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CONCEPT AND TOOLS FOR TECHNOLOGY TRANSFER IN THE DIGITAL ENVIRONMENT

Larisa A. I. Smagilova (a), Margarita P. Galimova (b), Tatiana A. Gileva (c)*, Timur S. Galimov (d)
*Corresponding author

(a) Ufa State Aviation Technical University, Ufa, Russia, ismagilova_ugatu@mail.ru
(b) Ufa State Aviation Technical University, Ufa, Russia, polli66@mail.ru
(c) Ufa State Aviation Technical University, Ufa, Russia, t-gileva@mail.ru
(d) National Research University Higher School of Economics, Moscow, Russia, galimovtimur45@gmail.com

Abstract

As a key condition for the effectiveness of technology transfer, the coordination of the interests of all participants in the process (government, science and business) is highlighted. A triad of economic interests is presented as the basis for determining the requirements for a technology transfer system. The possibilities of digital platforms in the direction of resolving contradictions at various stages of the technology transfer process are shown. The concept of technology transfer in the digital environment is proposed, its key principles are formed. The concept of a digital technology transfer platform is defined as a multilateral interactive platform that integrates participants in the technology transfer process by building a value chain in virtual space in order to obtain network effects. Based on the analysis of the content of tasks solved at various stages of the technology transfer process, the key roles of participants are identified. It is noted that an important feature of the technology transfer process in the digital environment is the ability of each of the participants to perform different roles. In the context of the selected roles, their potential network effects and risks are identified. A review of existing information resources supporting innovative processes is carried out, their limitations are shown. The requirements for the functionality of a digital technology transfer platform are formed.

Keywords: Technology transfer, agreed interests, digital platforms.

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1. Introduction

To date, innovation does not have a strong impact on the Russian economy. So, according to estimates (Nacional'nyj doklad…, 2015):

- the share of innovative products in the total output in the Russian Federation is 8–9 % of GDP and does not tend to change significantly, while in leading countries the share of innovative products is more than 15 % of GDP;

- Russia's share in global exports of high-tech products – 0.4 %;

- labor productivity in Russia is several times lower than in developed countries, and in non-primary sectors – even by 18 % less than in the economy as a whole.

A clear comparative assessment of the total level of innovative activity of enterprises in Russia and other countries, based on materials (Gohberg, 2018), is presented in Figure 1.

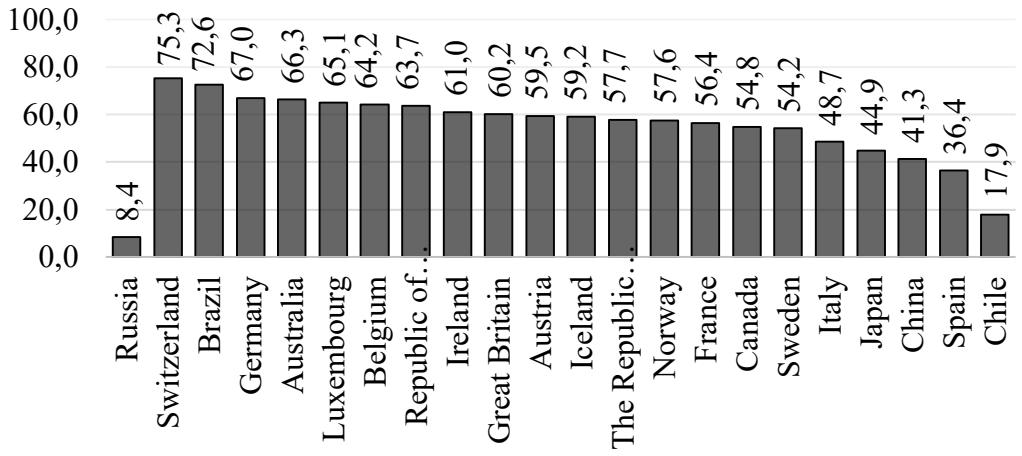

Figure 01. The total level of innovative activity of enterprises in Russia and other countries for 2016

Among the main factors hindering the introduction of innovations, along with a lack of funds, high costs and risks of innovations, invariably include: a lack of information on new technologies and markets, underdeveloped cooperation links and innovative infrastructure (intermediary, information, legal, banking and other services) (Gohberg, 2018; Ismagilova, Gileva, & Galimova, 2018). The latter barriers are most directly related to the technology transfer process, which historically has been one of the weakest links in the innovation activity of Russian enterprises.

The rapid development of information and communication technologies, the transition to a digital economy, the emergence and spread of new mechanisms and models for the interaction of economic entities opens up new opportunities in the field of technology transfer, determines the relevance of setting and solving problems in the development of the concept and tools for its implementation.

