

INNOVATION SCIENCE AND TECHNOLOGY

ISSUE 7, PART 1 / JULY 2026

 Acceptance of papers



**Acceptance of
papers**

Published monthly



Topics

economics,
technology, social
sciences



EDITOR-IN-CHIEF:

Mirzaliyev Sanjar Makhmatjon ugli

DEPUTY EDITOR-IN-CHIEF:

Makhmudov Nosir Makhmudovich
DSc., Prof., Academician

DEPUTY EDITOR-IN-CHIEF:

Ochilov Bobur Bakhtiyor ugli – Senior
lecturer at TSUI

THE SCIENTIFIC-POPULAR ELECTRONIC
JOURNAL **"INNOVATION SCIENCE AND
TECHNOLOGY"** HAS BEEN REGISTERED
UNDER THE NUMBER **C-5669633** BY THE
AGENCY FOR INFORMATION AND MASS
COMMUNICATIONS (AOKA) OF THE
REPUBLIC OF UZBEKISTAN, EFFECTIVE
FROM OCTOBER 9, 2024.

CONTACTS

Phone: **+998 50 737 87 88**

Website: <https://ist-journal.uz>

Email: innovationist2025@gmail.com

The scientific electronic journal "Innovation Science and Technology" has been included in the list of scientific publications recommended for the publication of main scientific results of dissertations for the award of PhD and DSc degrees in economics and technical sciences, in accordance with the Resolution No. 370 of the Presidium of the Higher Attestation Commission of the Republic of Uzbekistan, dated May 8, 2025.

Editorial board:



Sharipov Kongiratbay Avezimbetovich,
Doctor of Technical Sciences (DSc), Professor



Abdurakhmanova Gulnora Kalandarovna, Doctor of
Economic Sciences (DSc), Professor



Cham Tat Huei,
Doctor of Philosophy (PhD), Professor (Malaysia)



Muhammad Imran Sadiq
Doctor of Philosophy in Economics (PhD), Professor,
Malaysia



Ahmed Aziz Ismail
Doctor of Technical Sciences (DSc),
Professor (Egypt)



Lee Chin
Doctor of Philosophy in Economics (PhD), (Malaysia)



Asongu Simplice
Doctor of Philosophy in Economics (PhD), Cameroon



Rui Dang
Doctor of Chemistry (DSc), Professor, China



Zahoor Ahmed
Doctor of Philosophy in Economics (PhD), Turkey



Shujaat Abbas
Doctor of Philosophy in Economics (PhD), Russia



Tina A Coffelt
Doctor of Philosophy in Educational Sciences (PhD),
USA



Abdikarimova Dinara Rustamxanovna
Doctor of Economic Sciences (DSc), Professor

Kurbonbekova Mohichehra Turobjonovna
Doctor of Economic Sciences (DSc), Professor

Alimardonov Ilkhom Muzrabshokovich
Doctor of Economic Sciences (DSc), Professor



Razakova Barno Sayfieva
Doctor of Philosophy in Economics (PhD)



Khasanov Sarvar Ulugbek ugli
Doctor of Philosophy in Economics (PhD)



Kholikova Rukhsora Sanjarovna
Associate Professor (PhD)

CONTENTS

PLATFORM MIDDLEWARE-MANAGEMENT: FROM RESOURCE CONTROL TO INTERACTION COORDINATION IN DIGITAL SERVICE ECOSYSTEMS.....	8
Ilgor Abdullayev	
APPROACHES TO IMPROVING KNOWLEDGE EXCHANGE PROCESSES IN INDUSTRIAL CLUSTERS.....	16
Mamadaliyev Anaxon Ziyodillayevich	

APPROACHES TO IMPROVING KNOWLEDGE EXCHANGE PROCESSES IN INDUSTRIAL CLUSTERS

Mamadaliyev Anaxxon Ziyodillayevich

Lecturer, Namangan State Technical University

E-mail: anazkhon@mail.ru

Abstract: The study analyzed the theoretical foundations for improving knowledge exchange processes within industrial clusters. The cluster was interpreted as a system that facilitated knowledge flows among diverse participants and supported innovation activities. The relationship between knowledge flow, absorptive capacity, and network structure was examined, and the main factors strengthening knowledge exchange were systematically identified. Particular attention was given to organizational diversity, innovation networks, digital platforms, and trust-based cooperation mechanisms. The findings demonstrated that the effectiveness of knowledge exchange depended not on isolated tools but on their coordinated and integrated application. The study showed that strengthening human capital, enhancing collaborative relationships, and gradually introducing digital channels contributed to more effective knowledge sharing and innovation performance. Practical directions for developing knowledge exchange systems in emerging economies were also established.

