

Innovation Ecosystem Management Within the Framework of Digitalization

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Abstract — In order to achieve breakthrough innovation development, it is important to create a favourable innovation environment that will facilitate creating and commercialization of innovations into demanded market products in the economy and social sphere. However, in the context of digital transformation, the innovation ecosystem needs to be improved as its elements as well as their interrelationship need to be modernized. This created the need for conducting a study, aimed at developing theoretical provisions, methodological tools as well as an appropriate model for managing the innovation ecosystem as the most important condition for implementing effective innovations in the age of digitalization.

Keywords — *innovation ecosystem, digitalization, innovative environment, innovation infrastructure*

I. INTRODUCTION

According to objective estimation, current state of national economy is characterized by structural heterogeneity, which is manifested into weakness of high technology industries. The level of innovative development of a number of industries and complexes is not high. Notable exceptions are the types of activities related to the military-industrial complex. These are very few industries that show signs of the fifth technological mode. The rest of the industries can be identified as procrastinating, these are industries that are conscious of the extreme importance of innovative transformations, however, postpone them due to the necessity of investing into innovations. To eliminate this trend, a new way of development is required, we assume that innovations of a systematic nature are needed, which are manifested in the creation of new production, organizational and managerial technologies that contribute to the formation and development of a new technological mode in all types of economic activity including services, agricultural production as well as other traditionally conservative procrastinating industries.

Therefore, digital economy as a specific type of socio-economic relations based on the use of digital technologies should be considered as such a mode.

The digital economy should be considered as a favourable environment for implementing innovative potential of organizations, regions and industries. Through the use of digital technologies, the participants of economic relations are able to demonstrate the growth of innovative activity. Consequently, to some extent, digital economy is also the means of increasing innovation activity of ecosystems.

II. METHODS AND MATERIALS

The concept of ecosystem was drawn from the science of Ecology; it is characterized as a developing system that covers more and more territories, increasing biological diversity as well as growing of energy and biomass flows [4]. The application of this concept to the innovative ecosystem is observed in many works by different researchers studying ecosystem. That is the way [6] this concept is applied and used within the framework of development and innovation [7], interpreted from the point of view of the variety of activities within organisations that are part of the ecosystem. Territorial coverage is not reflected in the works of scientists, however a great number of scientists deal with the intensive development of the innovative potential of ecosystems.

A number of authors [5] combine the concept of an innovative cluster, an innovation system as well as an innovation ecosystem, considering that these concepts are identical at the launch stage of innovation projects. We are going to examine innovation ecosystem as a system that provides formation and development of the scientific as well as technical designs necessary for commercialization by means of network relationships.

This approach assumes that the increase in competitive advantage in the market through the introduction of innovative ideas is in a complex, dynamic interaction with the participants of innovation environment (institutional environment, investment environment, research environment, business environment, education environment) as well as innovative infrastructure (political, tax, business, investment social environment). The innovation ecosystem is designed to frame the efforts of all the participants, thereby, achieving a synergistic as well as systematic effect. Therefore, we should consider the innovation ecosystem in a comprehensive way, studying the participants and institutions of the environment along with their interaction networks within digital economy [2].

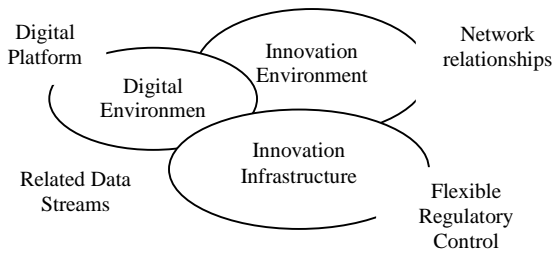


Fig. 1. Innovative ecosystem within the framework of digital economy

Proskurin S.D. [3] highlights several types of innovative ecosystems:

1. Global which is identified as to create the conditions for implementation of breakthrough innovation projects worldwide.
2. National, necessary for the formation of the society's innovative mentality, creating conditions for the generation of innovative ideas as well as subsequent commercialization, developing venture investment.
3. Regional – the most developed innovation ecosystems as it is both a customer and a consumer of innovations.
4. Technopolis or a local innovation ecosystem. It is one of the free economic zones forms, which unites the efforts of scientists and entrepreneurs in the innovation development.
5. Corporate ecosystems are formed on the basis of public-private partnerships as well as creating a network of small innovative enterprises.
6. Entrepreneurial ecosystems are companies, formed on the basis of a network of suppliers, consumers, competitors and intermediaries.
7. An individual ecosystem that has a certain level of competence for generating and implementing innovative ideas.

