mechanisms operate as a unified system rather than as isolated components.

The integrated model developed by the author aims to reduce existing institutional fragmentation in the commercialization of research outcomes in Uzbekistan, activate the functioning of technology transfer offices, and increase the likelihood of successful market entry for innovative projects. Its practical significance lies in its ability to balance the interests of science, business, and the state, thereby creating a sustainable foundation for the development of an innovation-driven economy.

CONCLUSION

The findings of this study indicate that the innovation development priorities outlined in the “Uzbekistan–2030” Strategy confirm the critical importance of integrating science, education, and the real sector in ensuring sustainable growth of the national economy. Scientific and applied analyses demonstrate the necessity of developing enterprise–university–research institution clusters in Uzbekistan, institutionally strengthening technology transfer offices, and improving financing mechanisms for startups and innovative projects. The integrated author-developed model proposed in this study enables the commercialization of research outcomes within a unified institutional ecosystem, thereby facilitating the alignment of the interests of science, business, and the state.

The proposed model holds significant scientific and practical value in several respects. First, it ensures the implementation of the stages of generating, evaluating, financing, and commercializing research outcomes through an integrated governance mechanism. Second, by incorporating a network of technology transfer offices, public–private partnership–based innovation clusters, and a hybrid financing mechanism, the model enhances the efficiency of innovative projects. Third, the model contributes to reducing institutional fragmentation between the research and production sectors in Uzbekistan and expands opportunities for the practical application of scientific developments within the economy.

Thus, the integrated author-developed model contributes to strengthening the sustainability of the national innovation system, fostering the development of an innovation-driven economy, and transforming scientific potential into tangible economic benefits.

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