Keywords: industrial cluster, knowledge exchange, knowledge flow, absorptive capacity, innovation network, digital platform, cluster policy, regional development.

Annotatsiya: Mazkur tadqiqotda sanoat klasterlarida bilimlar almashinuvi jarayonlarini takomillashtirishning nazariy asoslari tahlil qilingan. Tadqiqot davomida klaster turli ishtirokchilar o'rtasida bilim oqimlarini shakllantiruvchi va innovatsion faoliyatni qo'llab-quvvatlovchi tizim sifatida baholandi. Bilim oqimi, o'zlashtirish qobiliyati va tarmoq tuzilmasi o'rtasidagi bog'liqlik o'rganildi hamda bilim almashinuvini kuchaytiruvchi omillar tizimlashtirildi. Tashkiliy xilma-xillik, innovatsion tarmoqlar, raqamli platformalar va ishonchga asoslangan hamkorlik mexanizmlarining amaliy ahamiyati yoritildi. Natijalar bilimlar almashinuvi samaradorligi alohida vositalarga emas, balki ularning o'zaro muvofiqlashgan holda qo'llanishiga bog'liqligini ko'rsatdi. Tadqiqot rivojlanayotgan iqtisodiyotlarda inson kapitalini rivojlantirish, hamkorlik aloqalarini mustahkamlash va raqamli kanallarni bosqichma-bosqich joriy etish bo'yicha amaliy yo'nalishlarni asoslab berdi.

Kalit so'zlar: sanoat klasteri, bilimlar almashinuvi, bilim oqimi, o'zlashtirish qobiliyati, innovatsion tarmoq, raqamli platforma, klaster siyosati, mintaqaviy rivojlanish.

Аннотация: В исследовании были проанализированы теоретические основы совершенствования процессов обмена знаниями в промышленных кластерах. Кластер рассматривался как система, обеспечивающая формирование потоков знаний между различными участниками и поддерживающая инновационную деятельность. Была изучена взаимосвязь между потоком знаний, способностью к усвоению и сетевой структурой, а также систематизированы факторы, способствующие усилению обмена знаниями. Особое внимание было уделено организационному разнообразию, инновационным сетям, цифровым платформам и механизмам сотрудничества, основанным на доверии. Полученные результаты показали, что эффективность обмена знаниями определялась не отдельными инструментами, а их согласованным применением. Исследование обосновало практические направления развития человеческого капитала, укрепления кооперации и поэтапного внедрения цифровых каналов в условиях развивающихся экономик.

Ключевые слова: промышленный кластер, обмен знаниями, поток знаний, способность к усвоению, инновационная сеть, цифровая платформа, кластерная политика, региональное развитие.

INTRODUCTION

Industrial clusters, as territorial agglomerations of enterprises, research institutions, and public organizations, constitute the practical foundation of innovation-driven growth. However, their economic potential largely depends on how effectively knowledge exchange is organized among cluster participants. Viewing a cluster not merely as a concentration of enterprises but as a mechanism for knowledge and innovation exchange provides tangible practical benefits: clusters with stronger internal interactions introduce new products and technologies more rapidly, while expanding the competitive capacity of small enterprises [1]. Knowledge flows, in turn, serve as the primary source for fostering cluster innovation and developing efficient network-based production structures [2].

Improving knowledge exchange within cluster management generates measurable benefits in practice: it strengthens collaboration between enterprises and research institutions, reduces the costs of duplicated research activities, and transforms local knowledge resources into a shared strategic asset. The practical objective of this study is to systematize effective approaches to improving knowledge exchange processes in industrial clusters based on international experience and to present them as an integrated classification that can be applied by cluster managers and regional policymakers. Achieving this objective requires viewing knowledge exchange as a set of theoretically grounded yet practice-oriented mechanisms.

