Methodological basis for constructing a management system for a multi-level socio-economic system with information asymmetry

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Abstract. The modern world economy is in a constant state of transformation, and innovation has become a key success factor for states, companies and individual entrepreneurs. However, innovation is not limited to just developing new products or technologies. They also include the creation and development of innovation systems that ensure effective interaction between various levels and subjects in the process of innovation. Multi-level innovation systems are a complex and important aspect of the modern economy. This article examines the key aspects of such systems, their role in stimulating innovation and economic development, the prospects and challenges they face, as well as the concept of multi-level innovation systems, and explores their importance, features and practical aspects in the modern world.

1 Introduction

Innovation plays an important role in modern economies, contributing to productivity growth, competitiveness and improved quality of life. However, modern innovation is rarely limited to individual technological products or processes. Instead, they become part of more complex and multi-level systems that combine various subsystems, actors and processes. Multilevel innovation systems are a mechanism that ensures the development of innovation at many levels, including global, national, regional and organizational. This article is devoted to the analysis of multilevel innovation systems, their structure, functioning, development trends and challenges they face.

In modern economic literature, the issues of developing an innovative environment have begun to be considered as a key factor in ensuring the competitiveness of organizations and sustainable economic growth. Thus, the main principles and methods of developing an innovative environment are discussed in the work “Creating a Culture of Innovation: Strategies for Creating a Climate for Innovation and Change” (Pisapia, 2012), where the author highlights the importance of creating an innovative culture in an organization.

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presents strategies for creating a climate conducive to innovation, including stimulating creative thinking, supporting ideas, and developing leadership.

The famous scientist Peter Drucker in his work "Innovation and Entrepreneurship: Practice and Principles" (Drucker, 2014) analyzes the principles of innovation and entrepreneurship. He emphasizes the importance of meaningful innovation, the role of risk, and the need for innovation to be oriented toward solving real problems.

Christensen in his study "The Innovator's Dilemma: When New Technologies Cause Great Firms to Fail" (Christensen, 1997) explores the principle of the "innovator's dilemma", where established companies face difficulties adapting to new technologies. The author presents the concept of dividing innovation processes into "destructive" and "preserving" ones, emphasizing the importance of balance between them.

Eric Ries in his scientific work "The Lean Startup: How Today's Entrepreneurs Use Continuous Innovation to Create Radically Successful Businesses" (Ries, 2011) introduces the concept of "light startup", in which entrepreneurs actively test their ideas in the early stages of development. It presents a methodology for quickly adapting and changing business models in response to market feedback.

Joe Tidd, J.R. Bessant and John Wiley's study "Managing Innovation: Integrating Technological, Market and Organizational Change" (Tidd et al., 2018) highlights the importance of integrating technological, market and organizational change when managing innovation. The authors analyze various approaches to innovation management and present methods for coordinating changes at different levels of the organization, how different levels of the system influence the innovation process, and how the development of an innovation environment can be managed taking into account multi-level dynamics.

Developing an innovation environment requires a meaningful strategy and the application of specialized methods. Creating an innovation culture, taking risks and learning from mistakes, as well as actively testing and adapting ideas are the key principles for developing an innovation environment. In addition, the integration of changes at different levels of the organization makes it possible to effectively realize the potential of innovation.

Managing the innovation environment in multi-level systems is receiving more and more attention from researchers and practitioners. The development of an innovative environment in modern conditions is becoming a key task for achieving competitiveness and sustainable development. In this review, we will consider the basic principles and methods proposed in the literature for managing the innovation environment in an open multi-level system.

Study by Danish scientists "Innovation Networks: Theory and Practice" (Laursen et al., 2020) is devoted to the role of networks and interactions between various actors in the innovation environment. The authors analyze the principles of forming and managing innovation networks in a multi-level system and propose methods for enhancing collaboration and knowledge sharing.

