

Strategy of Development of the Regional Ecosystem “Education - Science – Industry”

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Abstract—The article is devoted to the consideration of the regional ecosystem “Education - Science – Industry”, the definition of the role of regional universities and scientific institutions in the technological and economic development of regions. The author’s vision of strategizing the regional ecosystem “Education - Science – Industry” and the socio-economic system of the region is presented. The use of digital twins of the regional ecosystem “Education - Science – Industry” and the socio-economic system of the region in the development of strategies for their development is justified. The role of the laboratory of analysis and forecasting as an element of the institutional infrastructure of regional development in the process of strategizing the regional ecosystem “Education - Science – Industry” and the socio-economic system of the region is outlined. A unique methodology for assessing the mutual influence of the authors of the regional ecosystem “Education - Science – Industry” and the region has been developed. The classification and ranking of indicators of the methodology for assessing the contribution of the regional ecosystem “Education - Science – Industry” to the development of the region are presented. The results of the work can be useful in the formation of innovative scientific and technological centers, consortia of universities, scientific institutions, and enterprises of the real sector of the regional economy, determining the strategic prospects for their development.

Keywords—strategizing, ecosystem “Education - Science – Industry”, region, digital twin

I. INTRODUCTION

In economic science and practice, there is not only a conceptual representation of the regional ecosystem – “Education - Science – Industry”, but also an effective

methodology for strategizing consortia “universities - scientific organizations - enterprises of the real sector of the regional economy”. The need for in-depth development of a large-scale scientific problem of strategizing the development of the ecosystem – “Education - Science – Industry” in the region is due to the need to integrate the actors of this system, the development and implementation of practice-oriented methods aimed at implementing the country's tasks. At present, Russian universities have entered the era of modernization, both management system itself and models of interaction with scientific organizations, industrial partners, and government bodies. Launch of the program of strategic academic leadership of universities, the need for systemic integration and coordination of the strategy of scientific and technological development of the Russian Federation, the new adjusted national project “Science and Universities” and its federal projects “Integration”, “Research Leadership”, “Personnel”, “Infrastructure” for the implementation of a scientific and technological breakthrough determine the relevance of the search for models and formats for effective cooperation of national flagship universities, scientific organizations, industrial partners and methodology for strategizing their joint development.

The structure of the organization of interaction between universities, scientific institutions and industrial partners in the regions is currently in a state of dynamic change. Over the past decades, research and educational centers, innovative scientific and technological centers, ecosystems of corporations (Sberbank, Megafon, etc.) have been actively

studied in the economic literature, ideas of entrepreneurial, network and other universities are being developed. Each of these collaborations has its own characteristics, purpose, conditions for effective functioning and interaction with other forms. Despite the research devoted to each of these forms, the problems of strategizing their development remain unresolved. For the Russian economy, these problems are of particular importance not only in the context of the long-term search for a mechanism for the effective organization of cooperation between science, education, industry, and the regional environment, but also in view of the emerging difficult situation in determining the role and place of Russia in the scientific and educational space and technological development in the world.

Universities should be effective participants in regional economic planning as key components of the regional economy, considering that their uniqueness lies in the fact that, unlike most elements of the regional environment, they are historically one of the most durable institutions [1]. They can be leaders and main collaborators in planning and promoting the economic development of the country and the region [2]. In this regard, a special place in the strategic development of the “Education - Science – Industry” ecosystem in the region belongs to regional universities, which have chosen responsible behavior in relation to the city and the region as a vector of their progress and synergy of mutual influence of participants.

The concept of integration of industry, science, and education “Triple Helix” and its modifications are proposed in the works of such authors as G. Itskowitz, L. Leidesdorf, I. Kai, M. Ranga, A. Brehm, C. Jow, H. Lundberg and others. Questions of the theory of strategic management are disclosed in the works of I. Ansoff, A. P. Gradov, P. Drucker, R. S. Kaplan, G. B. Kleiner, V. D. Markova, G. Mintzberg, D. P. Norton, J. A. Pierce, T. Peters, V. M. Polterovich, A. J. Strickland, A. A. Thompson, Jr., R. Waterman, J. M. Higgins, S. M. Hosseini, C. J. Hatter, D.E. Shendel, K.R. Andrews and others. The problem of strategic planning for the development of an industrial complex was studied in the works of the authors: V.A. Bazarova, A. Yu. Goncharova, A.G. Granberg, A.M. Kalinin, I.E. Risin, V.L. Tambovtseva, A.I. Tatarin. The works of the corresponding member Kleiner G.B. are devoted to the issues of the systemic balance of the regions [3]. The systemic balance of the economy is also studied in the works [4-10].