2. Problem Statement

The technology transfer process involves various stages, each of which:

- has specific substantial differences;

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- implemented by many participants with conflicting economic interests;

- differs in the level of uncertainty in obtaining the final result and, accordingly, in the level of risk load;

- has a multi-level nature, that is, it is implemented at different levels of management;

- associated with various sources of financing, the acquisition of resources and competencies.

In accordance with the triple helix model (Etzkowitz, 2008), the main groups of participants in the innovation process are the state, science and business. Despite the general focus on the growth of innovative activity, there are certain contradictions between the selected groups of participants due to their role in the innovation process. Therefore, the coordination of interests of all participants is a prerequisite for increasing the effectiveness of the technology transfer process.

Based on the analysis of the content of the various stages of the technology transfer process and the nature of the interactions of the three enlarged groups of its participants (state, business and science), a triad of economic interests is formed, presented in table 01.

Table 01. The triad of economic interests of technology transfer participants

Participant	Economic Interests
State	1. Obtaining economic and reputational dividends, including: - the growth of budget revenues due to the growth of innovative products; - GDP growth and labor productivity; - Attracting foreign investors by increasing investment attractiveness. 2. Transparency of the actions of all participants in the innovation process, understanding of their interests in order to smooth out contradictions and bridge gaps. 3. The ability to monitor and manage innovative processes and projects. 4. Creation of a base of projects, a knowledge base and a base of partners.
Business / Investors	1. Getting a competitive product in a competitive time frame. 2. Return on investment, exponential growth in income. 3. The ability to generate income for a long time from being tied to a business. 4. Minimizing the risk of investing in a non-competitive product. 5. Scaling a business. 6. Protection of investor rights. 7. Protection of intellectual property from unauthorized access and diversion to competitors. 8. Search for a joint business partner. 9. Minimizing the cost of finding partners. 10. Minimizing the cost of promoting a business.
Science / Innovators	1. Find the consumer of your scientific product. 2. Find quickly a partner in an innovative project (cooperation). 3. Find quickly the missing resources (experimental sites, experimental equipment, etc.). 4. Find a quick investor. 5. Protection of intellectual property from unauthorized access and diversion to competitors. 6. Getting solutions to problems in one place. 7. Find an effective technology transfer model 8. Promotion of its know-how to the consumer. 9. Promotion of the image as an author. 10. Minimization of transaction costs for finding partners. 11. Minimization of risks (security).

In the process of achieving their goals, participants in the technology transfer process often have two types of problems: lack of necessary information and lack of resources (financial, material, labor). A modern tool for solving these problems are digital platforms.

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3. Research Questions

One of the key conditions ensuring the effective functioning of the technology transfer system is the coordination of the interests of all participants in the process. Multilateral platforms (Yablonskij, 2013) are a productive mechanism for implementing the interaction of various groups of participants. Digital platforms are a kind of multilateral platforms and are hybrid structures focused on creating value by providing direct interaction and transactions between several groups of third-party users based on the use of information and communication technologies (Geliskhanov, Yudina, & Babkin, 2018).

The main advantages of the platforms are: the ability to significantly reduce transaction costs, accelerate and simplify interaction processes, shorten operating cycles, as well as clearly regulate the interaction of participants and the mutually beneficial relationship. Digital platforms increase the efficiency of business processes, provide fast and reliable communications, create opportunities for the development of a shared economy, create new ways of creating value and mechanisms of interaction between economic agents, and reduce the role of geographical and temporal factors (Evans, Gawer, & 2016; Geliskhanov et al., 2018; Parker, van Al'stin, & Chaudari, 2017). The value of the platform is determined by the ability to ensure interactive interaction of participants, during which the coordination of their interests is ensured (Galimova, 2017).

According to (Jacobides, Sundararajan, & Van Alstyne, 2019), the emergence and spread of digital platforms as a new organizational form is as significant as the transition from trade crafts to industrial firms a century ago. Platform firms introduce innovations faster, work with fewer employees (often by an order of magnitude). According to the results of the study (Bughin, Catlin, & Dietz, 2019), platform companies achieve greater returns in both revenue and growth. This is largely due to the presence of “network effects” when users create value for users, which attracts more users, and, in turn, creates more value, attracts more users, etc. Network effects force companies to “invert” value creation from within the company beyond (Jacobides et al., 2019).