For example, in the article "Multilevel innovation policy mix: Measurement and assessment of its critical factors" (Edler et al., 2019), the issues of multilevel innovation policy and assessment of the critical factors of its success are revealed. The authors explore how different levels of government influence the creation and support of an innovation environment, and also propose a methodology for assessing the effectiveness of policies.

The article "Open Innovation in Multilevel Systems: A Review and Future Research Agenda" (van de Vrande et al., 2017) are of genuine interest. This study is devoted to the analysis of the role and open innovation in multi-level systems. The authors highlight key principles for managing open innovation and suggest directions for future research.

The work "Managing Open Innovation in Multilevel Innovation Systems" (Osiyevskyy et al., 2018) and research focuses on managing open innovation in multilevel systems. The authors analyze the role of information asymmetry in open innovation processes and propose methods for managing these complexities.
Managing the development of an innovation environment in an open multi-level system requires an integrated approach. The principles of integration, networking, evaluation and openness of innovation play a key role in managing the innovation environment. Methods for managing multi-level innovation policy and taking into account information asymmetry are also important aspects when forming a successful strategy for managing the innovation environment.

2 Material and research methods

The study of multi-level innovation systems requires an integrated methodological approach that combines various methods from the fields of economics, sociology, political science and management. Below are the main materials and methods that can be used in the analysis and research of multi-level innovation systems.

- Documents and reports: Analysis of government documents, research reports, strategic plans for innovative development, budget documents and legislation related to innovation.
- Statistics: Collection and analysis of statistics on research and development costs, volume of innovative products, patents, investment in innovation and other related indicators.
- Expert interviews and surveys: Conduct interviews and surveys with experts from government agencies, the private sector, educational institutions and public organizations to obtain quality information and opinions.
- Archival Research: Analysis of archival data, studies and articles previously published on the topic of multi-level innovation systems.

3 Methods

SWOT Analysis: Using SWOT (Strengths, Weaknesses, Opportunities, Threats) analysis to identify the strengths, weaknesses, opportunities and threats of a multi-level innovation system.

Network Analysis: Applying network analysis to examine interactions and connections between participants in a multi-level system, identifying key actors, and identifying potential bottlenecks.

Case studies: Conducting case studies on specific examples of multi-level innovation systems for the purpose of more detailed analysis and identification of practical features.

Modeling and simulation: Using mathematical models and simulations to analyze the long-term effects of innovative changes and predict system development.

Qualitative Research: Conducting qualitative research, such as focus groups and field observations, to understand the sociocultural aspects of innovation processes.

Economic Analysis: Application of economic analysis methods such as Cost-Benefit Analysis and Environmental Impact Assessment.

Statistical Analysis: Using statistical techniques such as regression analysis and time series analysis to identify correlations and trends in data.

Benchmarking: A comparative study of different multi-level innovation systems in different regions or countries to identify best practices and training materials.

The study of multi-level innovation systems requires an interdisciplinary approach and the use of a variety of methods and materials to fully understand their structure, functioning and potential for stimulating innovation and sustainable development.
4 The essence of multi-level innovation systems

Multilevel innovation systems (MIS) are a set of interconnected and interacting actors and institutions operating at different levels of the hierarchy to stimulate innovation and technological development. These systems include government agencies, academic research institutions, industrial companies, financial institutions and other participants.

Multilevel innovation systems (MIS) are the interconnection of complex economic and social structures, including various levels of management and interaction between participants in the innovation process (Fig. 1). These levels can range from the global level to the local level, including government agencies, industrial clusters, scientific research institutes, universities, companies, and even individual entrepreneurs.

Fig. 1. Multi-level innovation systems.