At the same time, the analysis of domestic and foreign studies devoted to the stated scientific problem allows us to conclude that a number of its essential aspects are insufficiently developed: a methodological approach to the study of the process of strategizing regional ecosystems “Education - Science – Industry”, functions of strategizing the development of regional ecosystems “Education - Science – Industry”, instrumental support of the process of strategizing the development of regional ecosystems “Education - Science – Industry”.

The authors used the approach of Kleiner G.B. to the definition of strategizing, based on the systemic paradigm, which makes it possible to single out stable groupings of components with a systemic organization and universal configuration in the conceptual representation of the strategizing of regional ecosystems “Education - Science –

Industry” (Kleiner G.B. designates them as “tetrads”). Using this approach, the regional ecosystem “Education - Science – Industry” involved in the strategic process is considered by us as a complex system with a complex configuration, in which the balance and productivity of connections between components play an important role, which ensures the effectiveness of strategy.

In the process of strategizing regional ecosystems “Education - Science – Industry” we consider the important role of regional universities. At the same time, we proceed from the role of universities as producers of new knowledge and technologies, introducing them into regional socio-economic and production systems [11, 12]. At the same time, it is important to understand that the results of innovation activities of universities (patents, licenses, know-how, etc.) are mainly localized in the regional ecosystem “Education - Science – Industry” [13]. Also, the contribution of universities to the formation of the socio-economic environment is not limited to scientific research and educational activities, but also includes market initiatives in a geographically limited area [14]. Regional universities make a special contribution to the development of innovation ecosystems [15], conduct joint research with industry [16] create new knowledge-intensive enterprises [17, 18]. Universities’ role in the birth and diffusion of knowledge contributes to the development of the region [19]. There is a need to comprehend the role of the innovative development of regional universities, methods for assessing the impact of the regional ecosystem “Education - Science – Industry”, based on the assessment of the productivity of the actors of this system to create conditions conducive to the emergence of breakthrough social and technological innovations [20].

II. RESULTS

At present, strategizing is becoming a separate independent subsystem of economic science [21]. We consider the strategy of the development of the region and the regional ecosystem “Education - Science – Industry” as a set of their models (digital twins), institutions of strategic analysis and forecasting that form managerial decisions, methodologies for assessing the mutual influence of the actors of this ecosystem and the region.

In the process of strategizing, we highlight the methodology for assessing the mutual influence of the actors of the “Education - Science – Industry” ecosystem: the regional university, scientific institutions, enterprises of the real sector of the economy and the region. Within the framework of this methodology, we have developed an author’s methodology for assessing the impact of educational and scientific organizations on the socio-economic development of the region.

The indicators are divided into groups, the groups are ranked according to their importance for the region. Thus, indicators of contribution to its economy, demographic development and integration, investment processes and technological development of the region are critically important for the region. The contribution to the labor market, social and innovative development of the region is of great importance. In third place is the contribution to the intellectual potential of the region and the development of its infrastructure.

When assessing the effect of technological development in a region, it is important to identify the market orientation of the National Technology Initiative (NTI). NTI is a public-private partnership program for the development of new markets based on high-tech solutions. These markets are either absent or underdeveloped. However, it is they who will determine the progress, the creation of a new technological order in 15-20 years in the Russian Federation and in the world.

In addition, we divided the indicators into criteria of efficiency (effectiveness) of the university and scientific institutions and criteria for the contribution of the actors "Education" and "Science" to the development of the region. The short-term indicators are highlighted, allowing to assess the contribution of the actors "Education" and "Science" as an effect from the activities of the university, scientific institutions, manifested within 1-2 years, and long-term, allowing to assess the contribution of the actors "Education" and "Science" as an effect that appears in 5-7 years. So, for example, we have determined the following by short-term indicators of the contribution of the actors "Education" and "Science" to the development of integration, investment processes and technological development of the region: the number of universities and research organizations participating in consortia with the university, the number of scientific collaborations, the amount of funds for grants, received as a result of joint applications with members of the consortium, INTC. These indicators affect the image of the region, the growth of investment attractiveness and the rating of the region, as well as the growth in the number of new jobs.

The technical equipment of the research and development sector of the university, scientific organizations and enterprises of the real sector of the economy obtained as a result of interaction in the "Education - Science - Industry" ecosystem (this can be quantified as the book value of machinery and equipment per researcher), the volume of compensation for deficits in resource provision through cooperation with scientific institutions, other universities, industrial partners create conditions for the growth of the number of scientists and their results. This can be measured by indicators: growth in the number of personnel engaged in research and development, including in the category of "researchers"; movement of personnel engaged in research and development (taken from other scientific organizations); growth in the number of new technologies, including in terms of technology readiness levels.

