Technologies for the Development of Methods for Evaluating an Innovative System

N.A. Kulagina, O.V. Mikheenko, D.G. Rodionov

Abstract: The purpose of this work is to develop proposals for improving the methodology for assessing the innovative development of the socio-economic system of Russian regions based on the achievements of international theory and practice in this field of research. To accomplish the task, the authors considered both conceptual and empirical approaches to the assessment of regional innovation systems in modern conditions of development. The article presents a new structure of the integral innovation index of the regions of Russia based on a critical review of the results of well-known scientific research and approaches that are used by leading development institutions. The authors have proposed the grouping of primary indicators into subindexes, reflecting the potential, conditions for development, activity and effectiveness of the innovation system of the region. The calculation of the value of the final integral index is carried out by taking into account the weights of the subindexes, while the study presents theoretical and practical developments that largely shift the emphasis on the effectiveness and efficiency of innovation activities. Special attention is paid to the interpretation of assessment results. Based on the range of possible values it was proposed to group regions by the identified types of innovation systems. The authors have tested the developed method on the example of the subjects of the Central Federal District of Russia, the results of which are illustrated by the innovation map of the regions. Based on the clustering of assessment results, a typology of regional innovation systems has been developed reflecting their heterogeneity. The work substantiates the need for a differentiated innovation policy for different types of regions, taking into account the complex of identified barriers and weaknesses. This will allow to level the obstacles to regional innovation and industrial growth. Thus, we are talking about the need to form a "smart strategy" of the region's innovative development.

Keywords: region, innovation system, innovation development, assessment methods, region innovation development index, index structure, innovation system performance, types of innovation systems, innovation map of regions, innovation policy, smart strategy.

I. INTRODUCTION

The formation of an economy of innovation type based on intellectual knowledge is a new paradigm of long-term state economic policy [1]. This concept sets the priority for creating a favorable institutional environment for the emergence of new innovative companies and the development of high-tech industries in all sectors of the Russian economy [2]. The new model of the "economy of leadership and innovation" implies a competition in the markets for goods and services, which stimulates entrepreneurial activity and raising funds. At the same time not only business enterprises but also regions of Russia are considered as competitors [3]. Each region is characterized by a complex of individual features in terms of assessing the potential of its socio-economic system, the conditions for the development of innovation activity, the level of innovation activity of economic entities, etc. This makes it absolutely unique.

The formation of a model of growth of the national economy based on the trinity of science, technology and innovation has been at the center of the government agenda for over ten years. In the majority of scientific works devoted to the study of the organization of the system of management of regional economic systems, it is noted that the most effective, but at the same time, the most difficult way out of development is to create a favorable environment conducive to enhancing innovation. This issue has not been sufficiently considered in the works of economists and still needs further research, especially in the development of institutional support and public policy to stimulate regional growth [4].

In this regard, the actual scientific task seems to be building a mechanism for managing the innovative development of the regional economic system, indispensable signs of which, according to leading economists who carried out research in this area, are:

- the presence of an ordered set of elements and established relationships between them;

- the existence of clearly defined and approved targets for growth and development, the achievement of which is the strategic goal of the interaction of all elements of the system;

- the possibility of implementing with the help of various levers and instruments of control action on the control objects.

Initially, the concept of the innovation system was applied at the national level [5] – [9].Based on the provisions of these works, the concept of regional innovation systems, developed by Cook [10] – [12], still remains very influential both in scientific terms and in practice. No less significant is the cluster policy approach presented in the works of Porter [13], [14]. Regional innovation systems (RIS) and government approaches to building innovation policy are considered in [15], [16].

The last two decades have been characterized by active research in this scientific direction with a decisive influence on the theory and practice of regional innovation policy provided work in the field of formation and evaluation of regional innovation systems and clusters [17], [18],

an effective mechanism for managing the development of human capital assets as the basis of the regional economy [19], as well as the role of innovation potential as a major factor in improving competitiveness [20]. The experience and practices of different countries are important for building effective regional innovation systems [21] - [25].

Regional innovation systems alone do not guarantee the emergence of new growth paths for the region's economy or any major structural changes [26], the government faces the important task of supporting the business environment for knowledge application and commercialization [15]. At the same time, innovation policy should not be applied in a standardized way, but should be focused on the specific problems and needs of a specific type of region and take into account specific strengths and weaknesses and conditions [27] – [29]. Lead researchers note that there is no single "best practice" approach for innovation policy that can be applied to any type of region [30] – [32]. An interesting development in the scientific field under consideration is the idea of "smart" specialization [33], [34].

In this regard, the need to assess the regional innovation system in order to develop a "smart strategy for innovation development" [35] focused on the strength and competitive advantages of each region comes to the fore. At the same time, it should be noted that the assessment methodology in our country today is in the formative stage. Different analytical centers periodically evaluate regional innovation systems using their own unique methods, but the final ratings do not reflect objectively the actual system, which determines the relevance of the research topic.

Thus, the purpose of this study is to develop a method for assessing the level of development of the regional innovation system in order to build a perspective innovative policy that takes into account both the individual characteristics of the regional economy and the patterns of development of the type of its innovative system.