REVIEW OF LITERATURE ON THE SUBJECT

Research on knowledge exchange in industrial clusters has evolved along three major directions: the organizational and network foundations of knowledge exchange; the internal structure of knowledge exchange and absorption mechanisms; and the institutional and digital instruments that enhance knowledge sharing. The following discussion presents these directions sequentially, progressing from theoretical foundations to practical mechanisms.

The effectiveness of knowledge exchange primarily depends on the composition of cluster participants. Organizational diversity—represented by the participation of universities, research institutions, and non-market organizations—enhances the integration of heterogeneous knowledge and strengthens the overall innovative capacity of the cluster [3]. While structural diversity ensures access to a broad range of knowledge sources, the mere availability of such sources does not automatically guarantee knowledge exchange; dedicated mechanisms are required to activate this process. Arsanti, Rupidara, and Bondaruk demonstrate that, within collaborative innovation processes, knowledge flows emerge through two interrelated mechanisms—knowledge sharing and knowledge absorption—while intermediary actors play a central role in managing interorganizational knowledge flows [4]. Distinguishing between the intermediary and absorption stages makes it possible to interpret knowledge exchange as a manageable process.

The dynamic nature of knowledge flows raises the issue of regulating their development over time. He and co-authors developed a dynamic model of knowledge diffusion within regional innovation ecosystems and demonstrated that the rate of diffusion can be optimally managed under conditions of digitalization [5]. The institutional environment in which knowledge exchange becomes most effective is also of considerable practical importance. Nguyen and Nguyen show that industrial parks function as moderators that strengthen knowledge flows and that the impact of network innovation on firm value becomes fully apparent only over a specific period [6]. Maintaining the sustainability of knowledge exchange also depends on the incentive structure among participants. Li and colleagues, using a fairness preference-based model, argue that equitable distribution of investments and benefits is a necessary condition for preventing free-rider behavior in knowledge-sharing activities [7].

The structural dimension of knowledge exchange is equally significant. Zhang and co-authors demonstrate that the centrality, strength, and density of innovation networks positively influence cluster innovation performance, while digital capabilities amplify these effects by overcoming the constraints imposed by geographical distance [8]. Knowledge exchange is not confined to relationships within a single cluster. Færevik and Mæhle show that inter-cluster brokerage facilitates cross-industry knowledge transfer, enabling enterprises to enter new and more sustainable development trajectories [9]. Examining knowledge exchange from organizational, dynamic, structural, and cross-industry perspectives provides a solid foundation for conceptualizing it as an integrated and coherent mechanism.

RESEARCH METHODOLOGY

The study was based on qualitative conceptual synthesis and comparative logical analysis. Rather than collecting new empirical data, the research aimed to systematically synthesize findings reported in internationally recognized scientific publications and, on this basis, develop an integrated classification of approaches to improving knowledge exchange.

The selection of sources was guided by three criteria. First, the sources were drawn from internationally indexed, open-access scientific journals and publications issued by recognized research institutions. Second, according to the criterion of thematic relevance, only studies directly related to clusters, knowledge flows, knowledge sharing and absorption, innovation networks, and the management of digital knowledge-sharing channels were included. Third, the findings of each source were verified, and only validated studies with publicly accessible references were incorporated into the analysis.

The analysis was conducted in two stages. In the first stage, each source was categorized according to the aspect of knowledge exchange it addressed, and its corresponding practical mechanism was identified. In

the second stage, these aspects were grouped based on their interrelationships, resulting in the development of an integrated classification of knowledge exchange improvement approaches and a corresponding practical implementation sequence. The distinctive feature of this study is that it does not introduce new quantitative measurements; instead, it provides a theoretical and practical synthesis grounded in validated research findings. Accordingly, the conclusions presented below are based not on numerical indicators but on the original results reported in the reviewed studies.

ANALYSIS AND RESULTS

The reviewed findings made it possible to consolidate practical approaches to improving knowledge exchange in industrial clusters into twelve interconnected directions. These directions are not mutually exclusive; rather, they form a unified architecture of knowledge exchange and can be classified into three functional layers: the organizational layer, which expands knowledge sources; the network and mechanism layer, which activates knowledge exchange; and the digital and institutional layer, which strengthens and sustains knowledge exchange. The complete set of directions and their corresponding sources are presented in Table 1 (Table 1).

