Efficiency of the Innovation System Development under Integration Process

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Abstract. This article analyzes the different assessment techniques as elements of integrated assessment of the formation and development of the Eurasian Economic Cooperation Union (EAEU) innovation system in the context of integration process. Authors designed an integrated approach to assessing the effectiveness of the EAEU innovation system development in the context of integration. This approach includes the basic estimation principles, levels and indicators.

The basic principles of the selection of assessment indicators include: scientific substantiation, the possibility of quantification, results-orientation, concreteness and uniqueness, probabilistic character of indicators, system approach, the combination of aggregate and individual indicators, the optimal ratio of different groups of indicators, the combination of statistical, factual and forecasting indicators, the interconnectedness and compatibility of indicators, identity, commonality, compatibility of indicators in time and levels of management. The stages and indicators of the assessment of the EAEU innovation system development in the context of integration are proposed in the article. On this base, authors calculated the index of the EAEC innovation system development.

1. Introduction
The processes of globalization has been intensifying now. For Russia, the issue of integration into the world economic space is acute. The common features of the economies of the former Soviet republics and their potential were the prerequisites for their integration. As a result, the political leadership of Russia, Belarus and Kazakhstan made a decision about the creation of the Eurasian Economic Union (EAEU). The Republic of Armenia and the Republic of Kyrgyzstan joined to this union later. This union should contribute to the rapid economic development of its member countries.

2. The theoretical background for innovation systems assessment
In modern conditions, the competitiveness of the different countries depends on the ability to organize and implement innovative activities in the interregional, regional, sectoral and social levels. The production, distribution and effective application of new knowledge and technologies in economic development determine the place and role of the country on the world market, as well as the level of national security, what is especially important in the current circumstances. In the welfare of various countries, the results of the science and technological progress are increasingly important. In industrialized countries, the bulk of GDP growth comes from new knowledge, which is embodied in advanced tech-
nologies. This situation became possible due to the creation of new mechanisms for organizing innovation activities. They allowed highly developed countries to ensure economic breakthroughs.

Today, when the EAEU states are striving to move to an innovation path, to shift from a raw material economy to high-technology production, it is necessary to find effective mechanisms to do it. The most effective solution to this problem is the creation of an innovation system (IS) of the EAEU member countries.

An effective innovation system of the EAEU member countries forms a system of relationships between science, business and society, where innovations are the basis for the development of the economy and society, and the main trends in science are determined by innovation development needs.

However, now, as O.G. Golichenko says, the concept of innovation systems lacks completeness and efficiency, and sometimes it is difficult to apply it [1]. One of the problems that must be solved is the problem of access, distribution, use of knowledge in the economic system [1]. In our opinion, the innovation systems concept presupposes new approaches to determining the effectiveness of innovation development. This implies the development of theoretical base for the assessment of the building the EAEU innovation system in the context of integration. The research results in this field are uncompleted. It is still impossible to say that a system of indicators has been created that allows to fully evaluate the effectiveness of the EAEU innovative system and the level of its development. It should be noted that the level of development of the EAEU innovation system is determined by the level of development of "knowledge", by the level of development of "business", by key areas that include a number of indicators, which are statistical indicators of the EAEU member countries and regions.

From the analyzed methods of various researchers, we note the works of S. Kiselev the methodology of factor analysis of the region's innovative potential, developed by Amosenok and Bazhenov the regression analysis technique of Shtrertser (although these two methods are used more often to identify factors affecting the level of innovation activity) [4], the method of structural analysis of territorial innovative activity according to the industry criterion developed by Kortov [5], the methodology for rating the regions according to their innovation development of Gusev.

Assessment of territorial innovation development with various indicators and indicators is highlighted in the works of E. Divaev [7], P. Makarova, N. Flood [8] I. Ferova, Yu. Startseva, E. Inyukhina EV [9], A. Chugunov [10], I. Tatarintseva [11], S. Terebova [12], A. Trukhlyaeva

3. Conceptual issues: types and principles of assessing EAEU innovation system In the scientific literature, normative documents and management practices, the approaches to assessing the level of innovation systems development, especially in the context of international and interregional integration, are undeveloped. This undoubtedly reduces the the effectiveness of the innovation policy of the EAEU countries and the efficiency of spending. Tools and approaches to assessing the development of the EAEU innovation system remain one of the debatable issues in the scientific literature. There is no universal approach to solving this problem.

In this case, an assessment of the efficiency shows the economic relations between the innovation system of the EAEU countries and the society regarding the repletion of social needs with the products of organizations.

According to this methodological approach, we can purpose the comprehensive assessment of the formation and development of the EAEU innovation system in the context of integration. This assessment includes the following types:

- the assessment of the level of the innovation system development in the context of integration process (assessment of resources and conditions of direct formation, functioning and development

- the evaluation of the results of formation, functioning and development an innovation system in the context of integration process;

- the evaluation of the effectiveness of formation, functioning and development of innovation system in the context of integration process.
Understanding of the evaluation as an economic relation determines the multidimensionality of approaches to it. The starting points of the multidimensional approach are "time", "space" and "target orientation".