The provisions that form the basis of the author's research are:

- The integral indicator for assessing the level of RIS development should include a block of indicators reflecting its effectiveness (innovation performance);

- Assessment of the innovative development of the region should be carried out by taking into account the different weights of the individual components of RIS in the structure of the composite indicator;

- Interpretation of evaluation results for the purposes of developing an innovative policy for the future is based on an analysis of the level of development of individual sub-indices;

- Depending on the results of the assessment, different types of regions are identified based on the level of RIS development;

- The strategy of the perspective innovative development of the socio-economic system of the region should be developed by taking into account the results of the assessment of its current state.

B. Theory

International experience in this area - The Global Innovation Index [36], as well as foreign methods: Regional Innovation Scoreboard for Europe [37] and Portfolio Innovation Index for the United States [38], [39] and domestic techniques used by experts from the National Research University Higher School of Economics [40] and the Association of Innovative Regions of Russia [41] played a great role for the methodological basis for the development of the author's system of assessing the level of innovative development of regional economies.

II. PROPOSED METHODOLOGY

A. Foreign Approaches to RIS Assessment

In the framework of the EIS, since 2001, an assessment of the research and innovation activities of EU member states has been carried out annually, the purpose of which is to identify the competitive advantages and weaknesses of the RIS of the countries studied. An assessment of the development of RIS is given on the basis of the value of the Consolidated Innovation Index, which is formed as an integral value of the following components: innovation potential, firm performance and results. Components are calculated based on the values of 25 particular indicators, which are grouped into eight thematic areas.

Based on the calculated values of the Composite Innovative Index RIS of European countries, it is customary to subdivide into four types:

1. "Leaders" - RIS, the effectiveness of innovations of which exceeds the EU average by more than 20%.

2. "Strong innovators" - the effectiveness of innovations is 90-120% of the average for the EU.

3. "Moderate innovators" - an indicator of the effectiveness of innovations is in the range of 50-90%.

4. "Modest innovators" - RIS, the effectiveness of innovations of which are significantly lower (less than 50%) than the average level in the EU.

The assessment of the level of US RIS development is based on the definition of the PII - Composite Index of Innovative Development. The method of calculation is different from the European one. The value of the final index is determined on the basis of summing up the weighted values of the following components (subindexes): human capital (the weight of the subindex in the final estimate is 30%), factors of economic development (30%), labor productivity and employment (30%), economic well-being (10%). The values of subindexes are calculated as a weighted average of primary indicators (from 5 to 7 as part of each subindex).

In accordance with the received PII RIS value, the USA is divided into five types:

1. RIS, having a PII value above 110% of the average for a group of regions;

2. RIS, PII of which varies from 100 to 110% of the average for a group of regions;

3. RIS whose PII varies from 90 to 100% of the average for a group of regions;

4. RIS, PII of which varies from 80 to 90% of the average for a group of regions;

5. RIS whose PII value is below 80% of the average for a group of regions.

Summarizing the modern foreign methods of RIS assessment, it should be noted that the value of the final index is usually calculated on the basis of several sub-indices, each of which characterizes a separate direction of innovation activity. At the same time, subindices are based on the system of primary indicators, the source of which is most often the official statistics. Without fail, the basis for calculating the final index of RIS development is laid down the indicators characterizing the innovative potential of the system and its results (innovation efficiency).

C.Contemporary Russian practice of RIS assessment

Today in Russia there is no uniform methodology for assessing the level of development, state, or effectiveness of RIS [42], [43]. Periodically, various research centers analyze innovation activities in regions of the country, the results of which are different ratings based on their own methods and approaches [44]. The most popular domestic ratings of innovation development of regions are compiled by expert analysts of the National Research University Higher School of Economics (HSE) and the expert-analytical committee of the Association of Innovative Regions of Russia (AIRR). It should be noted that the comparison of the results of domestic ratings for the same period often gives a different idea about the level of innovative development of domestic RIS.

The HSE appraisal methodologies applied since 2012 are based on our own system of quantitative and qualitative indicators. The type of RIS is determined based on the value of the Russian Regional Innovation Index (RRII) and is calculated as a weighted average of its constituent sub-indices: the socio-economic conditions of innovation activity (ISED), scientific and technical potential (INTP), innovation activity (IID), quality of innovation policy (IKIP).

Depending on the final RRII value, the regions are ranked, which are proposed to be divided into four groups:

1. regions, the RRII value of which is higher than 135% of the average for a group of regions;

2. regions, the value of RRII which is from 100 to 135% of the average for a group of regions;

3. regions, the value of RRII which is from 70 to 100% of the average for a group of regions;

4. regions, the value of RRII which is less than 70% of the average for a group of regions.

