

Integrated Economic and Mathematical Approach to Regulation of Clustering and Innovative Development of Russian Regions

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Abstract—The article discusses the features and contradictions of clustering and innovative development, as well as the integrated approach to regulation of clustering processes at the regional level. The author's approach to the development of an integrated clustering model of the economic space of the Russian regions is to consider innovative clusters as the fundamental segments of innovative economy. Within the framework of the study comprehensive methodology for assessing the innovative potential of regions is considered. The article deals with the analysis of economic, financial, scientific and technological conditions for regulating clustering processes and innovative development on example of the Volga region. The scientific novelty of the work lies in the method of complex analysis of the potential of innovative development of regions. The proposed methodology includes both indicators for assessing the factors of formation of a new innovative economy, and indicators of the effectiveness of innovative development, which form the technological and resource reserve for further economic development of the region. The advantage of using proposed methodology is the possibility of separating for each economic district and interregional cluster the leading regions, which acts as the center of innovative transformation of the economic space of the neighboring regions.

Keywords—*cluster policy, Volga region, economic development, innovative cluster, regional economy*

I. INTRODUCTION

To date, cluster formation is a widely recognized tool in world science and management practice that accompanies innovative development and increases the competitiveness of regions [1]. In modern conditions, increasing the region's competitiveness through innovative transformation is a fundamental element of development strategies in most of the majority of countries [2]. The rapidly expanding number of

cluster initiatives in both industrialized and developing regions of Russia reflects their effectiveness [3]. In modern economic conditions, the use of the cluster approach has already taken one of the key places in the strategies of socio-economic development of a number of regions of the Volga region [4]. The economic space of the Volga region is also significantly differentiated by the level of innovative development and the degree of production clustering [5].

The main directions, mechanisms and tools for achieving the strategic goals of innovative development of the Volga Federal district provide for the implementation of measures to overcome the following factors and problems:

- strengthening global competition that covers not only traditional markets for goods, capital, technology, and labor, but also national governance systems, innovation support, and human development [6];
- expected new wave of technological changes that strengthen the role of innovation in socio-economic development and reduce the impact of many traditional growth factors;
- increasing role of human capital as the main factor of economic development;
- exhaustion of the potential of the export-raw material model of economic development based on the accelerated increase in fuel and raw material exports.

II. PROBLEM STATEMENT

A significant number of works by leading researchers and research teams are devoted to the study of clustering economy [7]. At the same time, the processes of innovative development in the Volga region and their relationship with

the cluster policy of regional development remain insufficiently studied [8]. The need for a detailed assessment of the processes of changing the innovation potential of the Volga region regions at the first stage of implementing cluster policy in the Russian Federation determined the purpose and objectives of this study.

III. RESEARCH QUESTIONS

It seems appropriate to develop a system of indicators for evaluating innovative regional innovation systems.

No less important for the study is analysis of the potential for innovative development of the Volga region regions in the context of clustering features of their economic systems.

Defining the features of innovative transformation of the Volga region's economic space will help to explain the contradictions of cluster development.

IV. PURPOSE OF THE STUDY

The aim of the study is to develop economic and mathematical approach to the regulation of clustering and

innovative development of region, as well as features of the spatial distribution of the potential for the formation of an innovative economy in the context of cluster policy.

V. RESEARCH METHODS

To assess the innovative transformation of the economic systems of the Volga region regions, the author developed a method for a comprehensive analysis of the potential of innovative development of the regions [9]. The proposed methodology includes both indicators for assessing the factors of formation of a new innovative economy, and indicators of the effectiveness of innovative development, which form the technological and resource reserve for further economic development of the region [10]. The final index of the region's innovative development potential (IRIDP) is formed on the basis of four subindices that reflect the key factors and directions of development of the innovative economy. These subindex in turn are formed from the second level subindexes and separate indicators of innovative development of the region [11]. Indicators and subindexes of the potential for innovative development of regions are presented in Table I.

TABLE I. INDICATORS AND SUB-INDICES OF THE REGION'S INNOVATIVE DEVELOPMENT POTENTIAL

Indicators and sub-indices of the region's innovative development potential	Convention
1. Economic potential of innovative development of the region	IEP-1
1.1. Economic development of the region	IEP-1.1
1.1.1. Gross regional product per employed resident of the region	IEP-1.1.1
1.1.2. The coefficient of renewal of fixed assets in the region	IEP-1.1.2
1.2. Effectiveness of innovative development of the region	IEP-1.2
1.2.1. Share of innovative goods, works, and services in the total volume shipped by industrial enterprises	IEP-1.2.1
1.2.2. Share of innovative goods, works, and services new to the market that have been newly introduced or have undergone significant technological changes in the total volume shipped by industrial enterprises	IEP-1.2.2
2. Personnel potential of innovative development of the region	IHRP-2
2.1. Human resources potential of the knowledge-intensive and high-tech sectors of the economy	IHRP-2.1
2.1.1. Share of employees in high-tech industries in the total number of employees	IHRP-2.1.1
2.1.2. Share of employees in knowledge-intensive service industries in the total number of employees	IHRP-2.1.2
2.2. Educational potential of the region	IHRP-2.2
2.2.1. Share of the population with higher education in the total economically active population of the region	IHRP-2.2.1
2.2.2. Number of students enrolled in higher education programs by 10 thousand. inhabitant of region	IHRP-2.2.2
2.3. Personnel potential of regional science	IHRP-2.3
2.3.1. The ratio of the average wages of employees engaged in R&D in the average salaries in the region	IHRP-2.3.1
2.3.2. Share of employees engaged in R&D in the average annual number of employees in the region	IHRP-2.3.2
2.3.3. The share of young researchers total number of researchers in the region	IHRP-2.3.3
2.3.4. The ratio of researchers with a degree in the total number of researchers in the region	IHRP-2.3.4
3. Financial potential of innovative development of the region	IFP-3
3.1. Budget financing of innovative development of the region	IFP-3.1
3.1.1. Share of expenditures on civil science from the consolidated budget of the region in the total amount of expenditures	IFP-3.1.1
3.1.2. Share of expenditures of the consolidated budget of the region in the total amount of expenditures on technological innovations	IFP-3.1.2
3.1.3. Ratio of Federal subsidies for the development of innovative infrastructure to the gross regional product	IFP-3.1.3
3.2. The R&D funding at the expense of own funds of organizations	IFP-3.2
3.2.1. Internal costs on research and development in % to gross regional product	IFP-3.2.1
3.2.2. Internal costs on research and development per researcher in the region	IFP-3.2.2
3.2.3. Share of expenses of commercial organizations in the total volume of internal expenses of organizations for R&D	IFP-3.2.3
3.2.4. Intensity of expenditures on technological innovations by industrial enterprises	IFP-3.2.4
4. Scientific and technological potential of innovative development of the region	ISTP-4
4.1. Scientific potential of innovative development of the region	ISTP-4.1
4.1.1. Number of published scientific articles per 10 researchers in the region	ISTP-4.1.1
4.1.2. Number of patent applications for inventions per 1 million of the economically active population of the region	ISTP-4.1.2
4.1.3. Number of advanced production technologies created per 1 million people of the economically active population of the region	ISTP-4.1.3
4.1.4. The ratio of the volume of revenues from technology exports to the gross regional product	ISTP-4.1.4
4.2. Technological potential of innovative development of the region	ISTP-4.2