Table 1. Practical Approaches to Improving Knowledge Exchange in Industrial Clusters¹

Improvement Approach	Description and Mechanism	Source
Expanding organizational diversity	Integrating diverse knowledge through the participation of universities, research institutions, and non-market organizations	[3]
Strengthening interconnected knowledge flow channels	Disseminating knowledge and developing network structures through interregional technological linkages	[2]
Institutionalizing knowledge sharing and absorption mechanisms	Managing knowledge flows through collaborative teams, intermediary actors, and knowledge absorption stages	[4]
Managing diffusion dynamics	Optimizing the rate of knowledge diffusion under digitalization conditions	[5]
Developing cluster infrastructure	Enhancing knowledge flows through industrial parks and shared infrastructure	[6]
Introducing fair incentive systems	Reducing free-rider behavior through equitable distribution of benefits	[7]
Optimizing innovation network structures	Increasing network centrality, strength, and density while leveraging digital capabilities	[8]
Promoting inter-cluster (cross-industry) collaboration	Transferring knowledge to new sectors through cluster-to-cluster brokerage	[9]
Implementing digital platforms	Expanding knowledge exchange among small enterprises through industrial Internet platforms	[10]
Developing a digital innovation ecosystem	Encouraging knowledge exchange through a coordinated configuration of enabling conditions	[11]
Adapting cluster policies to contextual conditions	Creating an institutional environment that supports knowledge transfer	[12]
Strengthening trust-based informal institutions	Facilitating knowledge exchange through trust-based "soft" mechanisms that complement formal institutions	[13]

The organizational layer provides the essential input for knowledge exchange by ensuring access to knowledge from diverse sources. Expanding organizational diversity [3] and strengthening interconnected knowledge flow channels [2] enable clusters to attract heterogeneous knowledge and disseminate it through interregional linkages. This layer determines the breadth of knowledge exchange, while its depth depends on the effectiveness of the subsequent layer.

The network and mechanism layer operationalizes knowledge exchange in practice. Institutionalizing knowledge sharing and absorption mechanisms [4], managing diffusion dynamics [5], and developing cluster infrastructure [6] transform knowledge exchange from a spontaneous activity into a coordinated process. The sustainability of this process is reinforced through fair incentive systems [7] and optimized innovation network structures [8]. The former increases participants' willingness to share knowledge, whereas the latter accelerates

¹ Source: Developed by the author.

knowledge exchange by enhancing network centrality and density. Inter-cluster collaboration [9] further extends knowledge exchange beyond the boundaries of a single industry.

The digital and institutional layer elevates knowledge exchange to a more advanced level. The implementation of digital platforms [10] creates institutional channels for knowledge sharing among small and medium-sized enterprises, while the development of a digital innovation ecosystem [11] promotes knowledge exchange through a coherent combination of enabling conditions rather than isolated instruments. Adapting cluster policies to local contexts [12] establishes an institutional environment conducive to knowledge transfer, whereas trust-based informal institutions [13] complement formal mechanisms and facilitate more effective knowledge exchange.

A comparison of the three layers reveals a clear pattern: the effectiveness of knowledge exchange depends not on the strength of individual approaches but on their coordinated implementation. Broad knowledge sources provided by the organizational layer cannot be fully utilized when the mechanism layer is weak, and digital channels fail to achieve their expected impact when participants lack sufficient absorptive capacity [4]. Therefore, the practical task of cluster management is to ensure the balanced and coordinated development of all three layers. **Figure 1** presents the conceptual framework of the knowledge exchange process, illustrating the relationships among knowledge sources, transmission channels, and absorption stages, as well as the feedback mechanism through which new knowledge is generated (Figure 1).