Among the shortcomings of the methodology, experts note a high level of differentiation of the subjects of the Russian Federation in the RIAI rating: the index value of the region-leading region and the region rounding it out differ by 3.53 times, which is higher compared to the level of the previous period. The geographical distribution of regions with different levels of RIS development is characterized by experts as stably uneven. This trend is also a characteristic of subindexes, with a sharper one. So, if for the INTP sub-index, the gap is 3.35 times, for the rest it is more significant: ISED - 4.87 times, ICIP - 7.11 times, and IID - 16.31 times.

In our opinion, the HSE methodology requires improvement, since it does not take into account a number of fundamental positions. Thus, the final value of the RIS

development index does not take into account the applied structure of the indicator (grouping by subindexes). In this connection, the fact of grouping has no practical application and loses expediency. Also, in our opinion, it is unfair to attach equal importance to subindexes.

The AIR publishes its own rating twice a year, which assessment methodology is a bit different. The final indicator is formed on the basis of the values of 29 primary indicators, divided into four subindexes: research and development, innovation activity, socio-economic conditions of innovation activity, and innovation activity of the region.

The assessment of the level of RIS development is carried out on the basis of the final index of innovation development, which is determined as an arithmetic average for all primary indicators. Then all RIS, depending on the level of development, was proposed to be divided into five groups:

1. "Strong innovators" - RIS, the performance of which is more than 140% than the average for the group.

2. "Medium-strong innovators" - RIS, whose effectiveness ranges from 110% to 140% of the group average.

3. "Average innovators" - RIS, whose performance ranges from 90% to 110% of the group average.

4. "Medium-weak innovators" - RIS, whose effectiveness ranges from 60% to 90% of the group average.

5. "Weak Innovators" - RIS, the performance of which is less than 60% than the average for the group.

We believe that the disadvantages of this technique are:

1) congestion with primary indicators;

2) RIS performance indicators, as well as indicators of its potential are dispersed in various thematic areas;

3) the weight of subindexes in the final index is calculated in proportion to the number of indicators included in this subindex to their total number. Then it turns out that an increase in the number of primary indicators is equivalent to an increase in its significance, which, in our opinion, is incorrect.

The main disadvantage that prevents the use of the studied foreign methods in Russian practice is that the primary indicators reflecting the state of RIS are absent in the national statistics. Whereas domestic approaches use exclusively open data of official state statistics.

At the same time, in the structure of the final innovation indices determining the level of RIS development, according to foreign approaches, the values of the sub-indices of the potential of the regional innovation system and its efficiency are calculated separately [45], which is not typical for the Russian practice. In our opinion, this is a significant omission since the effectiveness of the regional innovation system is the main criterion of its effectiveness. In this regard, the indicators characterizing the performance should be evaluated separately and, moreover, have more weight in the structure of the final index. This provision was fundamental in the development of the author's structure of the innovation index of the territory.

The integral indicator for assessing the level of RIS development should include a block of indicators reflecting its effectiveness (characterizing the effectiveness of innovation activity).

At the same time, the assessment of the innovative development of the region should be carried out taking into account the different weights of the individual components of RIS in the structure of the composite indicator.

D. Data and Method

Taking into account the advantages and disadvantages of the considered approaches to the assessment of the innovative development of the economic system of the region, we denote the main directions of their improvement:

1. structuring indicators in such a way that indicators, potential and effectiveness of RIS are included in different sub-indices;

2. redistribution of sub-index weights in the final indicator in order to shift the emphasis from the number of indicators used to their significance.

We consider the following distribution of primary indicators, reflecting the state of RIS, according to thematic areas of the sub-indices:

1. The sub-index "Potential" (P - "potential"), accumulating starting possibilities and conditions for the formation of an innovative system.

2. The sub-index "Conditions for the development of RIS" (C - "conditions"), which generalizes the factors of stimulating / restraining influence on the development of RIS.

3. The subindex "Innovation activity" (A - "activities") includes indicators characterizing the activity of innovation processes in the region, a qualitative characteristic of the innovativeness of economic entities.