Indicators and sub-indices of the region's innovative development potential	Convention
4.2.1. Share of industrial enterprises that implemented technological innovations	ISTP-4.2.1
4.2.2. Share of industrial enterprises that implemented organizational and marketing innovations	ISTP-4.2.2
4.2.3. Share of industrial enterprises that have developed and implemented technological innovations on their own	ISTP-4.2.3
4.2.4. Share of industrial enterprises implementing joint research projects	ISTP-4.2.4
4.2.5. Share of small enterprises that implemented technological innovations	ISTP-4.2.5

Note: Developed by the authors

When calculating the region's innovation development potential index (IRIDP), as well as sub-indices of both levels, all indicators are used with equal weight coefficients. At the same time, the initial values of indicators should be normalized in order to be able to use them within a single methodology. Accordingly, the region's innovation development potential index (IRIDP) is calculated using the following formula:

$$IRIDP^r = \frac{1}{n} \sum_{i=1}^n \frac{x_i^r - x_i^{min}}{x_i^{max} - x_i^{min}} \quad (1)$$

Where: $IRIDP^r$ – index of innovative development potential of the r -th region; n – number of indicators of the region's innovative development potential used for calculating the final index ($n=28$); x_i^r – value of the i -th indicator of innovative development potential in the r -th region; x_i^{max} – the highest

value of the i -th indicator of innovative development potential in the analyzed sample; x_i^{min} – the lowest value of the i -th indicator of innovative development potential in the analyzed sample.

VI. FINDINGS

It can be concluded that the most active cluster policy is implemented by such regions as the Republic of Tatarstan, Perm, Penza and Ulyanovsk regions. Cluster initiatives are noted in such traditional economic centers of the Volga region as the Nizhny Novgorod and Samara regions, the Republic of Bashkortostan. The “outsider regions” in the implementation of cluster policy include the Republic of Mari El, the Kirov and Orenburg regions. We can observe a similar distribution of regions into leaders and outsiders when analyzing the dynamics of the regional innovation development potential index (IRIDP) presented in Table II.

TABLE II. INDEX OF INNOVATIVE DEVELOPMENT POTENTIAL OF THE VOLGA REGION REGIONS

Region	2013	2014	2015	2017
VOLGA FEDERAL DISTRICT	0.344	0.357	0.355	0.356
VOLGA-KAMA MACROREGION	0.345	0.368	0.369	0.373
<i>Volga-Vyatka economic region</i>	<i>0.355</i>	<i>0.382</i>	<i>0.388</i>	<i>0.392</i>
<i>Nizhny Novgorod interregional cluster</i>	<i>0.384</i>	<i>0.435</i>	<i>0.424</i>	<i>0.426</i>
Nizhny Novgorod region	0.404	0.418	0.422	0.480
Republic of Mordovia	0.364	0.452	0.427	0.373
<i>Kazan interregional cluster</i>	<i>0.340</i>	<i>0.356</i>	<i>0.369</i>	<i>0.375</i>
Republic of Tatarstan	0.435	0.467	0.490	0.480
The Mari El Republic	0.282	0.294	0.308	0.332
Chuvash Republic	0.388	0.387	0.409	0.390
Kirov region	0.255	0.275	0.269	0.299
<i>Kama district</i>	<i>0.316</i>	<i>0.324</i>	<i>0.313</i>	<i>0.315</i>
Perm region	0.363	0.360	0.354	0.346
Udmurt republic	0.268	0.287	0.272	0.285
VOLGA-URAL MACROREGION	0.343	0.342	0.336	0.332
<i>Middle Volga region</i>	<i>0.361</i>	<i>0.350</i>	<i>0.339</i>	<i>0.345</i>
<i>Samara interregional cluster</i>	<i>0.399</i>	<i>0.376</i>	<i>0.370</i>	<i>0.366</i>
Samara region	0.376	0.364	0.379	0.346
Ulyanovsk region	0.423	0.389	0.361	0.386
<i>Saratov interregional cluster</i>	<i>0.323</i>	<i>0.323</i>	<i>0.309</i>	<i>0.324</i>
Saratov region	0.274	0.290	0.295	0.287
Penza region	0.372	0.357	0.322	0.360
<i>South Cis-Ural region</i>	<i>0.308</i>	<i>0.326</i>	<i>0.328</i>	<i>0.307</i>
Republic of Bashkortostan	0.347	0.392	0.408	0.366
Orenburg region	0.269	0.261	0.248	0.247

Note: Developed by the authors

The author combined the Volga regions into macro-regions, districts, and interregional clusters based on previous research. In each group, you can identify the “leading region” and lagging regions. We can conclude that there is a fairly strong heterogeneity of regions in terms of the average level and direction of the dynamics of the index values. The high

value of the index and its positive dynamics over the analyzed period are demonstrated by only two regions: Nizhny Novgorod region and the Republic of Tatarstan. Consider the dynamics of the economic potential of the Volga regions, the subindexes of the economic potential of innovative development are presented in Table III.

