The comprehensive assessment of the availability of unique resources and competencies of participants in the innovation ecosystem

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Abstract. The article describes the proposed comprehensive methodology for assessing the availability of unique resources, competencies and abilities to ensure sustainable balanced development of participants in the innovation ecosystem. The methodology reflects a new approach to the integrated assessment of the innovation ecosystem through an emphasis on the complex spiral nature of the implementation of innovations in it. It involves an integral assessment of the flow of innovation in three dimensions: flow velocity, strength and directivity. The developed approach is based on the identification, development and recombination of dynamic interaction abilities, as well as balancing the resulting effects. Information on the results of intellectual activity included in the assessment stages contributes not only to the unification of the main participants in the innovation process, but also serves as an objective basis for decision-making on the formation of a sustainable value of interaction in a strategic perspective. A set of techniques, methods and tools for the implementation of analysis in each of the three measurement directions is described, and the sequence of steps for their application is presented.

1 Introduction

In conditions of high variability and weak predictability of the external environment, the analysis of internal resource opportunities for the formation of strategic competitive advantages seems more promising [1,2]. There is a significant increase in the role of unique resources, competencies and abilities in the value chain of the final product, work, and service. Consequently, the problem of determining the optimal approaches and tools that make it possible to fully disclose these capabilities of individual participants in the production and economic system through the implementation of synergetic effects of interaction is becoming increasingly relevant.

On the other hand, the transition of import substitution needs of Russian participants in the production and economic system to critical ones has even more acutely actualized the tasks

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of modernization based on innovations [3, 4]. If earlier they were considered as directions of development and ensuring competitiveness in the future, now they have become necessary for survival. The report [5] emphasizes that horizontal coordination, diversified supply channels, a well-developed subcontracting network, and the interest of individual participants in their own technological development act as powerful neutralizers of the implementation of sanctions risk. The structural changes that have taken place have focused attention on the problems of fragmentation of industrial and economic entities in domestic practice, as well as on the targeted nature of measures to work with innovations.

2 Analysis of existing approaches and methods

Limited resources and the need for urgent transformations in response to large-scale structural changes from the external environment necessitate a resource-based approach to determining the guidelines for the strategic development of industrial and economic systems at the present time. For Russian participants, an integrated and integrated approach is important due to the urgency of measures to solve the described tasks and limited resources, which is emphasized in the integrated model for the implementation of innovative activities at industrial enterprises [6]. The complexity of most modern goods and their resource intensity, combined with the specialization of manufacturers within the framework of one stage of value creation or the implementation of a separate function, forces a comprehensive approach to solving the identified tasks, observing the balance of interests and the share of responsibility of each participant in the final result.

Taking into account the growing interest in ecosystems as forms of organizing interaction to overcome the noted problems, the search for approaches and tools for their assessment, as well as the analysis of this phenomenon for the formation of managerial impacts and the forecast of development seems promising [7]. The highlighted features of the implementation of innovative activities at the present stage are taken into account and disclosed as fully as possible within the framework of the principles of the ecosystem approach, the key difference of which is co-development. In this case, the ecosystem is considered as a community represented by a wide range of subjects of the innovation process, in which agents who do not have sufficient resources and competencies can, taking into account mutual cooperation, receive these resources and competencies, creating advantages for each participant and for the community as a whole [8]. The number of subjects of the innovation process and the number of connections between them in this methodology act as critical assessment parameters and reflect the level of maturity of the ecosystem as a kind of measure of the dynamics of diversity. At the same time, the sustainable development of the ecosystem is not determined by the mechanical "sum" of the elements. The key to the ecosystem approach is to focus on the joint creation of value [9].

The ecosystem as a new organizational and managerial model that ensures the integration of production and economic entities in the process of economic growth, innovation and sustainability has a number of fundamental distinctive features [10] that must be taken into account when analyzing and evaluating it. The concept of shared value combines competitiveness with social and economic sustainability, as they offer a holistic view of the diverse interacting elements needed to share knowledge in an emerging ecosystem, which, in addition, needs to create a common vision with stakeholders, stimulate intersectoral knowledge and technological complementarity for new solutions and involve participants. Innovations in the ecosystem are created through complex and constantly evolving dynamics of relationships, including with the participation of government agencies [11]. It is emphasized that with the current decrease in resource opportunities for the development of enterprises and organizations, deglobalization trends in the development of the world economy, scale effects and synergies are becoming a priority [10]. At the same time, the

ecosystem approach of obtaining the entire range of goods, works and services in one place, at one time based on digital technologies [12, 13] significantly strengthens it.