Based on the current trends in the digitalization development, it was possible to identify a digital innovation ecosystem, which elements are digital infrastructure, digital tools and digital competences that are able to minimize the time of development as well as commercialization of innovation products.

In connection with universal penetration of the Fourth Industrial Revolution technologies; increasing the importance of forming and developing ecosystems on the terms of partnership, integration and cooperation, implementing a rapid transition to a new format products and services demanded by the market, which makes technology and production more complicated, followed by total digitalization throughout the entire life cycle of products and services, it is necessary to develop integration links within the ecosystem, which will ensure the implementation of the life cycle of innovations [8] (figure 2).

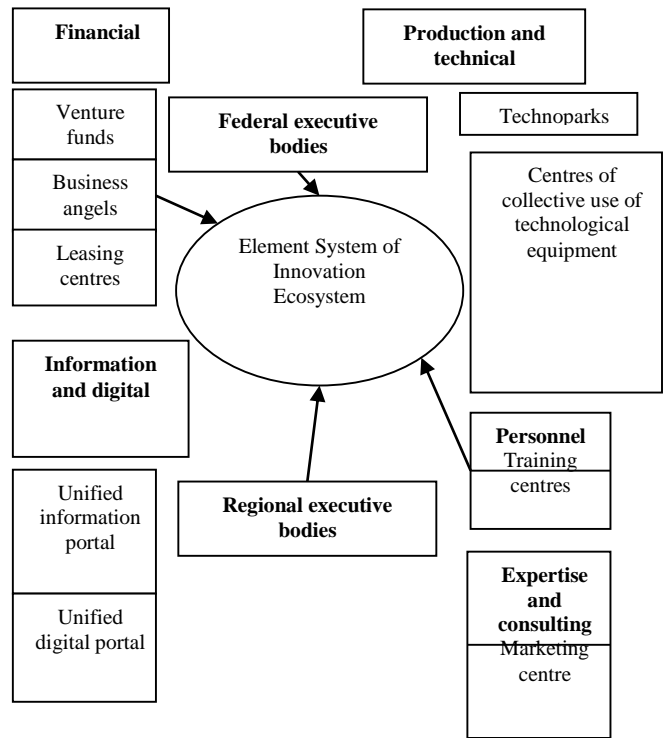


Fig. 2. The elements of innovation ecosystem

The presented elements of the innovation ecosystem of additional and optimizing institutions within the digital environment that are able to solve the following tasks:

- creation of telecommunication platforms for organizing interaction between scientists and business representatives;
- implementation and actualization of a multi-level training system for the benefit of innovation ecosystem;
- creation of digital platforms that combine information, production and human resources opportunities of the innovation ecosystem;
- activation of competence transfer processes at various levels of interaction between ecosystem participants;
- creation and development of a specialized innovation market;

To solve these problems, it is necessary to create a system of interaction between the participants of the innovation ecosystem. Scientists consider an innovative ecosystem based on the "triple helix" model, which assumes the presence of three elements: science, production, and the state [1].

In this regard, we are going to consider the interaction system of the innovation ecosystem elements, the core of which should be the educational and research environment. It is considered the source of innovation and personnel, whose task is to create digital platforms involving scientists, company managers as well as investors. Creating an interaction network between business companies that have the ability and resources to implement innovative developments, as well as public authorities that determine the dynamics of the innovation ecosystem development, which will contribute to its spread to the lower levels of the national economy, regional and corporate, should revolve around the core of the innovation ecosystem.

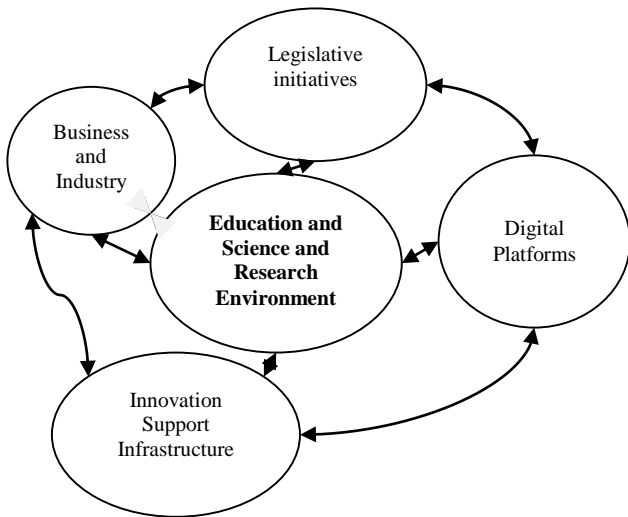


Fig. 3. Interaction mechanism of innovation ecosystem

These data allow asserting the potential for the development of the core of the innovation ecosystem in the Russian Federation.