In "time", the evaluation of functioning can be provided by a combination of operational (monthly, quarterly), current (annual) and periodic (2-5 years) assessments. Such a sequence allows to ensure continuity of indicators, preservation and accumulation of necessary information. In the "space", it is advisable to evaluate the functioning in accordance with the "horizontal-vertical" scheme. "Horizontal" means the assessment and effectiveness of the subsystems of the EAEU IS, or of industries. "Vertical" - according to the elements of the subsystems of the EAEU innovation system, by country, by region.

The "target orientation" of the evaluation of the functioning of the EAEU innovation system is determined by the tasks it solves in accordance with the regional innovation policy.

The lack of a unified methodological approach sets a task: set out clearly the principles by which partial indicators required to assess the formation, functioning and development of EAEU innovation system are selected. At the same time, it is necessary to take into account the following points: the systematic nature of indicators, the possibility of changing them over time, the diversity of indicators, the need to take into account the changes (for example, globalization process).

These principles are formulated on the basis of analysis of more fundamental principles that are known and recommended in the evaluation of innovation process in general, taking into account the overall conditions and the specifics of the formation and development of EAEU innovation system.

The basic principles necessary for the selection of a system of indicators for assessing EAEU IS can be attributed as: scientific validity, the possibility of quantitative determination, focus on final results, concreteness and uniqueness, the probability of indicators, the complexity of the approach, the combination of integral and partial indicators, the rational combination of individual groups of indicators, statistical, actual and forecasted indicators, the division of indicators into indicators of results and indicators of efficiency, the controllability of indicators, interconnection and compatibility of indicators, identity, generality, reducibility of indicators by levels of the hierarchy of management and in time [14].

These methodological principles can be divided into three groups:
- principles, that will contribute to the selection of indicators that characterize the results;
- principles, that will contribute to the selection of indicators that characterize the forms of their representation and their correlation,
- principles, that will contribute to the selection of indicators that enable their application to solve various problems.

The main principle is scientific validity. Following to this principle, the selected indicators for IS estimation should reflect all the results - economic, social, environmental, etc. and should be integrated logically into the overall assessment system. The principle of scientific validity must also be observed when subsystems and elements are estimated [15, 16].

The most important principle that should be the basis of assessing the level and efficiency of the EAEU IS is an orientation towards the final results. Depending on whether the level of development of the EAEU IS is determined or the level of its effective functioning, the results may be different. Therefore, when the level of development of the EAC is assessing, in the field of material and technical base the result can be the level of technical equipment of the scientific worker. As for the evaluation of efficiency, the final results are the growth of GDP and labor productivity, etc.

In addition, the complexity of the assessment is the important principle of assessing the development and functioning of the innovation system. The assessment should be carried out in a comprehensive manner, taking into account the specific types of work performed, determined by the purpose of the functioning of the individual subsystems and the EAEU IS as a whole.

When the development of the EIS is evaluating, it is necessary to take into account the activities of many organizations involved into different subsystems. The statistical base can be insufficient. In this
case, the principle of combining statistical, actual and forecast indicators plays a very important role, including indicators in retrospect. In addition, systematic monitoring of the EIS development and functioning without this principle is difficult.

The principle of regulating makes it possible to take into account regional features. Observance of the principle of interconnection and compatibility of indicators is extremely necessary when the numerical values of individual indicators are inflated. This can distort the innovation landscape of the EAEU countries and their regions.

Credibility and impartiality of the assessment of EIS can to some extent be ensured by the selection of indicators, on the base of the principle of probability of indicators. This principle presupposes the qualitative analysis using for identifying the possible values of individual indicators for a given country or region, if these values exceed reasonable limits.

Based on mentioned methodological principles, it is possible to develop methodological base for assessing the level of development and effective functioning of the EAEU IS.

4. Methodology of EAEU innovation system assessment

Based on the above, we note that the methodological postulates for an assessment of the EAEU IS can be divided into three levels: supranational (supreme), national (medium) and regional (low). To the highest level you can include:

- methods for assessing the level of development of the EIS in whole,
- To the middle - methods of assessing the level of development of EAEU countries’ innovation systems.
- To low level - the methods of assessing the level of development of regional innovation systems of the EAEU countries.

One of the most important conditions for the development of unbiased assessment system for EIS functioning is the selection of key indicators that enable to evaluate reasonably and reliably its level of development, results and effectiveness. The well-founded choice of such indicators is extremely complicated; therefore, an absolutely accurate and justified choice of them may be impossible. Some deviations and conventions may be allowed.

As a result of the analysis of various approaches to the evaluation of innovation activity, in particular, the innovative potential, the composition and number of separate indicators used and recommended were identified. They can be used for an unbiased assessment of the EIS only under certain conditions.