Long-term indicators of the contribution of the "Education" and "Science" actors to the integration, investment processes and technological development of the region are the following: the number of universities and research organizations participating in consortia with the university, the number of scientific collaborations, the university's participation in the creation of clusters, and the ITC. These indicators provide a contribution to the development of the region and can be assessed by statistical indicators: developed advanced production technologies in the region (total and by groups of advanced production technologies, by types of economic activity); number of advanced production technologies used in the region by groups of advanced production technologies.

Indicators of "internal" performance of the actors "Science" and "Education" is the number of new areas of research and development work; the number of projects (programs) within the framework of the implementation of research and development work that meet the current international research agenda in the priority areas of the Strategy for Scientific and Technological Development - ensure the growth of the following indicators of regional development: the number of researchers in the region by fields of science; the movement of personnel engaged in research and development (accepted after graduation); the number of personnel engaged in research and development, including in the category of "researchers"; the number of researchers with academic degrees; number of researchers by age group, including up to 29 years old.

Performance indicators of the "Education" and "Science" actors: the amount of funds from R&D performance under contracts with organizations of the real sector of the region's economy; the share of university funds from R&D performance under contracts with organizations of the real sector of the region's economy, in the turnover of organizations in the real sector of the region's economy; the share of university purchases from enterprises and organizations in the region. The financial "strength" of universities, scientific institutions affects the growth of the gross regional product, the growth of labor productivity at the enterprises of the region, an increase in the volume of shipped goods of own production of the manufacturing industries in the region. Indicators of the contribution of the university and scientific institutions to the economic development of the region can be the following: the share of taxes paid by the university and scientific institutions, their employees to the regional and city budgets (the share in the amount received by the region and the city of land tax, personal income tax, transport, tax income tax, corporate property tax).

An analysis and forecasting laboratory is needed in the institutional environment of the region, to ensure the process of strategizing the development of the region and the regional ecosystem "Education - Science - Industry". Among the main activities of such a laboratory is the analysis of trends in the development of the economy, technologies, markets, industries, education; economic, regional, sectoral, social research; assessments, analysis, forecasts, situational analysis; information, model support of tasks of situational analysis and forecasting socio-economic processes; modeling (market, financial, scenario); market analysis (assessments and forecasts), identifying new needs and markets, assessing the potential of markets, modeling completely absent markets); benchmarking (market analysis based on socio-economic benchmarking - statistics and business climate), we highlight the creation of a digital twin of the region and the regional ecosystem "Education - Science - Industry" and their use to strategize the development of the region and the regional ecosystem "Education - Science - Industry" based on options modeling.

It is known that the concept of "digital twin" became an element of the fourth industrial revolution [22]. Digital solutions enable strategic benefits to be identified.

The digital twins of the region and the regional ecosystem "Education - Science - Industry" are their prototypes. Using such tools, it is possible to analyze the life cycles of these

objects, their reactions to various influences or changes. So, for example, the purpose of the digital twin of the regional ecosystem “Education - Science – Industry” in the strategy of its development is the following: modeling options for changing the volume and share of production of high-tech products, labor productivity growth, depending, for example, on an increase in the number of students, the opening of new educational programs, implementation innovations in industrial facilities, etc.

It is important that the digital twin allows using predictive analytics, conducting virtual experiments, and predicting the behavior of objects.

The digital twin of the region is considered by us as a system of information technology, analytical and organizational tools for collecting, storing, and processing information about the main subjects and processes of the socio-economic system of the region. And the digital twin of the regional ecosystem “Education - Science – Industry” is a part, a subsystem of the digital twin of the socio-economic system of the region. Therefore, modeling and forecasting is possible to make a reasonable choice of a strategy for their development because of the mutual influence and interaction of these systems.

Digital twins of the region and the regional ecosystem “Education - Science – Industry” are intended not only for strategizing to support decisions on managing the region and ecosystem, but also for monitoring and analyzing the state of objects.

The toolkit for the digital twins of the region and the regional ecosystem “Education - Science – Industry” should be aimed at solving many management problems. Among them, we will single out the assessment of the investment climate and investment risks of the region, the investment attractiveness of the regional ecosystem “Education - Science – Industry”, the assessment of the level of security of territories [23], solving the problems of location and optimization of production or logistics of product sales.

III. CONCLUSION

A new scientific result is a set of proposed tools for strategizing the development of regional ecosystems “Education - Science – Industry” and the region: digital twins of the regional ecosystem “Education - Science - Industry” and the socio-economic system of the region, laboratories of analysis and forecasting as an element of the institutional infrastructure of regional development in the process of strategizing the regional ecosystem “Education - Science – Industry” and the socio-economic system of the region, a unique methodology for assessing the mutual influence of the authors of the regional ecosystem “Education - Science – Industry” and the region.

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