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Volga Federal District: Trends in Technological Development

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ABSTRACT
This paper aims to investigate trends in the technological development of Russian regions using a combined approach that integrates resource-, process- and efficiency-based views. The proposed approach can be used to characterise regional development both in its static and dynamic aspects, in particular to identify specific features of regional technological development and patterns of implementing the potential of technological development, as well as to determine trends in the technological development of regions. Using this approach, statistical data for the Volga Federal District of the Russian Federation for 2010-2018 were processed. As a result, groups of regions were distinguished and management decisions were justified. The conducted study proved a high level of differentiation between the regions of the Volga Federal District in terms of technological development. In addition, foci requiring managerial attention were identified, and guidelines for the development of regional development strategies were formulated.

Keywords: *Regional technological development, R&D, Technologies, Facilities, Staff acquisition, Innovation, Resource-based view, Process-based approach, Efficiency-based approach.*

1. INTRODUCTION

The dominant feature of regional development in the modern economy is the focus on innovative development. At the same time, technological development is increasingly determining progressive transformations in regional economies. In this regard, the current trends in technological development should be studied, on the one hand, in the context of identifying transformations in the structure of the economy, and, on the other, in terms of forecasting and adjusting regional socio-economic policies.

At the moment, there are various approaches to the study of technological processes in the economy [1-11]. All of them can be combined into three groups: resource-based, which involve the study of resources and determination of the potential for technological development; process-based, which reveal the features of transforming resources into a result; and efficiency-based, which focus on analysis of the results of technological development. Regarding the advantages and disadvantages of each of the selected groups, the authors consider the combined approach as the most appropriate one, which consists in a combination of resource-, process- and efficiency-based views.

2. TECHNOLOGICAL DEVELOPMENT OF REGIONS: METHODOLOGY OF ANALYSIS

Within the framework of this study, a methodology for studying trends in the technological development of regions was largely based on the approach of E. Mazilov [12-16]. Based on the essential characteristics of technological development, 5 basic blocks were designated as key indicators: research and development, technologies, the state of the facilities of technological development, staff acquisition, innovation. These blocks are complementary to E. Mazilov's approach regarding the state of the main production assets and determining their ability to ensure the technological development of the territory. To characterise each of the blocks, specific indicators were determined on the basis of official statistics, which ensures the reliability, comparability and relevance of the results obtained.

Any developmental process implies an access to resources that is a potential, providing "entrance" to the system. "Exit" from the system is considered according to the results obtained for each of the selected blocks. The very process of transforming resources into a result is considered as a certain "black box" and can be studied under the process-based approach. Thus, the study of trends in technological development can be carried out in the context of five identified blocks under the resource-, process- and efficiency-based approaches (Table 1).

Table 1. Indicators of technological development of regions

Approach / Block	Research and Development	Technologies	Facilities	Staff acquisition	Innovations
Resource-based	Share of local expenditures for research and development, as a percentage of the gross regional product (GRP),%	Share of organisations using information and communication technologies in the total number of observed organisations,%	Share of capital investments in GRP, %	The number of personnel engaged in research and development in the total population,%	The share of expenditures for technological innovations, as a percentage of the total amount of delivered goods, works, services
Process-based	Share of local operating costs for the equipment in the total amount of local expenditures, %	The ratio of the applied and the developed advanced technologies,%	Depreciation rate of fixed assets, %	Increase in high-productivity jobs in the region	Innovative activity of organisations, %
Efficiency-based	Ratio of the issued patents and the received patent applications,%	Share of high-tech and knowledge-intensive industries in the gross regional product, %	Fixed assets renewal ratio, %	Increase in labour productivity, %	Share of delivered innovative products in GRP, %

Of note is the specific character of technological development indicators: being a result in one distinguished period, they can be considered as a resource in subsequent periods.

Based on the proposed approach, the authors analyse the prerequisites and indicators of technological development for the data of the regions of the Volga Federal District for 2010-2018, presented in the "Official statistics" page on the Rosstat website.

3. TECHNOLOGICAL DEVELOPMENT IN THE REGIONS OF THE VOLGA FEDERAL DISTRICT

3.1. Potential for technological development

Perspectives for technological development of regions are determined by the region's potential. Within the framework of this study, it seems appropriate to consider the potential for technological development in terms of the indicators presented in Table 1.