TABLE III. ECONOMIC POTENTIAL OF INNOVATIVE DEVELOPMENT OF THE VOLGA REGION REGIONS

Region	IEP-1				IEP-1.1				IEP-1.2			
	2013	2014	2015	2017	2013	2014	2015	2017	2013	2014	2015	2017
VOLGA FEDERAL DISTRICT	0.16	0.22	0.31	0.24	0.21	0.23	0.32	0.22	0.11	0.22	0.31	0.26
VOLGA-KAMA MACROREGION	0.16	0.23	0.34	0.27	0.20	0.20	0.30	0.21	0.13	0.26	0.38	0.33
<i>Volga-Vyatka economic region</i>	<i>0.17</i>	<i>0.26</i>	<i>0.38</i>	<i>0.28</i>	<i>0.20</i>	<i>0.20</i>	<i>0.29</i>	<i>0.19</i>	<i>0.14</i>	<i>0.32</i>	<i>0.47</i>	<i>0.36</i>
<i>Nizhny Novgorod interregional cluster</i>	<i>0.19</i>	<i>0.28</i>	<i>0.42</i>	<i>0.29</i>	<i>0.18</i>	<i>0.20</i>	<i>0.26</i>	<i>0.15</i>	<i>0.20</i>	<i>0.35</i>	<i>0.59</i>	<i>0.42</i>
Nizhny Novgorod region	0.18	0.23	0.29	0.25	0.20	0.28	0.29	0.19	0.16	0.18	0.28	0.32
Republic of Mordovia	0.21	0.33	0.56	0.32	0.17	0.13	0.22	0.11	0.25	0.53	0.89	0.53
<i>Kazan interregional cluster</i>	<i>0.15</i>	<i>0.25</i>	<i>0.36</i>	<i>0.27</i>	<i>0.20</i>	<i>0.20</i>	<i>0.31</i>	<i>0.21</i>	<i>0.10</i>	<i>0.30</i>	<i>0.41</i>	<i>0.33</i>
Republic of Tatarstan	0.29	0.35	0.53	0.41	0.37	0.41	0.54	0.42	0.21	0.30	0.52	0.39
The Mari El Republic	0.12	0.36	0.44	0.30	0.20	0.14	0.21	0.12	0.04	0.59	0.67	0.49
Chuvash Republic	0.13	0.12	0.30	0.22	0.15	0.08	0.29	0.14	0.10	0.16	0.31	0.29
Kirov region	0.08	0.15	0.18	0.16	0.10	0.15	0.21	0.16	0.07	0.15	0.15	0.16
<i>Kama district</i>	<i>0.15</i>	<i>0.16</i>	<i>0.22</i>	<i>0.25</i>	<i>0.20</i>	<i>0.22</i>	<i>0.32</i>	<i>0.25</i>	<i>0.09</i>	<i>0.11</i>	<i>0.12</i>	<i>0.25</i>
Perm region	0.18	0.16	0.26	0.28	0.22	0.23	0.37	0.27	0.14	0.09	0.14	0.29
Udmurt republic	0.11	0.17	0.18	0.22	0.18	0.21	0.28	0.23	0.05	0.12	0.09	0.21
VOLGA-URAL MACROREGION	0.16	0.21	0.28	0.21	0.23	0.27	0.34	0.24	0.08	0.15	0.22	0.17
<i>Middle Volga region</i>	<i>0.16</i>	<i>0.20</i>	<i>0.29</i>	<i>0.22</i>	<i>0.21</i>	<i>0.27</i>	<i>0.31</i>	<i>0.23</i>	<i>0.11</i>	<i>0.13</i>	<i>0.26</i>	<i>0.21</i>
<i>Samara interregional cluster</i>	<i>0.21</i>	<i>0.22</i>	<i>0.37</i>	<i>0.27</i>	<i>0.24</i>	<i>0.24</i>	<i>0.34</i>	<i>0.26</i>	<i>0.18</i>	<i>0.21</i>	<i>0.39</i>	<i>0.29</i>
Samara region	0.24	0.31	0.44	0.31	0.27	0.29	0.36	0.29	0.22	0.32	0.53	0.33
Ulyanovsk region	0.17	0.14	0.29	0.23	0.21	0.18	0.33	0.22	0.14	0.10	0.24	0.24
<i>Saratov interregional cluster</i>	<i>0.11</i>	<i>0.17</i>	<i>0.21</i>	<i>0.17</i>	<i>0.17</i>	<i>0.30</i>	<i>0.29</i>	<i>0.21</i>	<i>0.04</i>	<i>0.05</i>	<i>0.13</i>	<i>0.14</i>
Saratov region	0.09	0.12	0.18	0.13	0.15	0.20	0.27	0.22	0.04	0.03	0.09	0.05
Penza region	0.12	0.23	0.23	0.21	0.20	0.40	0.30	0.20	0.04	0.06	0.17	0.23
<i>South Cis-Ural region</i>	<i>0.16</i>	<i>0.24</i>	<i>0.26</i>	<i>0.18</i>	<i>0.28</i>	<i>0.28</i>	<i>0.38</i>	<i>0.26</i>	<i>0.04</i>	<i>0.20</i>	<i>0.14</i>	<i>0.09</i>
Republic of Bashkortostan	0.17	0.34	0.30	0.19	0.28	0.31	0.37	0.26	0.06	0.38	0.24	0.13
Orenburg region	0.15	0.13	0.22	0.16	0.28	0.25	0.39	0.26	0.01	0.01	0.05	0.06

Note: Developed by the authors

Consider the dynamics of the second-level subindex “1.1. Economic development of the region”, which includes indicators of the gross regional product per employed resident and the coefficient of renewal of fixed assets. For all regions, there is a significant increase in the values of the subindex in 2015 and an equally significant decrease in the software in 2017 compared to 2015. For the second-level sub-index “1.2. Effectiveness of innovative development of the region” (characterizes the share of innovative and newly introduced goods, works, and services), there are generally similar trends with more stable growth over the analyzed five-year period.