In [14], a fairly detailed analysis of ecosystem assessment tools is presented, revealing its individual aspects as a specific form of organization of the activities of industrial and economic entities. At the same time, there are no aggregated groups that focus on the value creation process implemented within the ecosystem based on the flow of innovations. In turn, it is this consideration that gives a comprehensive view of the ecosystem, its effectiveness, while maintaining the dynamics of its changes. It allows not only to evaluate the performance of the system, but also the speed of movement of innovations within the system in order to timely identify and eliminate the "bottlenecks" of their movement [15]. The ecosystem assessment methodology [16] reveals the interdependent and co-evolving roles of its elements in institutional mechanisms at the level of the territory, the formation itself and individual participants. Consideration of both the geographical context of the benefits of localization of participants in the assessment of the ecosystem, and social relations inside and outside it is reflected in [17]. The authors emphasize the importance of a process approach, assessing the dynamics of interactions and complementarity, and not just taking into account the benefits "in the moment". It is noted that innovation is currently turning from a discrete process into a continuous and purposeful process, as well as often nonlinear, which is primarily due to the human factor. This is reflected in the model of the innovation process of the ecosystem as a flow based on the information component of its functioning and the consideration of information as providing the possibility of the existence of space and the evolution of the production and economic system [18].

To assess the innovation ecosystem of China's high-tech industry, a four-link spiral model was used, which allows analyzing the possibilities of coordinated sustainable development at three levels [19]. This view allows for measurements of various aspects, as well as a multidimensional analysis of differences and trends in each of them. An analysis of the above practical implementation experience in China allowed us to confirm that a low level of coordination in development hinders the realization of ecosystem benefits.

With this understanding of the system of building interaction, the task of creating, organizing and ensuring a balanced sustainable development of the elements of socio-economic systems and themselves becomes urgent and difficult. The requirements for a balance of interests and the effects of interaction arise at different levels and from the point of view of the interests of various participants. In this regard, when developing tools for managing innovation activities of domestic industrial enterprises, special attention should be paid to maintaining the integrity of the production cycle, prioritizing measures for the prompt and fullest possible use of limited resources, and organizing opportunities for their joint use.

3 Results

Despite the fact that the concept of "innovation flow" is often used in relation to the formation and development of an innovation ecosystem, there is no interpretation and description of the assessment methodology. When characterizing the innovation flow, domestic research often focuses only on regulatory influences or resources [15]. At the same time, taking into account its specific flow features as part of the logistic approach will allow for comprehensive diagnostics, including studies of quantitative and temporal parameters, and will also make it possible not only to assess the productivity of the association, but also the speed of movement of innovations in order to timely identify and eliminate bottlenecks in their movement [15].

Many of the modern innovations are technologically quite complex, expensive and risky in nature, which implies the distribution of the stages of their creation between individual production and economic entities and further joint work. Moreover, this integration goes both

horizontally and along the stages of the innovation life cycle. The innovation process involves the interaction of business, science and government structures at the pre-production, production and post-production stages. All aggregates of these connections and the directions of their changes accompany information flows. The significant influence of information and digital technologies on the evolution of the regional economic system is highlighted [18]. However, the transition to evaluating only information flows is not entirely correct, since the strength and direction of their implementation within the ecosystem are formed and set by the need to create added value and benefit from joint activities within it. Modern ecosystems rely on non-linear, continuous and purposeful flows of new knowledge generation for their implementation in technology, product, service, which form the basis for their sustainable growth in a strategic perspective and, thereby, obtaining competitive advantages, as well as the diffusion of such experience. It is he who is the key, connecting element of the ecosystem and allows us to reveal the key features of this formation. In [15], the concept of "innovation flows" is proposed to understand the directional movement between the subjects of innovation activities of innovations/innovations, in the process of which the transformation of innovation into innovation occurs.