In the Russian Federation, in order to improve the interaction between science and business, to intensify the process of technology transfer, in 2011–2012 32 technological platforms were created with the participation of a wide range of stakeholders (Rossijskie tekhnologicheskie platformy, 2019). On the basis of the technological platform, the interaction of various stakeholders (universities, scientific organizations, industrial enterprises, authorities, etc.) is built to solve the strategic tasks of the scientific and technological development of industries and sectors of the Russian economy. Technological platforms are defined as a forum with a large number of participants, within which development priorities are identified, a research program is developed at a pre-competitive stage, horizontal coordination of various policy areas (innovative, industrial, educational, etc.) is formed, as a comprehensive tool that brings together all the main actors in areas of science, technology, and innovation (Rudnik, 2011).

Despite their importance in ensuring the innovative development of the Russian economy, technological platforms can be attributed to the “previous generation” of platforms, since they do not provide many of the above advantages. Technology platforms have an industry orientation with a focus on solving a specific problem, as well as traditional forms of organization (non-profit partnership, association, consortium) and limited possibilities for scaling and creating network effects.

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Thus, the digital technology transfer platform is a multilateral interactive platform that integrates participants in the technology transfer process by building a value chain in virtual space in order to obtain network effects. The interaction of affiliated groups of participants in the technology transfer process within the digital platform allows to largely solve traditional problems and creates a higher value, providing:

- reducing the cost of market research, the search for business partners, buyers and suppliers;
- reduction of transaction costs in the interaction of various participants in the technology transfer process;
- access to the information necessary for making informed decisions;
- access to missing resources and competencies.

4. Purpose of the Study

The purpose of this work is to formulate a system of principles for implementing the technology transfer process in the digital environment and justify the functionality of the technology transfer platform as a tool for coordinating the interests of process participants taking into account network effects and risks.

5. Research Methods

According to the results of the analysis, the concept of technology transfer in the digital environment should take into account the following approaches:

- the theory of the triple helix (Etzkowitz, 2008) reflecting the features of the interaction of participants in the innovation process in the context of the increasing role of knowledge in economic development. The triple spiral symbolizes the union between the state, business and the university, while the interaction of government, science and business is characterized by a non-linear, interactive nature of innovation processes and is based on the network interaction of all participants in innovation activity;
- the concept of open innovation (Chesbrough, 2003), which is based on the experience of innovative leading companies reviewing internal R&D management processes towards their openness, diffusion of technologies based on the combined efforts of universities, start-up companies, suppliers, consumers, industry consortia. The modern technologies of interaction between participants in the innovation process that implement the principle of openness of innovation are crowd technologies (crowdsourcing, crowdfunding) (Karpov, 2012; Luksha, Natalenko, Pil'nov, & Yanovskij, 2017);
- the concept of a shared consumption economy, or sharing economy, based on the collective use of goods and services based on economic benefits: it is often cheaper and more convenient to pay for temporary access to a product than to own it. Sharing economy allows you to directly connect key economic agents (producers and consumers) and distribute products and services between them without intermediaries (Ekonomika sovmestnogo potrebleniya v Rossii…, 2018);
- the category “platform economy” (Evans & Gawer, 2016; Parker et al., 2017), which involves the creation and expansion of the use of digital platforms as a tool for mutually beneficial interaction between various groups of stakeholders (stakeholders);
- the concept of a business ecosystem (Jacobides et al., 2019; Kelly, 2015), which considers participants in the innovation process as a whole, with the properties of self-organization (the ability to develop without the participation of an external leader when changes occur spontaneously or as a result of

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local interactions of participants), emergence (possession of the system as a whole with properties that none of the elements taken separately possesses), co-evolution (interdependence, the process of mutual changes during the development of interconnected entities) and adaptive spine (adaptation to changing conditions by internal changes);

- the concept of creating joint value (co-creation) and intellectual entrepreneurship associated with the development of innovative products that did not exist on the market, focused on creating results that companies are not able to create alone.

An analysis of the complementary approaches discussed above made it possible to formulate the principles of interaction among participants that determine the requirements for the functionality of a digital technology transfer platform.

6. Findings

The concept of technology transfer in the digital environment is based on the following system of principles:

- the principle of coordination of interests, which implies taking into account the existence of various goals among different groups of participants in the technology transfer process, assessing the effects and risks of their interaction when making decisions;

- the principle of appropriate openness, which determines the conditions for the formation of mutually beneficial relations for participants in the technology transfer process, taking into account the requirements of digital technologies and the transition to an open innovation model;

- the principle of developmental ecosystems, which emphasizes the development of a technology transfer system as an ecosystem, characterized by the interaction and interdependence of participants in a constantly changing environment;

- the principle of intellectualization of development, which implies an increase in the role of knowledge sharing in the process of technology transfer, the unification of efforts in the field of development and promotion of innovation (co-creation);

- the principle of network combinations, taking into account the expansion of the scope of network interactions to solve various problems based on the use of digital technologies;

- the principle of interactive interaction, reflecting the continuous nature of the interaction and the changing roles of participants at various stages of the technology transfer process;

- the principle of a single window, which provides for the provision of the most complete range of services to key participants in the technology transfer process, which allows for faster and more efficient achievement of their goals, and easier resolution of problems, including through cooperative interactions.