Comparison of regions based on quantitative values of indicators included in the second-level subindex “1. The economic potential of innovative development” and their dynamics allowed us to draw the following conclusions. We note the key role of the Republic of Tatarstan for the innovative development of the entire Volga-Kama region, as well as the activation of innovative effects within the selected Kazan interregional cluster. Tatarstan is also one of the most active regions of Russia in implementing cluster initiatives. The high performance of the Republic of Mari El is explained by the system-forming role of large high-tech enterprises, including the military-industrial complex, for the economy of a small territory and population of the Republic. The Chuvash Republic is characterized by a developed electrical engineering cluster and a number of cluster initiatives in the field of high-tech manufacturing industries.

Rather high values of subindexes for the Republic of Mordovia against the background of the more developed Nizhny

Novgorod region are due, among other things, to the active development of the electrical industry. These regions have sufficient economic potential for interregional integration and the formation of both independent and joint cluster initiatives with other regions. In the Kama region, we note the leading role of the Perm region, which also shows sufficient activity in the cluster policy of economic development, while the Republic of Udmurtia is characterized by the concentration of large-scale production within a single machine-building cluster. In the Middle Volga region, the leading role is played by the Samara region. The Saratov and Orenburg regions lag behind other regions both in terms of the economic potential of innovative development and in the use of cluster mechanisms for economic growth. We also consider the values of the subindexes of human resources potential [12] for innovative development of the Volga region regions, presented in Table IV.

The values of the subindex “2.1. Personnel potential of the knowledge-intensive and high-tech sectors of the economy” show growth in most regions of the Volga region, with the exception of the Penza and Orenburg regions. The Samara region, despite a significant decrease in the subindex values, retains a leading position. The situation with the educational potential of the Volga region is much worse, the Republic of Tatarstan and Mordovia demonstrate growth over the past 5 years, and the Samara region also retains a leading position. This situation is explained by a general decrease in the number of school graduates and, consequently, students, as well as the outflow of applicants to large agglomerations and the capital region.