In the developed methodology, it is proposed to rely on taking into account the flow characteristics of innovations of the innovation ecosystem in a strategic perspective, which makes it possible to reveal the complex spiral nature of their creation and implementation in the ecosystem [20]. The implementation of a comprehensive assessment of the availability of unique resources, competencies and abilities of participants in the innovation ecosystem, taking into account the noted aspects and principles of its creation and development, it seems advisable to carry out in three directions of change: the speed of the flow of innovations, strength and orientation. It is these three areas that will allow us to comprehensively reveal the dynamics of changes in this complex phenomenon (Figure 1) since the analysis in one of these dimensions is insufficient and does not provide complete information about the changes. At the same time, the assessment and analysis within each of the sections should be interrelated and adjusted depending on each other's results in real time. After all, it is in the alignment and co-development of these key areas of development that the essence of the innovation ecosystem is revealed.

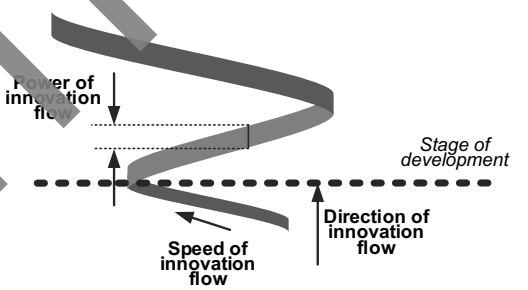

Fig. 1. General presentation of the methodology for the comprehensive assessment of the presence of participants in the innovation ecosystem, *Source: developed by the authors*

It involves considering the processes of formation and development of innovative ecosystems through the implementation of the innovation flow in them. Therefore, the choice, priority, time and strength of managerial influences are determined based on whether they contribute to or create barriers to the initiation, formation and maintenance of effective functioning or damping of the flow of innovations.

The priority of scientific and technological development of domestic industries and the solution of import substitution problems in accordance with the described aspects of the implementation of the innovation process at the present stage, structural changes in the

environment and the socio-economic systems themselves lies in the formation of a single cyclical spiral flow of innovations based on results of intellectual activity (RIA). This form of its implementation creates a real objective basis for reformatting the value chains of domestic industrial enterprises, ensuring the sustainability of their functioning, maintaining efficiency and growth opportunities. Only in this case, this activity will be aimed not only at the formation of an alternative offer in the already existing "narrow" meta ("catching up practice"), but also the development of new competitive products and services in strategically important areas ("leading practice"). The choice of RIA as the core of the innovation flow and the formation of a spiral is due to the fact that patent and licensing information reflects not only the scientific and technological groundwork in the subject area, but also the potential for its commercialization. At the same time, thereby linking scientific and research processes and production and economic ones. This determines their relationship, reducing the time for communication and contributing to the formation of a proposal of exactly the right quality, at exactly the time and place that the need arises for it.

At the same time, the flow-cyclical nature of the creation and development of modern innovations is revealed in a spiral value chain to build the potential of each of the participants, where, moving along its turn, each new science is its continuation, but gaining strength, it contributes to the transition of the entire association to the next round.

Changes in the external environment have determined the need for each country and region to rely on its own potential, making maximum use of its resource base and strive, above all, to maintain sustainable development. In this regard, at the first stage, the strength of ecosystem interaction is assessed. Within the framework of the resource approach, in order to ensure key sustainable strategic advantages, it is proposed to analyze it as the effectiveness of the implementation of three main processes: identification of dynamic abilities (DS), mastery of DS and recombination of DS. The organization of continuity and interconnectedness of their repetition within the framework of a single directional cycle of innovative transformations contributes to the development of each of its participants and elements, as well as the ecosystem as a whole by "feeding" each other. This mutual enrichment is its key, system-forming element of this form of interaction.

As part of the identification of DS, it is necessary, first, to assess the concentration of resources and their characteristics. For example, using such tools as: VRIO analysis, Grant resource model, Wheeler model, business Innovation Cycle Network models (NEBIC), etc.

Within the framework of mastering DS, it is analyzed how the DS of the participants and the system as a whole are developing (strengthening, fading, new ones appear). The most appropriate tools here will be the analysis of the specialization of individual participants, the life cycle of their goods, works, services, and the degree of centralization of the DS among the participants. At the same time, since based on empirical data it is confirmed that the key factor in the power level of the flow of innovative knowledge are scientific and innovative networks [21] infrastructure assessment, as well as structural and situational factors, should be given attention at this step of the analysis.