At the moment, the centre for financial innovation and non-cash economy of the Moscow school of management "SKOLKOVO" has formed a rating of regions on the level of digitalization development named "Digital Russia". The data are presented in figure 4.

Thus, we can see that the leaders of the digital technologies introduction in the country's economy are Moscow, the Republic of Bashkortostan, Tatarstan, Saint Petersburg, Khanty-Mansiysk Autonomous Okrug – Yugra, YANAO Moscow Region, Tyumen Region, etc. Close the rating of the Jewish Autonomous region. The Karachay-Cherkess Republic, the Republic of Kalmykia, the Republic of Ingushetia, the Republic of Tyva, however, we can observe a decrease in the gap between the leading and trailing regions of the Russian Federation over the period 2017–2018.

The basic conditions for the innovation ecosystem development are: the availability of investment resources, the effective use of the accumulated innovation potential, and the effective use of the existing innovation infrastructure [9].

In order to understand the concept of the potential of the core of the innovation ecosystem, we present statistical information on the objects of the innovation infrastructure as well as objects of the educational and research environment.

TABLE I. THE OBJECTS OF RUSSIAN INNOVATION INFRASTRUCTURE AND EDUCATION AND RESEARCH ENVIRONMENT IN 2018

Objects	Quantity, items
Universities	1171
Scientific and research institutions	4169
Testing laboratories	1901
Centres of collective use of scientific equipment	573
Business incubators	82
Co-working	321
Laboratory facilities	311
Regional centres of enterprise support	78
Engineering centres	68
Techno parks	63
State Scientific centres	45
Научно-технические центры	33
Scientific and technical international organisations	18
Accelerators	39
Science Cities	13
Nanotechnology Centres	13
Territory development centres	2
Science tonic valleys	1
Innovation Centre	1
Regional institution of development	1
Innovation and Production Centre	1

The rating of regional innovation development presented below (Fig. 5) showed that at the end of 2017, the rating of Russian regions in terms of innovative development is again headed by Moscow, while the regions were divided into four groups based on the size of the lag between the values of the integral indicator and the result of the leading region. The first group includes those whose regional innovation development rating differs from the leader by 20 % , and these include the same regions that lead in the rating in terms of digitalization development (Moscow, the Republic of Tatarstan and St. Petersburg, etc.). The second group includes 42 regions that have already lost 40 % to the leader, and the third group is formed on a 60 % gap from the leader, which includes 29 regions, and the fourth group contains six regions with a gap of more than 60 % in the RRII value.

Moscow's leading position is due to the fact that the "Information city" programme is being implemented on its territory, Moscow, alongside with the Federal center, is developing the ANO "Digital economy" and a number of technological areas are already being tested within the framework of the program.

Next the national rating agencies of investment climate in 2018 in the Russian regions will be found, compiled by the Agency for strategic initiatives, which shows working efficiency of regional authorities in the sphere of formation of favorable business environment and allows assessing the quality of the investment climate.