4. Subindex "Results" (R - "results"), reflecting the performance of the innovative system of the region and the effectiveness of innovation in the field of creating innovations (Fig. 1).
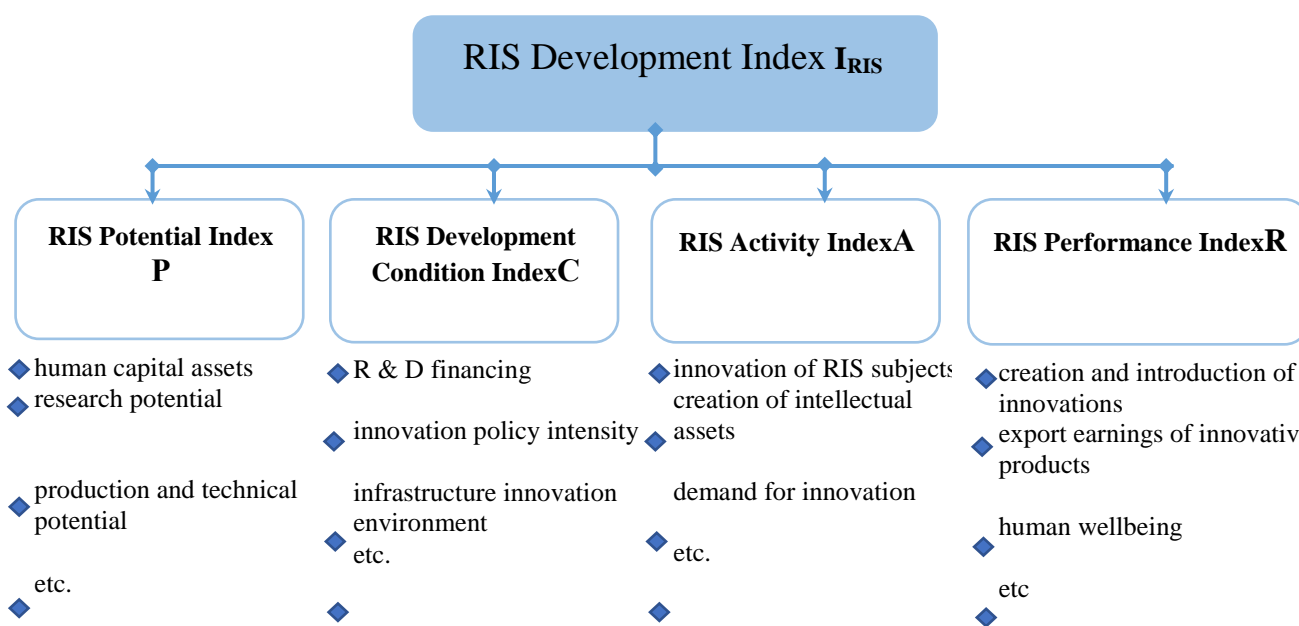
Fig. 1. Structure of the RIS Development Index

Thus, all primary indicators which allow to establish the level of RIS development are distributed into groups (sub-indices) in accordance with the structure of the integral index proposed in the table. The total value of the indicator for each group reflects the state of RIS in various thematic areas.

The calculation of the values of individual subindices in the context of the formed groups compensates for a large number of primary indicators and allows to increase the analytical value of the assessment procedure.

At the same time, an important step is the procedure of "smoothing" the influence of extreme parameters with the asymmetric nature of the distribution of indicator values in groups. Transformation should be carried out if the asymmetry coefficient is higher than 0.5. The value of the asymmetry coefficient is calculated by the formula:

$$k_a = \frac{\mu^3}{\sigma^3}, \quad (1)$$

where μ^3 – central moment of the third order;

σ^3 – cube of standard deviation.

central moment of the third order μ^3 can be found:

$$\mu^3 = \frac{\sum(x-\bar{x})^3 n}{\sum n}, \quad (2)$$

where x – is an initial indicator value;

$\bar{x}$ – the average value of the indicator in the group.

The standard deviation is determined by the formula:

$$\sigma = \sqrt{\frac{\sum(x-\bar{x})^2 \cdot n}{\sum n}}. \quad (3)$$

Transformation of indicator values is carried out according to the formula:

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$$\tilde{x} = \sqrt[s]{x}, \qquad (4)$$

where $\tilde{x}$ – is the transformed value of the indicator;

s – is the transformation ratio (from 2 to 4, depending on the value of the asymmetry coefficient).

Since all the indicators in the group are of different sizes, to ensure the representativeness of the assessment results, it is necessary to carry out a rationing procedure, the results of which will result in a system of homogeneous and comparable data:

$$I_{norm} = \frac{x - x_{min}}{x_{max} - x_{min}} \qquad (5)$$

where I_{norm} – is the normalized indicator value;
x – is the actual value of the indicator;
x_{min} (x_{max}) – is the minimum (maximum) value of the indicator.

After the procedures of smoothing and rationing indicators within the group are held, the value of the subindexes can be determined by the arithmetic average formula:

$$S = \frac{\sum_{i=1}^{n} I_{norm\ i}}{n} \qquad (6)$$

where S – is the sub-index value in the thematic area of the group of normalized indices;
n – is the number of normalized indices in the group;
$I_{norm\ i}$ – is the value of the i normalized index.

The final index of the level of innovation development of the regional economic system is calculated by the formula:

$$I_{RIS} = \sum_{j=1}^{m} w_j \cdot S_j \qquad (7)$$

where I_{RIS} – is a complex characteristic of the level of innovative development of a regional economic system;
m – is the number of sub-indices;
w_j – is the weight coefficient of the j subindex;
S_j – is the value of the j subindex.

The calculation of the final index of RIS development should be determined by taking into account the weights of sub-indices, which, in our opinion, it is fair to establish as follows: sub-index "Innovation potential" - 0.15, sub-index "RIS development factors" - 0.2, sub-index "Innovative activity" 0.25, sub-index "Results" - 0.4.

$$I_{RIS} = 0.15 \cdot S_P + 0.2 \cdot S_C + 0.25 \cdot S_A + 0.4 \cdot S_R \quad (8)$$

The high weight of the subindex characterizing the results of RIS functioning is determined by the economic value of the indicators of this group. We explain this distribution by the fact that the effectiveness of innovation activity is the goal of forming a regional innovation system and the main condition for increasing the competitiveness of a region and developing its economy. At the same time, Russian practice shows that the value of the innovation potential often does not correspond to the level of development of the innovation system. This determines the low weight of the subindex in the final structure of the region's innovative development index. The value of the integral index determines the level of development of the regional economic system.