TABLE IV. PERSONNEL POTENTIAL OF INNOVATIVE DEVELOPMENT OF THE VOLGA REGION REGIONS

Region	IHRP-2				IHRP-2.1				IHRP-2.2				IHRP-2.3			
	2013	2014	2015	2017	2013	2014	2015	2017	2013	2014	2015	2017	2013	2014	2015	2017
VOLGA FEDERAL DISTRICT	0.40	0.40	0.38	0.44	0.41	0.43	0.45	0.46	0.41	0.40	0.39	0.38	0.39	0.39	0.35	0.46
VOLGA-KAMA MACROREGION	0.39	0.40	0.38	0.44	0.40	0.42	0.45	0.48	0.41	0.40	0.39	0.38	0.38	0.39	0.35	0.45
<i>Volga-Vyatka economic region</i>	<i>0.40</i>	<i>0.42</i>	<i>0.40</i>	<i>0.46</i>	<i>0.40</i>	<i>0.42</i>	<i>0.45</i>	<i>0.50</i>	<i>0.43</i>	<i>0.43</i>	<i>0.42</i>	<i>0.41</i>	<i>0.39</i>	<i>0.41</i>	<i>0.36</i>	<i>0.47</i>
<i>Nizhny Novgorod interregional cluster</i>	<i>0.42</i>	<i>0.44</i>	<i>0.42</i>	<i>0.48</i>	<i>0.42</i>	<i>0.44</i>	<i>0.46</i>	<i>0.49</i>	<i>0.46</i>	<i>0.48</i>	<i>0.47</i>	<i>0.45</i>	<i>0.40</i>	<i>0.42</i>	<i>0.38</i>	<i>0.48</i>
Nizhny Novgorod region	0.49	0.51	0.49	0.53	0.46	0.48	0.50	0.46	0.43	0.43	0.43	0.41	0.54	0.57	0.51	0.64
Republic of Mordovia	0.35	0.37	0.35	0.42	0.39	0.40	0.41	0.52	0.48	0.53	0.51	0.50	0.26	0.27	0.25	0.33
<i>Kazan interregional cluster</i>	<i>0.40</i>	<i>0.41</i>	<i>0.39</i>	<i>0.45</i>	<i>0.39</i>	<i>0.41</i>	<i>0.44</i>	<i>0.50</i>	<i>0.42</i>	<i>0.41</i>	<i>0.40</i>	<i>0.39</i>	<i>0.39</i>	<i>0.40</i>	<i>0.35</i>	<i>0.46</i>
Republic of Tatarstan	0.43	0.45	0.44	0.49	0.50	0.54	0.55	0.49	0.55	0.55	0.56	0.56	0.34	0.35	0.33	0.45
<i>The Mari El Republic</i>	<i>0.37</i>	<i>0.37</i>	<i>0.38</i>	<i>0.47</i>	<i>0.36</i>	<i>0.37</i>	<i>0.44</i>	<i>0.56</i>	<i>0.39</i>	<i>0.35</i>	<i>0.35</i>	<i>0.35</i>	<i>0.37</i>	<i>0.39</i>	<i>0.36</i>	<i>0.48</i>
Chuvash Republic	0.44	0.44	0.41	0.47	0.42	0.44	0.49	0.58	0.42	0.40	0.39	0.40	0.45	0.46	0.38	0.45
Kirov region	0.34	0.36	0.32	0.39	0.28	0.29	0.30	0.36	0.33	0.32	0.28	0.26	0.38	0.42	0.35	0.47
<i>Kama district</i>	<i>0.36</i>	<i>0.35</i>	<i>0.34</i>	<i>0.38</i>	<i>0.41</i>	<i>0.43</i>	<i>0.45</i>	<i>0.44</i>	<i>0.36</i>	<i>0.31</i>	<i>0.31</i>	<i>0.27</i>	<i>0.35</i>	<i>0.33</i>	<i>0.31</i>	<i>0.41</i>
Perm region	0.43	0.41	0.40	0.41	0.51	0.53	0.55	0.49	0.32	0.26	0.27	0.24	0.44	0.43	0.40	0.46
Udmurt republic	0.30	0.29	0.28	0.35	0.30	0.33	0.34	0.39	0.39	0.35	0.35	0.31	0.25	0.23	0.22	0.35
VOLGA-URAL MACROREGION	0.41	0.40	0.38	0.43	0.42	0.44	0.46	0.44	0.40	0.41	0.39	0.37	0.41	0.39	0.34	0.46
<i>Middle Volga region</i>	<i>0.42</i>	<i>0.42</i>	<i>0.40</i>	<i>0.46</i>	<i>0.48</i>	<i>0.50</i>	<i>0.52</i>	<i>0.49</i>	<i>0.44</i>	<i>0.44</i>	<i>0.43</i>	<i>0.41</i>	<i>0.39</i>	<i>0.37</i>	<i>0.34</i>	<i>0.47</i>
<i>Samara interregional cluster</i>	<i>0.49</i>	<i>0.48</i>	<i>0.45</i>	<i>0.50</i>	<i>0.60</i>	<i>0.62</i>	<i>0.64</i>	<i>0.61</i>	<i>0.47</i>	<i>0.46</i>	<i>0.45</i>	<i>0.44</i>	<i>0.45</i>	<i>0.41</i>	<i>0.36</i>	<i>0.48</i>
Samara region	0.52	0.49	0.47	0.50	0.67	0.69	0.68	0.58	0.58	0.56	0.56	0.56	0.42	0.37	0.31	0.44
Ulyanovsk region	0.46	0.46	0.44	0.50	0.52	0.56	0.59	0.64	0.36	0.37	0.33	0.33	0.48	0.45	0.41	0.52
<i>Saratov interregional cluster</i>	<i>0.36</i>	<i>0.36</i>	<i>0.36</i>	<i>0.42</i>	<i>0.36</i>	<i>0.37</i>	<i>0.40</i>	<i>0.38</i>	<i>0.40</i>	<i>0.41</i>	<i>0.41</i>	<i>0.38</i>	<i>0.34</i>	<i>0.33</i>	<i>0.31</i>	<i>0.46</i>
Saratov region	0.33	0.35	0.36	0.43	0.34	0.35	0.38	0.41	0.43	0.44	0.46	0.43	0.28	0.30	0.31	0.43
Penza region	0.38	0.37	0.35	0.41	0.37	0.38	0.41	0.35	0.37	0.38	0.37	0.33	0.39	0.35	0.31	0.48
<i>South Cis-Ural region</i>	<i>0.38</i>	<i>0.38</i>	<i>0.34</i>	<i>0.37</i>	<i>0.30</i>	<i>0.32</i>	<i>0.34</i>	<i>0.32</i>	<i>0.34</i>	<i>0.35</i>	<i>0.31</i>	<i>0.30</i>	<i>0.44</i>	<i>0.42</i>	<i>0.36</i>	<i>0.43</i>
Republic of Bashkortostan	0.41	0.40	0.40	0.43	0.40	0.41	0.44	0.42	0.35	0.33	0.32	0.32	0.46	0.42	0.41	0.48
Orenburg region	0.35	0.36	0.29	0.32	0.21	0.23	0.23	0.21	0.33	0.36	0.30	0.28	0.42	0.42	0.31	0.38

Note: Developed by the authors

We note the growth of the values of the subindex “2.3. Personnel potential of regional science” for the analyzed period for all regions of the Volga region, with the leaders being the Nizhny Novgorod region and the Ulyanovsk region,

whose scientific and educational centers are Ulyanovsk and Dimitrovgrad. Values of subindexes of the financial potential of innovative development of the Volga region regions, presented in Table V.