Multilevel innovation systems are complex networks of interactions and relationships between different levels and actors that interact to create, diffuse and apply innovations. The main components of such a system include:

- Levels of innovation: These can be macro levels (government policies and strategies), meso levels (industry and sectors) and micro levels (companies, universities, innovative start-ups).
- Actors: Multi-level innovation systems involve various actors, such as governments, industrial associations, universities, research laboratories, enterprises and investors.
- Innovation Processes: These systems include innovation processes and cycles, including research and development, commercialization, diffusion and application of innovations.
- Infrastructure and resources: Innovation systems depend on infrastructure, including research centers, incubators, technology transfer infrastructure and financial resources.

An important characteristic of MIS is their ability to integrate different types of knowledge, resources and competencies at different levels. This allows us to speed up the process of innovation and create more favorable conditions for economic growth and increased competitiveness.
Key elements of multi-level innovation systems

1. Research and Development (R&D)

Research and development plays a central role in MIS. Universities, research institutes and companies carry out research work that becomes the source material for innovation. It is important that these organizations are interconnected and facilitate the exchange of knowledge and technology.

2. Financing

Successful development of innovation requires funding. In MIS, there are various sources of financing such as government grants, venture capital, bank loans and other instruments. Ensuring access to finance is critical to accelerating innovation.

3. Education and training

Competent specialists play an important role in innovation systems. Universities and educational institutions must provide high-quality education and training that meets the needs of the labor market and innovative projects.

4. Interaction between participants

Interaction between the various participants in an MIS is a key factor for success. Effective communication and collaboration between universities, companies, government agencies and other entities facilitates the exchange of knowledge and experience.

Multilevel innovation systems function as dynamic networks where actors and levels interact and influence each other. Key aspects of operation include:

- Innovation Clusters: Clusters or regions that contain a high concentration of innovative actors and resources play an important role in stimulating innovation.
- Public Administration: Government policies and regulations can have a significant impact on innovation systems through the allocation of financial resources, the creation of legal incentives, and the regulation of markets.
- Interaction with the academic sector: Universities and scientific institutes play a key role in research and development, as well as in training personnel for the innovation sector.
- Investment and financing: Access to financing and investment is critical to developing innovation and scaling innovation projects.

Fig. 2. Main subsystems of the national innovation system and interaction between them

The main components of the MIS include:

- Policy and regulation: State and regional authorities develop policies and regulations that promote innovation and provide financial support for research and development.
- Scientific research and education: Universities and scientific institutes carry out basic and applied research, as well as train specialists in the field of science and technology.
- Innovative enterprises: Companies develop and implement new technologies and products, and also invest in innovative projects.
- Financial institutions: Banks and investment funds provide financial support for innovative projects and start-ups.
Technology platforms and clusters: The creation of technology clusters and innovation platforms helps bring system participants closer together and improve cooperation.

The role of MIS in stimulating innovation

Multi-level innovation systems play a key role in promoting innovation and technological development. They contribute to:

Knowledge exchange: Interaction between universities, research centers and companies allows the exchange of knowledge and experience, which promotes innovation.

Financing and investment: Financial support and investment in innovative projects help them to be implemented and grow.

Creating an environment for start-ups: MIS create a favorable environment for the development of start-ups and new innovative companies.

Formation of innovation clusters: Technology clusters bring together companies and research organizations in certain industries, which promotes collaboration and competitiveness.

Modern multi-level innovation systems are subject to a number of trends that determine their development:

World Globalization: Multi-level innovation systems are becoming increasingly global, with actors and resources distributed throughout the world.

Technological revolutions: The development of new technologies such as artificial intelligence, quantum computing and biotechnology is leading to changes in the structure and functioning of innovation systems.

Digitalization: Digital transformation has a profound impact on multi-level innovation systems, changing the way actors interact and communicate.

Social and environmental challenges: Multi-level innovation systems are increasingly focused on addressing social and environmental challenges such as climate change and sustainability.

Challenges and prospects of MIS

Multi-level innovation systems also face a number of challenges that require attention and solutions:

Coordination and cooperation: It is not always easy to ensure effective interaction between the different levels and participants of an MIS.

Funding: Lack of funding for innovation can slow down the development of the system.