The next conceptual provision is the allocation of roles of technology transfer participants based on an analysis of the content of tasks to be solved at various stages of the process. The following key roles are identified in this study:

- technology developer - represents the field of basic and applied research and development work;

- producer (consumer of technology) - represents the sphere of implementation of R&D results in production;

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- investors - implement the function of providing the necessary financial support for technology transfer. Investors in the field of technology transfer, as a rule, have the goal of "linking" to the income of an innovative business and often choose the role of partners;

- partners - represent the sphere of innovation promotion and provide services at all stages of technology transfer, often provide their assets for joint use (sharing);

- suppliers - represent the scope of resource support. They unite suppliers of material and technical resources, energy resources, logistics, legal and consulting services, etc.

An important feature of the technology transfer process in the digital environment is that all its participants can play various roles. The loss of at least one of the participants from the transfer chain is critical for the continuity and duration of the commercialization cycle. A separate category of participants is the state, represented by executive bodies responsible for the implementation of development programs and strategies, state organizations that manage innovation processes.

Potential network effects and risks for all technology transfer participants are highlighted. For example, the network effects of participating in a digital technology transfer platform for technology developers are: reducing transaction costs, intensifying the exchange of information and increasing its availability and cost, reducing the duration of the technology transfer process, and reducing risks due to the distribution between participants. Risks: leak of commercially significant information, loss of intellectual property rights and income from its use.

Network effects for the manufacturer: reducing costs from scaling up production and customization, reducing the cost of acquiring equipment through the formation of a network partnership for asset sharing, reducing the duration of production cycles and the time to market new products.

Network effects for the state: reducing budget expenditures, shortening the technology transfer cycle, accelerating the diffusion of innovations by overcoming information and resource inequalities, increasing innovation activity, reducing the costs of monitoring transfer processes due to the concentration of participants in a single information space. Risks: lack of a regulatory framework governing the activities of platforms, concentration of risks in a single space, increased costs for promoting the platform, loss of platform manageability due to an increase in the number of participants.

Further, from the standpoint of the triad of interests, network effects and risks of technology transfer participants, a review of existing information resources supporting innovative processes was carried out, which showed that the expectations of the technology transfer participants and the opportunities provided by these sites were inconsistent. As a result, there is no comprehensive satisfaction of their economic interests and, as a result, breaks in value chains arise while promoting innovative ideas in the real economy. Given the capabilities of digital platforms, this confirmed the relevance of creating a digital technology transfer platform and made it possible to formulate requirements for its functionality. A digital technology transfer platform should provide:

- access to databases on products (R&D results), on partners, on investors, on patents, on equipment and personnel, on realized and in progress and on unrealized projects;

- services in the areas of virtual consulting, documentation support (application forms for an investor, business plan forms), legal and expert support;

- the possibility of dialogue (feedback), advertising and affiliate materials;

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- availability of information on regional projects and programs, electronic procurement sites, analytical market research,

- the formation and provision of access to frequently asked questions (FAQ), cases, articles and reviews;

- intuitive, intelligent design, multilingual implementation capabilities, ensuring a privacy policy and protecting personal data.

7. Conclusion

Features of the concept of technology transfer formed in a digital environment as a result of research are:

- the priority of harmonizing the economic interests of all participants in the technology transfer process;

- taking into account the non-linear and interactive nature of the processes of creating and commercializing innovations and, as a result, the need for network interaction;

- the formation of value chains based on the integration of various stages of the life cycle of innovations, the cooperation of participants in the technology transfer process to solve a set of interrelated tasks for the development, commercialization and promotion of innovations, including through joint ownership of assets;

- using the capabilities of the platform economy in terms of creating a system of rules and mechanisms for the interaction of interested parties that provide significant economic and reputational benefits to all participants in the technology transfer process;

- consideration of a digital platform as an ecosystem, representing a network of interconnected companies that interact with each other, supplementing or delivering the key components of value propositions (benefits for customers) within their products or services, working simultaneously in a format of competition and cooperation for the development, commercialization and promotion of innovative products (ideas, technologies, goods and services);

- emphasis on expanding interactions from the perspective of the concept of creating joint value (co-creation) and intellectual entrepreneurship, which implies the development of collective creative activity in the process of technology transfer from the scientific and technical sphere to production.

Such an understanding of the essence of technology transfer in the digital environment allows us to formulate requirements and determine the functionality of the digital technology transfer platform as a tool for coordinating the interests of process participants taking into account network effects and risks.

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