TABLE V. FINANCIAL POTENTIAL OF INNOVATIVE DEVELOPMENT OF THE VOLGA REGIONS

Region	IFP-3				IFP-3.1				IFP-3.2			
	2013	2014	2015	2017	2013	2014	2015	2017	2013	2014	2015	2017
VOLGA FEDERAL DISTRICT	0.26	0.29	0.29	0.30	0.10	0.17	0.17	0.13	0.38	0.39	0.51	0.43
VOLGA-KAMA MACROREGION	0.24	0.28	0.28	0.29	0.08	0.17	0.17	0.14	0.36	0.37	0.48	0.41
<i>Volga-Vyatka economic region</i>	<i>0.26</i>	<i>0.31</i>	<i>0.30</i>	<i>0.31</i>	<i>0.10</i>	<i>0.20</i>	<i>0.20</i>	<i>0.14</i>	<i>0.38</i>	<i>0.39</i>	<i>0.50</i>	<i>0.43</i>
<i>Nizhny Novgorod interregional cluster</i>	<i>0.29</i>	<i>0.41</i>	<i>0.35</i>	<i>0.39</i>	<i>0.10</i>	<i>0.32</i>	<i>0.17</i>	<i>0.21</i>	<i>0.44</i>	<i>0.47</i>	<i>0.66</i>	<i>0.53</i>
Nizhny Novgorod region	0.35	0.35	0.37	0.52	0.00	0.00	0.00	0.24	0.61	0.61	0.87	0.73
Republic of Mordovia	0.24	0.46	0.33	0.26	0.19	0.64	0.33	0.17	0.28	0.33	0.44	0.33
<i>Kazan interregional cluster</i>	<i>0.24</i>	<i>0.26</i>	<i>0.28</i>	<i>0.27</i>	<i>0.09</i>	<i>0.15</i>	<i>0.22</i>	<i>0.11</i>	<i>0.35</i>	<i>0.35</i>	<i>0.43</i>	<i>0.39</i>
Republic of Tatarstan	0.34	0.39	0.40	0.35	0.29	0.37	0.43	0.13	0.39	0.41	0.50	0.51
<i>The Mari El Republic</i>	<i>0.17</i>	<i>0.15</i>	<i>0.13</i>	<i>0.21</i>	<i>0.05</i>	<i>0.05</i>	<i>0.03</i>	<i>0.09</i>	<i>0.26</i>	<i>0.22</i>	<i>0.28</i>	<i>0.30</i>
Chuvash Republic	0.23	0.29	0.33	0.25	0.04	0.16	0.30	0.13	0.37	0.38	0.48	0.34
Kirov region	0.21	0.21	0.25	0.28	0.00	0.00	0.12	0.09	0.37	0.37	0.46	0.41
<i>Kama district</i>	<i>0.17</i>	<i>0.20</i>	<i>0.20</i>	<i>0.24</i>	<i>0.02</i>	<i>0.05</i>	<i>0.07</i>	<i>0.12</i>	<i>0.29</i>	<i>0.31</i>	<i>0.41</i>	<i>0.33</i>
Perm region	0.23	0.24	0.24	0.29	0.04	0.02	0.02	0.15	0.37	0.40	0.53	0.40
Udmurt republic	0.12	0.16	0.17	0.18	0.01	0.08	0.12	0.08	0.21	0.22	0.28	0.25
VOLGA-URAL MACROREGION	0.30	0.31	0.31	0.31	0.14	0.17	0.18	0.11	0.41	0.41	0.55	0.46
<i>Middle Volga region</i>	<i>0.33</i>	<i>0.31</i>	<i>0.31</i>	<i>0.31</i>	<i>0.18</i>	<i>0.16</i>	<i>0.15</i>	<i>0.09</i>	<i>0.44</i>	<i>0.43</i>	<i>0.57</i>	<i>0.47</i>
<i>Samara interregional cluster</i>	<i>0.44</i>	<i>0.40</i>	<i>0.38</i>	<i>0.36</i>	<i>0.21</i>	<i>0.16</i>	<i>0.10</i>	<i>0.10</i>	<i>0.61</i>	<i>0.58</i>	<i>0.77</i>	<i>0.56</i>
Samara region	0.33	0.30	0.33	0.26	0.18	0.18	0.21	0.14	0.45	0.39	0.56	0.35
Ulyanovsk region	0.54	0.49	0.42	0.47	0.24	0.14	0.00	0.05	0.77	0.76	0.99	0.78
<i>Saratov interregional cluster</i>	<i>0.22</i>	<i>0.22</i>	<i>0.24</i>	<i>0.25</i>	<i>0.14</i>	<i>0.15</i>	<i>0.20</i>	<i>0.09</i>	<i>0.28</i>	<i>0.28</i>	<i>0.37</i>	<i>0.37</i>

Region	IFP-3				IFP-3.1				IFP-3.2			
	2013	2014	2015	2017	2013	2014	2015	2017	2013	2014	2015	2017
Saratov region	0.15	0.23	0.25	0.21	0.00	0.17	0.15	0.02	0.26	0.27	0.44	0.35
Penza region	0.29	0.22	0.24	0.29	0.28	0.14	0.24	0.16	0.30	0.28	0.31	0.39
South Cis-Ural region	0.23	0.30	0.31	0.32	0.08	0.18	0.23	0.16	0.35	0.38	0.49	0.44
Republic of Bashkortostan	0.30	0.43	0.46	0.43	0.11	0.32	0.42	0.26	0.45	0.52	0.65	0.55
Orenburg region	0.16	0.16	0.15	0.21	0.04	0.05	0.03	0.05	0.25	0.24	0.33	0.34

Note: Developed by the authors

Based on the values of the subindex “3.1. Budget financing of innovative development of the region”, it is possible to identify regions that widely attract budget financing to the sphere of science and innovation at different stages. These regions are Nizhny Novgorod, republics of Mordovia, Tatarstan, Chuvashia; Samara, Ulyanovsk and Penza regions, the Republic of Bashkortostan. It should be noted that all the listed regions of the Volga region, in contrast to those lagging behind in this indicator, have a more active policy in the field of creating cluster initiatives within the framework of various federal programs.

The values of the sub-index “3.2. R&D financing at the expense of organizations 'own funds” indicate that the following regions have significant internal R&D financing potential: Nizhny Novgorod region, Republic of Tatarstan, Perm region, Samara and Ulyanovsk regions, Republic of Bashkortostan. Next, we will consider the values of the subindexes of the scientific and technological potential [13] of innovative development of the Volga region regions, presented in Table VI.