III. RESULT ANALYSIS

A. Approbation of The Author's Assessment Method on The Example of The Regions of The Central Federal District

The proposed RIS assessment method was tested on the example of the regions of the Central Federal District of Russia. The table below shows the rating of regions based on the values of the final integral index.

The results of the evaluation are subject to further analysis in order to identify the "weak points" of the RIS and it is important for the development of innovative policy in the region.

Analysis of the assessment results is the basis for the development of innovation policy and the most important element of the mechanism for managing the innovative development of the regional economic system. The results of the analysis allow us to identify problem areas of the entire system and determine the growth directions [46].

Table 1. Results of the evaluation of innovation systems of the regions of the Central Federal District

I_{RIS} Grade	Region	I_{RIS} Index value	P Grade	C Grade	A Grade	R Grade
1	Moscow	.6813	1	3	1	1
2	Kaluga oblast	.5639	4	1	3	3
3	Lipetsk oblast	.5158	5	10	2	4
4	Moscow oblast	.5121	3	2	5	6
5	Tula oblast	.4876	15	5	8	2
6	Vladimir oblast	.4641	9	9	4	5
7	Belgorod oblast	.4384	8	7	7	7
8	Yaroslavl oblast	.4066	6	11	10	8
9	Voronezh oblast	.4036	16	6	9	9
10	Ryazan oblast	.3632	10	13	6	12
11	Tambov oblast	.3496	14	4	12	14
12	Bryansk oblast	.3411	12	8	17	10
13	Tver oblast	.3188	13	14	11	17
14	Oryol oblast	.3098	11	15	13	15
15	Kursk oblast	.3040	17	12	16	11
16	Smolensk oblast	.3001	7	16	15	16
17	Ivanovo oblast	.2987	2	17	18	13
18	Kostroma oblast	.2073	18	18	14	18

As evidenced by the data obtained during the assessment, in some regions there is a significant deviation in one or several values of sub-indices in comparison with the value of the final index. In our opinion, the RIS assessment should be more developed and the generalized values of subindexes should be taken into account, which is dictated by the peculiarities of significant differentiation inherent in the Russian region. Such an approach to assessing the level of RIS development will provide a comprehensive multilateral study of all its components and will allow to increase the effectiveness of regional innovation policy.

Assessing the innovative development of regional economic systems will determine the effectiveness of the generated RIS, and analyzing the dynamics of the data is the basis for developing organizational and management decisions to improve their effectiveness.
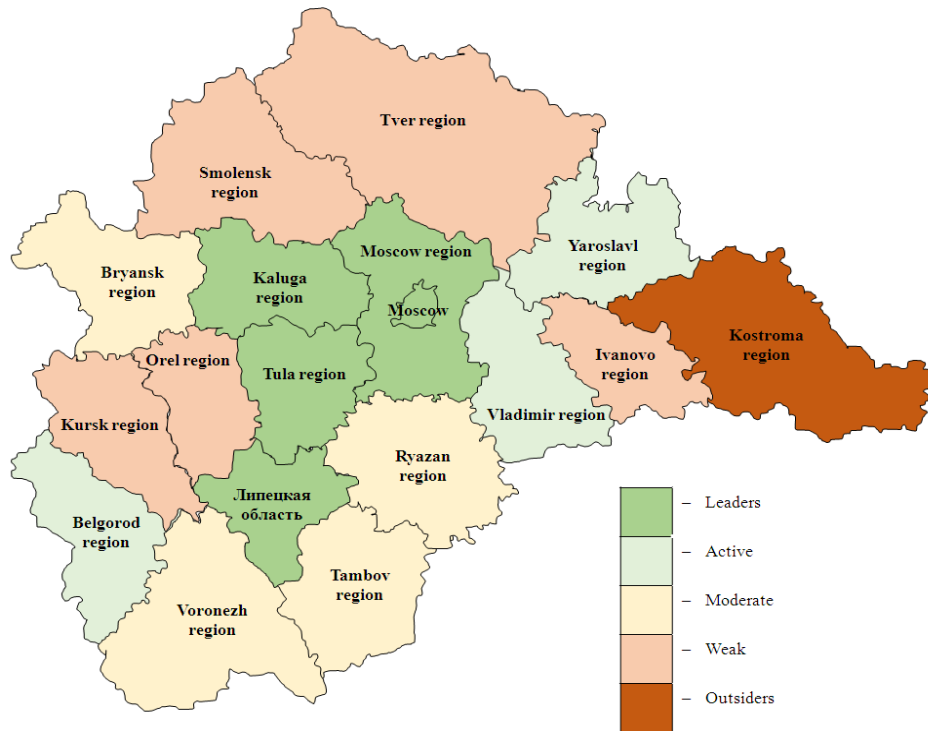
B. Regional Typology by The Level of RIS Development

Depending on the results of the assessment, different types of regions are identified based on the level of RIS development. To assess the proximity of regions by the level of RIS development, the authors of the study conducted a cluster analysis based on the division of regions into groups based on the value of the final index. It is proposed to allocate five groups:

1. "Leaders" - regions, the level of RIS development of which is more than 120% than the average for the studied group.