If you take into account the peculiarities of the EIS, its multi-subsystem nature (different levels) and multi-elementality, their complex interrelationships, the possibility of using heterogeneous individual indicators, then it becomes obvious the need to develop a specific system of indicators for the quantitative evaluation of the EIS, its subsystems and elements [17, 18].

Here, we single out three interrelated and interdependent aspects, representing a three-pronged task: assessment of the level of innovation system development, and factors influencing this development; results assessment; efficiency assessment.

This determines their methodological commonality and a complex character.

Currently, the assessment indicators are not generalized and not systematized, there is no their scientific classification. This can lead to incorrect conclusions and, as a result, to erroneous recommendations for the further development of the EIS.

The variety of recommended indicators, the ambiguity of a number of indicators, could not lead to erroneous solutions because of one reason: the level of scientific potential is still not accounted, and the question about the level of the innovation system development itself is a new. It is necessary to improve the methodological basis of the assessment, which consists in identifying the groups and subgroups of indicators, their structure, and the methodological features of their calculation [19, 20].

Considering this, it seems appropriate to assess effectiveness and productiveness with a set of indicators refined and enriched for the research object:

- partial, generalized, integral
- absolute and relative
- natural and value
- quantitative and qualitative
- the degree of influence on macroeconomic indicators.

Extended scorecard recommended for EIS assessment and comprising all groups of indicators presented in the Table 1.

**Table 1.** Stages and indicators of the assessing the building and development of the eaeu countries’ innovation system in the context of integration process.

| Assessment steps | A set of measures required to implement the steps |
|------------------|-----------------------------------------------|
| Assessment of the effectiveness of innovation system building and development in the EAEU countries | 1. Selecting partial indicators |
| 1.                             | 1.1 Scientific substantiation of the need for a set of partial indicators characterizing the effectiveness of the EAEU innovation system building and development |
| 1.                             | 1.2 Identifying groups, composition and structure of efficiency indicators of EAEU innovation system building and development |
| 1.                             | 1.3 Qualitative analysis of reliability and compatibility of indicators chosen for calculations |
| 2.                             | Selection of countries (regions) for comparative assessment of efficiency |
| 2.1.                          | 2.1. Accounting for the specifics of the country's socio-economic development and the trends in its innovation development |
| 2.2.                          | 2.2. Identification of possibilities for modeling in a select group of the EAEU countries |
| 2.3.                          | 2.3. Identification of the composition and structure of selected regions |
| 3.                             | Assessment of the integral indicator of the effectiveness of the EAEU innovation system building and development |
| 3.1.                          | 3.1. Choice of a model for estimating integral indicator based on an analysis of different approaches |
| 3.2.                          | 3.2. Justification and disclosure of singularities of the method of the normalizing function |
| 3.3.                          | 3.3. Identification of intensity indices, that reflecting the results EAEU innovation system building and development, by regions according to the selected model. |
| 3.4.                          | 3.4. Calculation of the standardized indicators for the selected model |
| 3.5.                          | 3.5. Identification of shortcomings associated with unreliable statistical data, incompatibility of individual indicators and their elimination |
| 3.6.                          | 3.6. Assessment of the use of the adjusted scorecard for the calculation of a consolidated IS effectiveness indicator |
| 3.7.                          | 3.7. Multivariate calculations of the summarizing indicator of IS effectiveness |
| 3.8.                          | 3.8. Ranking regions |
| 3.9.                          | 3.9. Classification of regions by the level of the generalized indicator of effectiveness |
| Assessment of the effectiveness of the EAEU innovation system building and development | 4. Selection of indicators for assessment |
| 4.1.                          | 4.1. Search for integral indicator reflecting the effectiveness of the innovation system |
| 4.2.                          | 4.2. Rationale and choice of indicators that form the basis of the integral effectiveness indicator |
| 4.3.                          | 4.3. Selection of the method for calculating the integral indicator |
Further, the IS development effectiveness index is calculated for the EAEU member countries. We will use a special integral indicator - the index of development of the innovation system of the EAEU member countries – $I_j$:

$$I_j = \frac{\sum_{i=1}^{5} k_i a_i}{\sum_{i=1}^{5} a_i}$$

where $I_j$ – index of the innovation system development $j$ of the level of innovation system, $j=1$–3.

$k_i$ – coefficient of the development level $i$ kind, $i=1$…5,

$a_i$ - the specific weight of coefficient $i$ type $j$, is identified by expert.

5. Conclusion

Thus, the proposed approaches to the assessment make it possible to comprehensively evaluate the effectiveness of the development of the EAEU innovation system development, as well as to identify the degree of influence of various components on the integral index and, to compare the success of the EAEU member countries in the context of integration and identify areas requiring additional efforts by the intergovernmental EAEU governance bodies and private organizations. These indicators allow for analysis and comparison of innovation activities in different planes in order to identify opportunities and reserves for economic growth, as well as opportunities for interstate and state policy in stimulating innovative development.

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