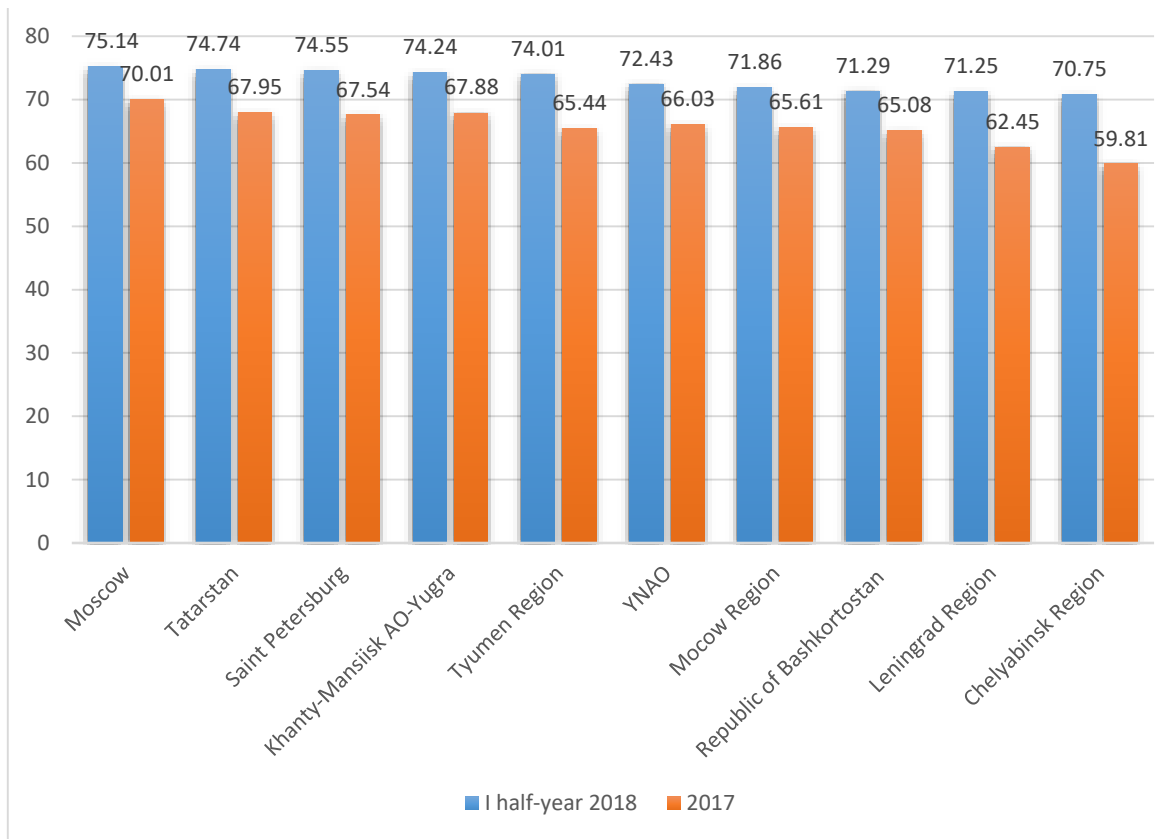


Fig. 4. Rating of regions by the level of digitalization development

I level										
The City of Moscow	Republic of Tatarstan	The City of Sankt-Petersburg	Moscow region	Tyumen region	Khanty-Mansijsk autonomous district - Yugra	Yamalo-Nenets autonomous district	Republic of Bashkortostan			
II level										
Leningrad region	Novosibirsk region	Belgorod region	Chelyabinsk region	Tula region	Lipetzki region	Kaluga region	Perm territory	Samara region	Republic of Sakha (Yakutia)	Rostov region
Voronezh region	Kaliningrad region	Vologda region	Murmansk region	Kursk region	Republic of Komi	Yaroslavl region	Irkutsk region	Udmurtian Republic	Orenburg region	Krasnodar region
Sverdlovsk region	Ulyanovsk region	Sakhalin Oblast	Nizhny Novgorod Region	Tomsk region	Krasnoyarsk region	Kemerovo region	Vladimir region	Volgograd region	Omsk region	Primorsky Krai
Khabarovsk region	Arhangelsk region	Chuvash Republic - Chuvashia	Ryazan Oblast	The Republic of Mordovia	Amurskaya Oblast	Tambov Region	Saratov region	Altai region		
III level										
Republic of Karelia	Chechen Republic	Kostroma region	Altai Republic	Nenets Autonomous Okrug	Penza region	Smolensk region	Republic of Crimea	The Republic of Khakassia	Magadan Region	The Republic of Dagestan
Kamchatka Krai	Astrakhan region	Kirov region	Novgorod region	Tver region	Ivanovo region	Bryansk region	Mari El Republic	Oryol Region	Sevastopol	The Republic of Buryatia
Republic of Adygea (Adygea)	Republic of North Ossetia-Alania	Kurgan region	Transbaikal region	Pskov region	Kabardino, Balkar Republic					
IV level										
Tyva Republic	Jewish Autonomous Region	Karachay-Cherkess Republic	The Republic of Ingushetia	Chukotka Autonomous Okrug	Republic of Kalmykia					

Fig. 5. Distribution of subjects of the Russian Federation by the value of the regional innovation index, 2017

TABLE II. STATE OF THE INVESTMENT CLIMATE IN THE REGIONS OF THE RUSSIAN FEDERATION

Region	Rating position 2018	Rating position 2017	Position shift 2018–2017
Tyumen Region	1	6	5
Moscow	2	3	1
Republic of Tatarstan	3	1	-2
Saint Petersburg	4	17	13
Tula Region	5	4	-1
Krasnodar Territory	6	7	1
Voronezh Region	7	8	1
Chuvash Republic	8	2	-6
Moscow Region	9	9	0
Ulyanovsk Region	10	10	0
Belgorod Region	11	23	12
Leningrad Region	12	20	8
Kaluga Region	13	5	-8
Khanty-Mansiysk Autonomous Okrug-Yugra	14	30	16
Kaliningrad Region	15	39	24
Tambov Region	16	11	-5
Yaroslavl Region	17	25	8
Khabarovsk Territory	18	40	22
Novosibirsk Region	19	27	8
Sverdlovsk Region	20	33	13