2. "Active Innovators" - the RIS development index is in the range of 100-120% of the group average.

3. "Moderate innovators" - the RIS development index is in the limit of 80-100% of the group average.

4. "Restrained innovators" - the RIS development index is in the range of 60-80% of the group average.

5. "Outsiders" - regions, the level of development of which RIS is less than 60% than the average for the group.

The innovation map of the regions of the Central Federal District in accordance with the typology developed on the basis of the RIS development levels established during the assessment is presented in the figure below.

Fig. 2. Grouping of the regions of the Central Federal District depending on the level of RIS development

The RIS typology by level of development is important, since it contributes to increasing the adoption of innovative processes in their wider socio-economic context. Innovation policy can be a direct incentive for interaction between the subjects of innovation activity [47]. This is particularly relevant when considering the relationship between sustainable innovation and economic performance. In this regard, it is important to take into account the fact that sustainable innovations have different meanings in different contexts [48]. A strategy for the prospective innovation development of the socio-economic system of a region should be developed taking into account the results of an assessment of its current state [16].

IV. DISCUSSION

The system of assessing the effectiveness of RIS as an element of the mechanism for managing its development performs a control function. At the same time, the results of the evaluation are a link, whose role is to compare the achieved indicators with the planned guidelines for the development of RIS. Since different types of RISs face specific challenges and obstacles to development, strategies and policies should be targeted and aligned with the relevant conditions [15]. Thus, the results of evaluating the effectiveness of the innovation system of the region are considered as the basis for the development of management decisions for determining the directions of its development.

In determining the directions for improving regional innovation activity, the external competitive environment should be taken into account, that is, the degree of innovation orientation of the socio-economic parameters of the region's development [49].

Table 2 suggests the directions of innovation policy, taking into account the identified features of RIS.

Table 2. Types of regions for the innovation policy

RIS types	Regions of the Central Federal district	RIS strategy	Directions of the innovation politics
leaders	Moscow Kaluga oblast Lipetsk oblast Moscow oblast Tula oblast	improving the position of the regional economy in the global economy of knowledge	– increasing of RIS international attractiveness – science-based and radical innovations – development of innovative forecasts and foresight
Active innovators	Vladimir oblast Belgorod oblast Yaroslavl oblast	formation of an innovative economy	– creation of new innovative enterprises – expanding the interaction between the business sector and the scientific community (knowledge providers)

Moderate innovators	Voronezh oblast Ryazan oblast Tambov oblast Bryansk oblast	regional economy update	– focus on fast-growing and innovative firms – comprehensive stimulation of innovation – further development of indirect measures to stimulate innovation
Restrained innovators	Tver oblast Oryol oblast Kursk oblast Smolensk oblast Ivanovo oblast	modernization of the regional economy	– strengthening RIS innovative potential – development of small innovative entrepreneurship – development of innovation infrastructure
outsiders	Kostroma oblast	strengthening the regional economy	– strategy of "catching up behavior" of leaders and active innovators – development of the regulatory framework governing innovation – increasing the strategic and innovative potential of the region

The typology of innovation systems remains an important area of innovation policy, just as the work on systemic innovation and innovation systems emphasizes the inculcation of firms' innovation processes in their wider socio-economic context [48]. This is particularly relevant when considering the relationship between sustainable innovation and economic performance.

V. CONCLUSION

Most modern approaches to assessing the level of RIS development are based on the calculation of the innovation index of a territory, the value of which is formed from several sub-indices. A subindex is a final value (most often an arithmetic average or weighted average) of primary indicators characterizing the state of the regional innovation system in a particular direction. Each methodology has an individual system of primary indicators of innovative development of the territory and a unique structure of the final index. But at the same time, each of the studied approaches has a number of advantages and disadvantages, which once again underlines the relevance of the research topic and necessitates the improvement of the methodology for assessing the level of development of RIS.

Evaluation of the development of the innovation system is a necessary element of the state regional policy and provides a sufficient basis for decision-making in terms of managing its development. The author's approach to the assessment procedure is based on international experience, taking into account the advantages of the most well-known methods, while, if possible, leveling the shortcomings of the latter. Thus, the advantage of the method presented in the work is the use of different weights of subindexes in the structure of the final indicator.

The author's approach can be implemented both for the assessment of a separate RIS and applied to a group of regions, which will allow them to build an innovation rating (the assessment steps and the analysis procedures are the same). In addition, the analysis of the results obtained may be broader than that presented, which is determined by the goals set. In particular, to determine the strengths and weaknesses of a separate RIS, attention should be focused on analyzing the structure of the final index, to assess the region's position on the level of innovative development it is necessary to conduct a ranking procedure; to build a trend line it is important to analyze the dynamics of the indicators.