TABLE VI. SCIENTIFIC AND TECHNICAL POTENTIAL OF INNOVATIVE DEVELOPMENT OF THE VOLGA REGIONS

Region	ISTP-4				ISTP-4.1				ISTP-4.2			
	2013	2014	2015	2017	2013	2014	2015	2017	2013	2014	2015	2017
VOLGA FEDERAL DISTRICT	0.44	0.43	0.40	0.38	0.44	0.39	0.36	0.37	0.44	0.45	0.43	0.38
VOLGA-KAMA MACROREGION	0.47	0.46	0.44	0.42	0.42	0.38	0.35	0.39	0.50	0.54	0.51	0.45
<i>Volga-Vyatka economic region</i>	<i>0.47</i>	<i>0.46</i>	<i>0.45</i>	<i>0.45</i>	<i>0.41</i>	<i>0.37</i>	<i>0.35</i>	<i>0.39</i>	<i>0.52</i>	<i>0.54</i>	<i>0.52</i>	<i>0.49</i>
<i>Nizhny Novgorod interregional cluster</i>	<i>0.51</i>	<i>0.52</i>	<i>0.49</i>	<i>0.47</i>	<i>0.42</i>	<i>0.41</i>	<i>0.39</i>	<i>0.43</i>	<i>0.58</i>	<i>0.61</i>	<i>0.56</i>	<i>0.50</i>
Nizhny Novgorod region	0.47	0.47	0.47	0.50	0.46	0.47	0.46	0.54	0.49	0.47	0.47	0.48
Republic of Mordovia	0.54	0.57	0.51	0.44	0.39	0.35	0.33	0.33	0.66	0.76	0.65	0.53
<i>Kazan interregional cluster</i>	<i>0.45</i>	<i>0.43</i>	<i>0.43</i>	<i>0.43</i>	<i>0.40</i>	<i>0.36</i>	<i>0.33</i>	<i>0.37</i>	<i>0.49</i>	<i>0.50</i>	<i>0.50</i>	<i>0.48</i>
Republic of Tatarstan	0.57	0.59	0.58	0.61	0.53	0.51	0.50	0.52	0.61	0.65	0.65	0.68
The Mari El Republic	0.36	0.31	0.32	0.32	0.42	0.38	0.37	0.47	0.31	0.25	0.29	0.21
Chuvash Republic	0.58	0.53	0.52	0.51	0.34	0.26	0.21	0.24	0.78	0.75	0.76	0.72
Kirov region	0.29	0.30	0.28	0.30	0.30	0.27	0.24	0.28	0.28	0.33	0.31	0.32
<i>Kama district</i>	<i>0.46</i>	<i>0.47</i>	<i>0.41</i>	<i>0.35</i>	<i>0.46</i>	<i>0.38</i>	<i>0.35</i>	<i>0.38</i>	<i>0.45</i>	<i>0.53</i>	<i>0.46</i>	<i>0.32</i>
Perm region	0.49	0.50	0.45	0.35	0.50	0.44	0.40	0.41	0.48	0.54	0.49	0.31
Udmurt republic	0.42	0.44	0.38	0.34	0.42	0.33	0.31	0.36	0.43	0.52	0.43	0.32
VOLGA-URAL MACROREGION	0.40	0.37	0.34	0.32	0.47	0.41	0.36	0.35	0.35	0.34	0.32	0.29
Middle Volga region	0.42	0.39	0.33	0.33	0.49	0.45	0.36	0.37	0.36	0.34	0.30	0.29
<i>Samara interregional cluster</i>	<i>0.37</i>	<i>0.34</i>	<i>0.29</i>	<i>0.29</i>	<i>0.52</i>	<i>0.47</i>	<i>0.39</i>	<i>0.44</i>	<i>0.25</i>	<i>0.24</i>	<i>0.22</i>	<i>0.17</i>
Samara region	0.34	0.32	0.31	0.29	0.48	0.44	0.41	0.42	0.22	0.23	0.23	0.18
Ulyanovsk region	0.41	0.36	0.28	0.29	0.57	0.50	0.37	0.46	0.28	0.25	0.20	0.15
<i>Saratov interregional cluster</i>	<i>0.47</i>	<i>0.44</i>	<i>0.36</i>	<i>0.36</i>	<i>0.46</i>	<i>0.42</i>	<i>0.33</i>	<i>0.30</i>	<i>0.48</i>	<i>0.45</i>	<i>0.39</i>	<i>0.41</i>
Saratov region	0.40	0.36	0.32	0.29	0.48	0.41	0.36	0.37	0.33	0.32	0.28	0.24
Penza region	0.54	0.51	0.40	0.43	0.44	0.44	0.30	0.23	0.62	0.57	0.49	0.59
South Cis-Ural region	0.37	0.34	0.36	0.30	0.42	0.34	0.37	0.32	0.33	0.35	0.35	0.27
Republic of Bashkortostan	0.40	0.38	0.42	0.34	0.43	0.35	0.49	0.36	0.38	0.40	0.37	0.33
Orenburg region	0.33	0.31	0.30	0.25	0.41	0.34	0.25	0.29	0.28	0.29	0.33	0.22

Note: Developed by the authors

In terms of scientific and technological potential, the following leaders were identified among the Volga regions, which showed an increase in the values of the first-level sub-index “4. Scientific and technological potential of innovative development of the region” for the analyzed period: Republic of Tatarstan, steady growth of science and innovation performance indicators in the analyzed period; Nizhny

Novgorod region, growth rate by 2017, high level of development of science and innovation in production.

The rest of the Volga region and the Federal district as a whole show a decline in science and innovation indicators by 2017. The situation remains relatively good in the regions that implement cluster initiatives. The republics of Mordovia and Chuvashia, as well as the Penza region, are characterized

by a decrease in the values of the subindex, while we note the preservation of high innovation activity of enterprises and organizations. Samara and Ulyanovsk regions, on the contrary, demonstrate a significant excess of scientific potential over technological. In 2017, there was a significant decrease in the scientific and technological potential of the Perm region and the Republic of Bashkortostan, which held leading positions in 2015.

VII. DISCUSSION

Based on the results obtained, which certainly have a debatable nature, it is possible to expand the scientific and practical discussion in relation to the chosen research problem. In particular, we can draw a conclusion about the correctly chosen goals and objectives of Russia's strategic development in the framework of an innovative scenario of economic growth [14]. At the same time, it should be concluded that the implementation of cluster policy is insufficient for the innovative transformation of the economy of Russian regions [15]. We also note the concentration of these strategic documents on the already industrialized territories without due attention to the processes of interregional cooperation in order to equalize the pace of socio-economic development [16].