Given the ratings of subjects of the Russian Federation allow identifying the relationship of digitization development, innovative development of regions and investment climate in the regions where leaders in each of the highlighted ratings are the same regions, this is because the basic conditions for the innovation ecosystem development should be the availability of investment resources, effective use of the accumulated innovative potential, efficient use of existing innovation infrastructure and digital capabilities in the region. However, there are conditions that delay the innovation ecosystem development, namely the lack of appropriate competencies; lack of responsibility for the strategic planning horizon; lack of necessary resources for innovation; institutional problems; lack of proper competition; lack of a system of interaction between participants in the process under consideration; lack of regulation and support for enterprises when entering the market with innovative products.

III. RESULTS

To minimize or eliminate barriers to the development of the innovation ecosystem in the digital economy, it is necessary to introduce a modern mechanism for managing a complex dynamic innovation ecosystem. In this regard we have developed a model for managing the innovation ecosystem based on the combination of two levels of power.

The Federal level is represented by members of the Federal institutes of development (SKOLKOVO, the Fund of assistance to development of small enterprises, the Russian Fund of fundamental research, ANO "the Digital economy, the Central Bank, JSC "Russian venture company" (JSC "Russian venture company"), the Agency for strategic initiatives, national research University "Higher school of Economics", the Foundation of digital platforms, etc.) and Advisory Council, which should include the Ministry of education and science of the Russian Federation, Ministry of economic

development of Russia, Ministry of industry and trade of the Russian Federation, Ministry of communication and mass communication of the Russian Federation, Federal Executive authorities, Russian Academy of Sciences). The Council of the innovation ecosystem will be the highest management body, which will include representatives of both the Federal and regional levels, and the Council will be entrusted with Trustee functions.

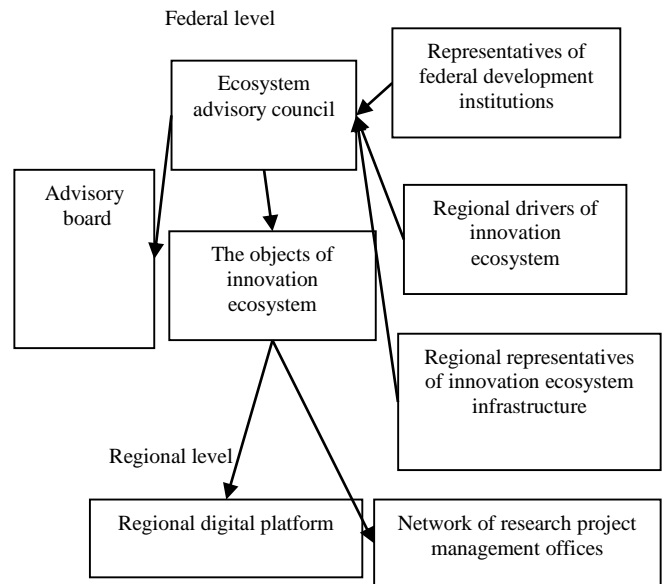


Fig. 6. Innovation ecosystem management model

As for the drivers of innovative development in the region, we will include universities, research organizations, and innovative business enterprises. We consider regional Executive authorities, funds promoting innovations, and clusters as representatives of the regional innovation ecosystem. The subject of management will be network project offices of scientific research. The offices of commercialization of enterprises as well as universities, venture companies, etc.

The regional digital platform should be formed on the basis of the region's existing digital competencies, digital infrastructure as well as digital tools.

The result of the effective functioning of the innovation ecosystem model will increase the commercialization of innovations that will involve an increase of economic efficiency of enterprises and enhance their competitiveness not only in the regional market in addition, improving the life quality of population.

The proposed innovation ecosystem model management is formed from the position of a system approach, which aims to create a network of relationships between ecosystem participants, which will allow efficient exchange of resources and opportunities to provide breakthrough technological and socio-economic development.

The functioning of the mechanism is determined by global trends, namely, widespread digitalization, social and demographic changes, the formation of a new paradigm of

scientific and technological development, the geopolitical situation, as well as the transition to the industry 4.0 model etc.

IV. CONCLUSION

According to the above mentioned aspects we can conclude that effective management of innovation ecosystem in conditions of digitalization, will allow forming and developing the changes required to reach ecosystem participants fundamentally new stages of development by converting existing qualities of the system with the use of digital technologies and will enable the exchange of necessary information as well as to ensure sustainable cooperation between all subjects of the innovation ecosystem.

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