REFERENCES

1. A. E. Skhvediani, T. Y. Kudryavtseva. The Socioeconomic Development of Russia: Some Historical Aspects. *European Research Studies Journal,* vol. 21(4), 2018, 195–207.
2. I. Kuzovleva, V. Alekseenko, T. Filippova, T. Kudryavtseva. Efficiency of construction cluster innovative potential management. *IOP Conference Series: Materials Science and Engineering,* vol. 497(1), 2019, 012033
3. V. Schepinin, A. Skhvediani, T. Kudryavtseva. An empirical study of the production technology cluster and regional economic growth in Russia. In M. P. C. Amorim, C. Costa, & M. Au-Yong-Oliveira (Eds.), *Proceedings of the European Conference on Innovation and Entrepreneurship, ECIE* (pp. 732–740). Academic Conferences and Publishing International Limited, 2018.
4. M.S. Gertler. Rules of the game: The place of institutions in regional economic change. *Regional Studies, vol.* 44, 2010, pp. 1–15.
5. B-E. Lundvall. National Systems of Innovation: Towards a Theory of Innovation and Interactive Learning, London: Pinter, 1992.
6. B-E. Lundvall, J. Bjern, S.A. Esben, D. Bent. National System of Production, Innovation and Competence Building. *Research Policy*, vol. 31, 2002, pp. 213–231.
7. R. Nelson. National Innovation Systems: A Comparative Analysis. Oxford, UK and New York, NY: Oxford University Press, 1993.
8. J. Niosi, P. Saviotti, B. Bellon, M. Crow. National systems of innovation. In search of a workable concept. *Technology in Society, vol.* 15, 1993, pp. 207–227.
9. OECD. Managing National Innovation Systems. OECD, Paris, 1999.
10. P. Cooke. Regional innovation systems: Competitive regulation in the new Europe. *Geoforum*, vol. 23(3), 1992, pp. 365–382
11. P. Cooke. Introduction: Origins of the concept. In: Braczyk H-J, Cooke P and Heidenreich M (eds) Regional Innovation Systems: The Role of Governances in a Globalized World. London, UK: UCL Press, 1998, pp. 2–27.
12. P. Cooke. Evolution of regional innovation systems – Emergence, theory, challenge for action. In: Cooke P, Heidenreich M and Braczyk H-J (eds) Regional Innovation Systems: The Role of Governances in a Globalized World, 2nd ed. Abingdon, UK and New York, NY: Routledge, 2004, pp. 1–18.
13. M.E. Porter. Clusters and the new economics of competition. *Harvard Business Review*, vol. 76(6), 1998, pp. 77–91.
14. M.E. Porter. The performance of regions. *Regional Studies, vol.* 37(6/7), 2003, pp. 549–578.
15. A. Isaksen, F. Tödtling, M. Trippl. Innovation policies for regional structural change: Combining actor-based and system-based strategies. In *New Avenues for Regional Innovation Systems-Theoretical Advances, Empirical Cases and Policy Lessons*, pp. 221-238. Springer, Cham, 2018.