VIII. CONCLUSION

Thus, we can observe an increase in the economic potential for the formation of an innovative economy in the Volga regions (sub-index 1). At the same time, it is necessary to note the positive impact of cluster development programs and complementary projects on the dynamics of performance indicators of innovative development in the region (sub-index 1.2), in particular for such regions as the Penza region, the Republic of Mordovia and Bashkortostan. The dynamics of indicators that characterize the financial potential of innovative development allows us to conclude that it is more effective to attract innovation financing for regions that have an active cluster policy. A key constraint for drawing conclusions about the impact of cluster policy on the innovative transformation of the Volga region economy is the fact that at the first stage of clustering, competitive industries in large economic and scientific and educational centers were subjected to clustering. At the same time, the relationship between innovation potential, innovation and cluster activity is traced.

It is concluded that it is necessary to solve social and institutional problems, the most important of which are: 1) significant levels of social and regional inequality, 2) high risks of doing business; 3) low level of competition in the market of products and services, which does not create incentives for cluster enterprises to increase labor productivity; 4) insufficient level of development of the national innovation system, coordination of education, science and business.

An integrated approach to the regulation of clustering and innovative development processes should be aimed at realizing the competitive advantages (technological and intellectual) of the Volga regions, which will ensure the development of the economy.

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References

- [1] I.N. Sycheva, E.M. Akhmetshin, A.N. Dunets, I.A. Svistula, T.A. Panteleeva, and I.Y. Potashova, "Labour relations in research of socio-economic systems". *European Research Studies Journal*, 2018, vol. 21(4), pp. 356-367. (In Russ.). DOI: <https://doi.org/10.35808/ersj/1126>
- [2] O. Solvell, G. Lindqvist, and C. Ketels, "The Cluster Initiative Greenbook", Ivory Tower Pub., Stockholm, 2003.
- [3] Russian cluster Observatory, (In Russ.). Retrieved from <https://cluster.hse.ru>
- [4] Yu.V. Maksimov, "Cluster initiatives in the economy of the Nizhny Novgorod region", *Bulletin of the Lobachevsky University of Nizhny Novgorod. Series: Social Sciences*, 2014, vol. 4(36), pp. 57-61. (In Russ.).
- [5] S.D. Bodrunov, "Role of regional clusters in the reindustrialization of Russia". Scientific report Institute of new industrial development (INIR). SPb., 2013. (In Russ.).
- [6] R. Prodani, J. Bushati, and A. Andersons, "An assessment of impact of information and communication technology in enterprises of Korça region", *Insights into Regional Development*, 2019, vol. 1(4), pp. 333-342. DOI: [https://doi.org/10.9770/ird.2019.1.4\(4\)](https://doi.org/10.9770/ird.2019.1.4(4))
- [7] F. Belloc, "Corporate governance and innovation: A survey". *Journal of Economic Surveys*, 2012, vol. 26(5), pp. 835-864. DOI: <https://doi.org/10.1111/j.1467-6419.2011.00681.x>
- [8] B. Bigliardi, and F. Galati, "Which factors hinder the adoption of open innovation in SMEs?", *Technology Analysis and Strategic Management*, 2016, vol. 28(8), pp. 869-885. DOI: <https://doi.org/10.1080/09537325.2016.1180353>
- [9] L.M. Gokhberg, E. Kutsenko and I. Kuzminov, "Rating of innovative development of subjects of the Russian Federation". Issue 6. National research. Higher school of Economics. Moscow, 2020. (In Russ.).
- [10] N.A. Prodanova, N.S. Plaskova, V.A. Dikikh, L.V. Sotnikov, L.K. Nikandrova, and G.A. Skachko, "Techniques for assessing the investment attractiveness of a commercial organization based on classical methods of strategic economic analysis", *International Journal of Economics and Business Administration*, 2019, vol. 7(4), pp. 35-46. (In Russ.). DOI: <https://doi.org/10.35808/ijeba/330>
- [11] Federal State Statistics Service of the Russian Federation, (In Russ.). Retrieved from <http://www.gks.ru/>
- [12] O. Korableva, T. Durand, O. Kalimullina and I. Stepanova, "Studying user satisfaction with the MOOC platform interfaces using the example of coursera and open education platforms", in *Proceedings of the 2019 International Conference on Big Data and Education (ICBDE'19)*, 2019, pp. 26-30. (In Russ.). DOI: <https://doi.org/10.1145/3322134.3322139>
- [13] E.M. Akhmetshin, "The system of internal control as a factor in the integration of the strategic and innovation dimensions of a company's development". *Journal of Advanced Research in Law and Economics*, 2017, vol. 8(6), pp. 1684-1692. (In Russ.). DOI: [https://doi.org/10.14505/jarle.v8.6\(28\).03](https://doi.org/10.14505/jarle.v8.6(28).03)
- [14] "The concept of long-term socio-economic development of the Russian Federation until 2020", Ministry of economic development of the Russian Federation, 2008. (In Russ.). Retrieved from <http://www.edqu.ru/upload/iblock/d08/3.1.2009.14.pdf>
- [15] S. Arvanitis, N. Sydow, and M. Woerter, "Is there any impact of university-industry knowledge transfer on innovation and productivity? An empirical analysis based on swiss firm data", *Review of Industrial Organization*, 2008, vol. 32(2), pp. 77-94. DOI: <https://doi.org/10.1007/s11151-008-9164-1>
- [16] "Forecast of long-term socio-economic development of the Russian Federation for the period up to 2030", Ministry of economic development of the Russian Federation, 2013. (In Russ.). Retrieved from http://old.economy.gov.ru/minec/activity/sections/macro/prognoz/doc20130325_06