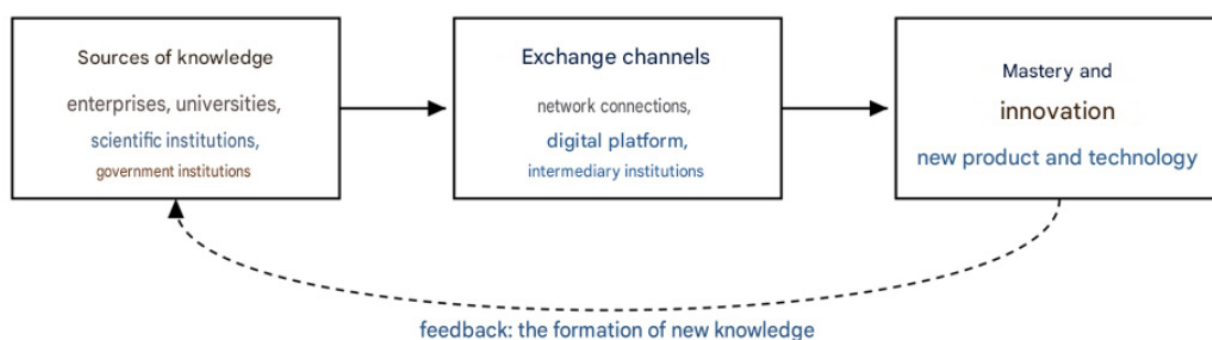


Figure 1. Structural Framework of the Knowledge Exchange Process in an Industrial Cluster²

CONCLUSIONS AND SUGGESTIONS

The approaches to improving knowledge exchange in industrial clusters encompass twelve interrelated directions, which are integrated into three functional layers: the organizational layer, the network and mechanism layer, and the digital and institutional layer. The main theoretical conclusion is that knowledge exchange is not a single instrument but a system of interconnected mechanisms whose effectiveness depends on the degree of coordination among these layers.

From a practical perspective, several recommendations can be proposed. First, cluster management should prioritize expanding the diversity of participating organizations as the initial step in strengthening knowledge exchange, since this provides access to the knowledge sources necessary for effective collaboration [3]. Second, to ensure the sustainability of knowledge exchange, it is recommended to institutionalize intermediary and knowledge absorption mechanisms while introducing fair incentive systems [7]. Third, the development of digital platforms and innovation ecosystems represents a promising approach to expanding knowledge exchange channels; however, these initiatives should be implemented alongside efforts to enhance participants' absorptive capacity [10].

For developing economies, this logic suggests a clear implementation sequence: first, strengthen the human, organizational, and network foundations of knowledge exchange; then gradually introduce digital channels and ecosystem-based mechanisms. Such an approach enhances the effectiveness of knowledge exchange by adapting cluster policies to the local context [12]. The proposed classification and the model of coordination among the three functional layers can serve as a solid foundation for future practical application in the industrial clusters of Uzbekistan and for improving regional knowledge exchange policies.

² Source: Developed by the author.

REFERENCES:

1. Franco M., Esteves L., Rodrigues M. Clusters as a Mechanism of Sharing Knowledge and Innovation: Case Study from a Network Approach // *Global Business Review*. 2024. Vol. 25, No. 2. P. 377-400. URL: <https://doi.org/10.1177/0972150920957270>
2. Xu Y., Li X., Tao C., Zhou X. Connected knowledge spillovers, technological cluster innovation and efficient industrial structure // *Journal of Innovation & Knowledge*. 2022. Vol. 7, No. 3. Art. 100195. URL: <https://doi.org/10.1016/j.jik.2022.100195>
3. Kim H., Hwang S.-J., Yoon W. Industry cluster, organizational diversity, and innovation // *International Journal of Innovation Studies*. 2023. Vol. 7, No. 3. P. 187-195. URL: <https://doi.org/10.1016/j.ijis.2023.04.002>
4. Arsanti T. A., Rupidara N. S., Bondarouk T. Managing knowledge flows within open innovation: knowledge sharing and absorption mechanisms in collaborative innovation // *Cogent Business & Management*. 2024. Vol. 11, No. 1. Art. 2351832. URL: <https://doi.org/10.1080/23311975.2024.2351832>
5. He Z., Wang H., Hu Y., Ma X., Zhao H. Dynamic analysis and optimal control of knowledge diffusion model in regional innovation ecosystem under digitalization // *Scientific Reports*. 2024. Vol. 14. URL: <https://doi.org/10.1038/s41598-024-63634-3>
6. Nguyen H.-O. T., Nguyen K.-D. Moderator effect of industrial park on knowledge spillover from sectoral innovation to firm performance in Vietnam // *Cogent Economics & Finance*. 2024. Vol. 12, No. 1. Art. 2403708. URL: <https://doi.org/10.1080/23322039.2024.2403708>
7. Li C., Cao X., Chi M., Jiang L.-L. Research on an evolutionary game model and simulation of a cluster innovation network based on fairness preference // *PLOS ONE*. 2020. Vol. 15, No. 1. Art. e0226777. URL: <https://doi.org/10.1371/journal.pone.0226777>
8. Zhang L., Xiong K., Gao X., Yang Y. Factors influencing innovation performance of China's high-end manufacturing clusters: Dual-perspective from the digital economy and the innovation networks // *Frontiers in Psychology*. 2022. Vol. 13. Art. 1012228. URL: <https://doi.org/10.3389/fpsyg.2022.1012228>
9. Faeroevik K. H., Maehle N. Cross-industry innovation for sustainable repositioning through cluster collaboration // *Economics of Innovation and New Technology*. 2024. Vol. 33, No. 8. P. 1185-1202. URL: <https://doi.org/10.1080/10438599.2024.2427837>
10. Li H., Yang Z., Jin C., Wang J. How an industrial internet platform empowers the digital transformation of SMEs: theoretical mechanism and business model // *Journal of Knowledge Management*. 2023. Vol. 27, No. 1. P. 105-120. URL: <https://doi.org/10.1108/JKM-09-2022-0757>
11. Liu Q., Zhang Y., Sun X. Digital innovation ecosystems and regional green technological innovation: Evidence from China's panel-QCA analysis // *Journal of Innovation & Knowledge*. 2025. Vol. 10, No. 5. Art. 100789. URL: <https://doi.org/10.1016/j.jik.2025.100789>
12. Parrilli M. D. Cluster policy: the challenging and complex horizon in the 2020s // *European Planning Studies*. 2024. Vol. 32, No. 9. P. 1868-1884. URL: <https://doi.org/10.1080/09654313.2023.2239281>
13. Remotti L. A. IoT innovation clusters in Europe and the case for public policy // *Data & Policy*. 2021. Vol. 3. Art. e25. URL: <https://doi.org/10.1017/dap.2021.16>

Proofreader: Zokir ALIBEKOV

Layout and Designer: Oloviddin Sobir ugli

2026. № 7

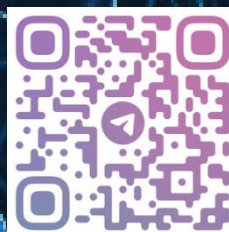
© When materials are reproduced, the INNOVATION SCIENCE AND TECHNOLOGY journal must be cited as the source. Authors are responsible for the accuracy of the information in materials and advertisements published in the journal. Editorial opinions may not always align with those of the authors. Submitted materials will not be returned to the editorial office.

To publish articles in this journal, you may submit articles, advertisements, stories, and other creative materials through the following links. Materials and advertisements are published on a paid basis.

You may subscribe to the journal at any time using the following details. Once subscribed, please send a screenshot or photo of your payment confirmation to our Telegram page @iqtisodiyot_77. Based on this, we will send the latest issue of the journal to your address each month.

“The journal “INNOVATION SCIENCE AND TECHNOLOGY” has been registered by the Agency for Information and Mass Communications under the Administration of the President of the Republic of Uzbekistan from 09.10.2024 under the registration number №390637. License number: C-5669633. PNFL: 30407832680027

Our address: Tashkent city, Yunusobod district, 19th block,
House 17.



Acceptance of articles

Published every
monthly



Directions

Social, economic, political,
technological, scientific



Scopus || Scientific electronic journal specializing in Scopus

CERTIFICATE NUMBER: №390637

**ORDER NUMBER ACCORDING TO
THE LICENSE REGISTER: C-5669633**

CONTACT:



Contact us
+998 50 737 87 88



Telegram channel
t.me/scopus_IST2100



Journal official website
<https://ist-journal.uz/index.php/IST>