Innovation and sustainability: IIAs should strive for sustainability and sustainable development, taking into account environmental and social aspects.

Global Competition: In the context of globalization, it is necessary to take into account global competition and international cooperation.

Practical aspects of multi-level innovation systems

Industrial clusters are one of the examples of successful use of MIS. These are geographically concentrated networks of companies specializing in a particular industry. In such clusters, businesses, academic researchers and educational institutions collaborate to develop new products and technologies. Examples of such clusters are Silicon Valley in the USA and Skolkovo in Russia.

Many countries are developing and implementing programs and strategies to promote innovation at the national level. This includes financial support, the creation of infrastructure for research and development, and measures to stimulate venture investment. Such programs contribute to the development of IIS and increase the country's competitiveness.

Innopolis in Russia is an excellent example of a multi-level innovation system. This project was created with the aim of developing information technology and digital innovation in the country.

Innopolis is an innovative city, but is not a science city, since the main goal of a science city is scientific discoveries. It should be noted that scientific and technological cities include
not only city-forming enterprises, but also educational institutions that train highly qualified personnel. It is for these reasons that state support for the development of high-tech cities is a necessary condition for Russia’s competitiveness in the innovation sphere. The center, the core of this city is Innopolis University, which specializes in IT and robotics. The teaching staff of the University is a union of the strongest professors from all over the world, united by a common goal, focused on the development of IT.

A special economic zone has been created on an area of 192 hectares in order to attract IT companies to the city. Today, more than 320 resident companies, partners and startups are registered in Innopolis. Special tax benefits are provided for residents, so the tax is 2% for companies on OSNO (Organizations on the general taxation system), the federal part is 2% from 2018, the regional part is 0% for the first 5 years and 5% for the next 5 years, and after after 10 years, this amount will be 13.5%. For companies operating under the simplified taxation system (STS), the tax is 1%. The same tax applies to organizations on the simplified tax system Income. For companies using the simplified tax system Income minus expenses, this amount is 5%. With all this, property taxes (property, transport, land) are completely absent - 0%. Moreover, residents of the zone have the right to receive land plots within the city limits on long-term preferential lease terms.

Here's how Innopolis illustrates the main components of a multi-level innovation system:

- Innopolis provides infrastructure for startups and innovative companies, including modern offices, laboratories and equipment necessary for research and development.

- Within the framework of Innopolis there are educational programs, including bachelor's and master's levels, as well as additional training programs. This contributes to the training of personnel with high competencies in the field of information technology.

- Innopolis promotes research and development in the field of information technology, collaborating with universities and research centers. This contributes to the creation of new technologies and products.

- Incubation and acceleration programs / Innopolis has incubators and accelerators that help startups develop by providing them not only with physical space, but also with advice, training and access to investors.

- Within Innopolis, many companies working in the field of information technology are concentrated, which promotes cooperation and technology transfer between the academic and industrial sectors.

- Innopolis receives support from the state, including tax breaks and investments in infrastructure. This helps create favorable conditions for the development of an innovative environment. Innopolis cooperates with foreign innovation centers and companies, which promotes the exchange of experience and access to global markets and technologies.

- Innopolis is a good example of a modern innovation ecosystem approach that brings together education, research, business and government to promote the development of information technology and digital innovation. This system creates favorable conditions for the growth and development of technology startups and innovative companies, and also promotes the exchange of knowledge and experience between ecosystem participants.

### 5 Conclusion

Multi-level innovation systems are an important factor in the development of a modern economy, promoting innovation, improving productivity and quality of life. They ensure effective interaction between different levels and subjects in the process of innovation, which helps accelerate development and increase the competitiveness of both individual companies and countries as a whole. However, to achieve their goals, MIS must overcome challenges and continue to evolve in accordance with the changing conditions and needs of society and the economy.
Understanding and active participation in multi-level innovation systems is becoming an integral part of success in the modern world.

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