Retrieval Number: C5714098319/2019©BEIESP
DOI:10.35940/ijrte.C5714.098319
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16. P. McCann, R. Ortega-Argilés. Modern regional innovation policy. *Cambridge Journal of Regions, Economy and Society*, vol. *6*(2), 2013, pp. 187-216.
17. M.-J. Aranguren, E. Magro J.R. Wilson. Regional competitiveness policy in an era of smart specialisation strategies. In: Huggins R and Thompson P (eds) Handbook of Regions and Competitiveness. Cheltenham: Edward Elgar, 2017, pp. 546–564.
18. E. V. Frank, O.V. Mashevskaya, L. V. Ermolina. Innovational Mechanism of Implementation of Cluster Initiatives in Business. *European Research Studies*, vol. *19*(1), 2016, 179.
19. N.Y. Azarenko, V.V. Kovalevsky E.D. Serova. Formation of an effective mechanism for managing the development of human capital as the basis for a regional economy. *Scientific and theoretical journal «Bulletin of BSTU. V.G. Shukhov»,* vol. 2, 2017, pp. 260-267
20. E.M. Kozlova. Innovative potential as a factor of competitiveness. *European Social Science Journal,* vol. 8, 2015, pp. 45-49.
21. B.T. Asheim, A. Isaksen. Location, agglomeration and innovation: towards regional innovation systems in Norway? *European planning studies*, vol. *5*(3), 1997, pp. 299-330.
22. D. Doloreux. Regional innovation systems in the periphery: the case of the Beauce in Quebec (Canada). *International Journal of Innovation Management*, vol. 7 (1), 2003, pp. 67 – 94.
23. D. Doloreux. Regional innovation systems in Canada: a comparative study. *Regional studies*, vol. 38(5), 2004, pp. 479-492.
24. A. Koch, T. Stahlecker. Regional innovation systems and the foundation of knowledge intensive business services. A comparative study in Bremen, Munich, and Stuttgart, Germany. *European Planning Studies*, vol. *14*(2), 2006, pp. 123-146.
25. X. Li. Specialization, institutions and innovation within China's regional innovation systems. *Technological Forecasting and Social Change*, vol. *100*, 2015, pp. 130-139.
26. R. Boschma, K. Frenken. Technological relatedness and regional branching. In: Bathelt H, Feldman M and Kogler D (eds.) Beyond Territory. Dynamic geographies of knowledge creation, diffusion, and innovation. London: Routledge, 2011, pp. 64-81.
27. F. Tödtling, M. Trippl. One Size Fits All? Towards a Differentiated Regional Innovation Policy Approach. *Research Policy*, vol. 34(8), 2005, pp. 1203-1219.
28. A. Asheim, R. Boschma, P. Cooke. Constructing Regional Advantage: Platform Policies Based on Related Variety and Differentiated Knowledge Bases. *Regional Studies,* vol. 45(7), 2011, pp. 893-904.
29. A. Isaksen, M. Trippl. Path Development in Different Regional Innovation Systems. In: Parrilli MD, Fitjar RD and Rodriguez-Pose A (eds.) Innovation Drivers and Regional Innovation Strategies, Routledge: New York and London, 2016, pp. 66-84
30. P. Cooke, P. Boekholt, F. Todtling. The Governance of Innovation in Europe. Pinter, London, 2000.
31. A. Isaksen. Building regional innovation systems: is endogenous industrial development possible in the global economy? *Canadian Journal of Regional Science,* vol. 1, 2001, pp. 101–120.
32. C. Nauwelaers, R. Wintjes. Towards a new paradigma for innovation policy? In: Asheim, B., Isaksen, A., Nauwelaers, C., Todtling, F. (Eds.), Regional Innovation Policy for Small–Medium Enterprises. Edward Elgar, Cheltenham, 2003, pp. 193–220.
33. D. Foray. Smart Specialisation: Opportunities and Challenges for Regional Innovation Policy. Abingdon, UK and New York, NY: Routledge, 2014.
34. P. McCann. The Regional and Urban Policy of the European Union: Cohesion, Results-Orientation and Smart Specialisation. Cheltenham, UK and Northampton, MA: Edward Elgar, 2015.
35. R. Camagni, R. Capello. Regional innovation patterns and the EU regional policy reform: Toward smart innovation policies. *Growth and change*, vol. *44*(2), 2013, pp. 355-389.
36. The Global Innovation Index 2016. Available: http://www.wipo.int/edocs/pubdocs/en/wipo_pub_gii_2016.pdf
37. European Innovation Scoreboard, 2016. European Commission. 2016. Available: ETAY16001ENN.en.pdf
38. Crossing the Next Regional Frontier. *Information and Analytics Linking Regional Competitiveness to Investment in a Knowledge-Based Economy*, 2009.
39. GE «Global innovation barometer-2016». GE at work General electric. Available: https://www.ge.com/reports/innovation-barometer-2016/
40. M. Gokhberg. Rating of innovative development of subjects of the Russian Federation. Issue 4; NAT. research. University "Higher school of Economics", 2016.
41. Association of innovative regions of Russia (2017). Rating of innovative regions. Available: http://i-regions.org/eng/
42. I. Rudskaia. A regional innovation system: Formation features and growth areas (case study: St. Petersburg). Proceedings of the 30th International Business Information Management Association Conference, IBIMA 2017 - Vision 2020: Sustainable Economic development, Innovation Management, and Global Growth, 2017a, pp. 541-547
43. I. Rudskaia. Regional innovation foresights: drivers and barriers for development. Proceedings of the 30th International Business Information Management Association Conference, IBIMA 2017 - Vision 2020: Sustainable Economic development, Innovation Management, and Global Growth, 2017b, pp. 889-903
44. A. Bychkova, I. Rudskaia. Assessing the efficiency of a regional innovation system as one of the models for running an innovative business. *ACM International Conference Proceeding Series*, 2018, pp. 208-212
45. J.M. Zabala-Iturriagagoitia, P. Voigt, A. Gutiérrez-Gracia, F. Jiménez-Sáez. Regional innovation systems: how to assess performance. *Regional Studies*, vol. *41*(5), 2007, pp. 661-672.
46. M. Trippl, B. Asheim, J. Miörner. Identification of regions with less developed research and innovation systems. *Innovation Drivers and Regional Innovation Strategies*, vol. *40*, 2016, p. 23.
47. J.P.J. De Jong, T. Kalvet, W. Vanhaverbeke. Exploring a theorethical framework to structure the public policy implications of open innovation. *Technology Analysis & Strategic Management*, vol. 22(8), 2010, pp. 877–896.
48. F. Boons, C. Montalvo, J. Quist, M. Wagner. Sustainable innovation, business models and economic performance: an overview. *Journal of Cleaner Production,* vol. 45, 2013, pp. 1-8.
49. H.J. Braczyk, P.N. Cooke, M. Heidenreich. (Eds.). *Regional innovation systems: the role of governances in a globalized world*. Psychology Press, 1998.