Within the framework of DS recombination, the degree of resource complementarity and its potential for determining points of interaction, integration and co-creation within the ecosystem are assessed. The more diverse the participants and their DS are, the potentially more points of interaction within the ecosystem can be formed. It also analyzes the possibilities of creating pairs of interactions, complementarity and connections (how flexible and stable they are) using scenario planning and foresight methods.

At the same time, it is important that the strength of ecosystem interaction based on its concept is not just the sum of participants, their DS and elements, but their integration system growth and the effects obtained in its process. Within the framework of recombination, the focus is aimed at working with the effects of interaction in the implementation of innovations: maximizing positive and leveling their negative manifestations, including through the

formation, active involvement of auxiliary and supporting elements and processes. The tasks of multi-criteria optimization are solved here. It is important in the implementation not to lose control over the main processes and the results of their implementation due to the direction of actions, as well as not allowing mutually suppressing effects and a way to coordinate and, accordingly, achieve targets with minimal costs.

The second section of the assessment (strength) helps to determine how quickly, intensively and predictably the innovation flow changes within the ecosystem. This information is proactive in nature, reflecting the dynamics of changes in individual elements, connections and the ecosystem as a whole. It is needed to adjust the flow rate. In terms of understanding innovation as a flow formed by ecosystem participants, it is proposed to measure such characteristics as: speed, predictability, intensity, distribution and efficiency. Here it is advisable to use an approach to evaluating scalar and vector parameters of the flow movement process [15], models of innovation process cycles [22] tools based on balanced scorecard systems.

The third section reflects an assessment of the direction of transformations based on the degree to which the goals of interaction are achieved at this turn of the spiral. This is an analysis of the compliance of current performance and targets of ecosystem development. It is conducted on a date for individual participants and for interaction in general. Its application helps to conditionally answer the question: "The flow of innovations is moving, actively, but is it where we need to go?". It also analyzes the degree of satisfaction of the needs of all participants in the interaction (external and internal).

The results of the assessment on the selected three aspects are analyzed and then adjustments are made to the functioning of the innovation ecosystem based on the degree to which priorities have been achieved for each of them or contradictions that have arisen between them and, accordingly, balancing needs.

4 Conclusions

Thus, within the framework of the study, an analysis of approaches and practical tools for the analysis and assessment of innovative ecosystems was carried out. The highlighted features of the implementation of innovations within the framework of specific, but critically important for their effective functioning forms of organization of modern production and economic systems, focused on the disparity of parameters in the assessment within the ecosystem, insufficient consideration of the dynamics of changes in the phenomenon, their complexity and the generated effects. The key aspects of the analysis and evaluation of such a multifaceted and complex phenomenon as the innovation ecosystem were identified and justified. The developed comprehensive methodology for assessing the sustainable balanced development of participants in the innovation ecosystem is also described. To implement it in a strategic perspective, it is advisable to rely on the concept of dynamic abilities. At the same time, it is essential in modern conditions and trends of their changes to focus on the choice of techniques, methods and procedures that do not create barriers, but contribute to the implementation of ecosystem principles of functioning of such a form of interaction organization. The emphasis on the analysis of the flow of innovations makes it possible to reveal the complex spiral nature of their creation and implementation in the ecosystem. In addition, this view makes it possible to track the dynamics of changes and their intensity.

It is proved that for an integral representation and the possibility of forming an objective basis for decision-making in a strategic perspective, it is advisable to conduct an analysis in three measurement directions: the speed of the flow of innovations, strength and orientation. It is this approach in three dimensions that allows us to obtain not point-by-point information, but a comprehensive picture that takes into account the streaming nature of innovations and the systemic effects of such a form of organization. It is important to include information about

REED in the methodology of analysis, as well as the potential for growth of synergetic effects from the dynamic development of the association's abilities. Because they take into account the interests, resource capabilities and limitations of individual participants.
The article describes a set of techniques, methods and tools for the implementation of analysis and evaluation in each of the three selected measurement directions, as well as the sequence of steps for their application.

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