In general, the Volga Federal District is characterised by the share of local expenditures on research and development in the amount of 1.46% of the gross regional product, which is 1.07 times higher than the national average of Russia (1.36%). Regarding investments in the district, the leaders in financing research and development are Nizhny Novgorod Oblast with 6.05%, Ulyanovsk Oblast – 4.02% and Penza Oblast – 1.5%. The highest average annual growth of research and development expenditures in the GRP since 2010 has been demonstrated by such regions as the Udmurt Republic (11.84%), the Chuvash Republic (9.81%), Ulyanovsk Oblast (6.43%) and Kirov Oblast (6.39%). The negative growth rates of the indicator under consideration is observed in Samara Oblast (-5.58%), the Republic of Mordovia (-2.51%) and the Mari El Republic (-0.9%). The negative dynamics is considered to be caused by a significant decrease in the amount of research and development funding in 2014-2016. The rest of the regions show a steady trend in providing research and development with local costs with a slight positive growth from 1.05% to 4.05%. Taking into account the rapidly growing demand for financing research and development, triggered by the sanctions the need to switch to import substitution using domestic technologies and equipment, only a stable dynamics of financing can provide a solution to

this problem. At the same time, it should be noted that a low growth or even a decrease in the research and development expenditures cannot be regarded as a negative factor, the very existence of this funding indicates the prerequisites for technological development. In addition, industry specialisation and the spatial location of research centres determine the speciality of the territory and focus on certain stages of the innovation process: some regions can be considered as idea generators, while others as conductors and main drivers for the development of innovations in the real economy.

The proportion of organisations using information and communication technologies in the total number of observed organisations is one of the indicators of the creation of conditions for the technological development of territories. In Russia as a whole, this indicator increased from 43.4% in 2003 to 91.1% in 2018. Such dynamics is typical for all regions of the Volga Federal District. In general, a certain homogeneity of territories in the use of information and communication technologies can be noted, which indicates the formation of a single information space – necessary to ensure progressive development in the context of the economy digitalisation.

In terms of capacity building for technological development, the facilities occupy one of the key positions. The issue of dynamic technological development correlates with a matter of capital investments. In terms of capital investments, the Republic of Tatarstan is in the lead, investing 30.2% of the GRP in the development of the facilities of the region. The Republic of Mordovia (27.4%) and Ulyanovsk Oblast (24.7%) are dominating. The lowest positions in terms of capital investment are occupied by the Mari El Republic (14.2%) and the Udmurt Republic (15%). In other regions, the share of capital investments in GRP ranges from 18.8% to 22.5%. Capital investments contribute to the formation of facilities, serving as a platform for technological development. However, not all kinds of capital investments provide conditions for technological development. Of great importance is the correspondence of investment objects to advanced technologies and the correlation of their realisation with the dynamics of scientific and technological progress.

In terms of the number of personnel engaged in research and development in the total population, Nizhny Novgorod Oblast is the leader (1.27%), outperforming the closest "pursuers" (Penza and Ulyanovsk Oblasts) by almost 3 times. The specific location of research centres determines the low number of people engaged in research and development in Orenburg Oblast (0.05%) and in the Mari El Republic (0.04%). As a matter of fact, it is in this segment of the employed where the intellectual capital is concentrated, providing the ideas generation for the formation of prerequisites and determining the vector of technological development not only of separate regions, but also of the country and the world community as a whole. It should be noted that since 2010 this indicator has increased by 83% in Samara Oblast due to the support of the scientific sector and the formation of prerequisites for conducting research. At the same time, this indicator has decreased by almost 2 times in the Udmurt Republic. Changes in the structure of the employed serve as an indicator of the distribution of territories at a certain stage of innovation process, determining the possibilities of their comprehensive, interregional interaction in ensuring technological development. A comparative analysis of the indicators demonstrates a direct relationship between the number of employees and the level of expenditures for research and development. The identification of this correlation determines the exclusive focus on the resource and process-based principles of ensuring technological development, rather than on the principles of target performance. This fact is partly explained by the need to conduct fundamental research with uncertain character of their specific results, however, the prevalence of resources allocated to the financing of applied studies determines the need to finance research and development per capita as well as the correalation between the achieving certain results and launching motivational tools to stimulate inventive activity.

A share of expenditures for technological innovations of the total amount of delivered goods, works, services in the Volga Federal District comprises 3% which is 1.4 times higher than the national average. At the same time, among the regions of the Volga Federal District, Nizhny Novgorod Oblast is in the lead with an indicator value of 6.1%, significantly ahead of the Republic of Tatarstan with 4.5%. The Mari El Republic demonstrates 0.6% – the lowest share of expenditures on technological innovation in the total volume of delivered goods, works, services. It is technological innovations that form the basis for the technological development of the economy and create the prerequisites for further progress. The high level of differentiation of territories by this indicator testifies the presence of gaps and problem points in the aspect of implementation of technological transformations.

Summarising the results of analyses of the territories according to the selected indicators of the

potential for technological development, the authors come to the conclusion that, despite the general patterns in the formation of the prerequisites for technological development, there is also a significant imbalance that hinders cooperation-based interregional integration.

To synthesise the results of the analysis, it is proposed to position the regions of the Volga Federal District by the potential of technological development based on the ranking by particular indicators (Table 2). Given the relativity of the indicators in use, the additional rate settings are considered unnecessary.

Thus, considering the potential for technological development of the Volga Federal District, all regions could be distributed into several groups. The group of leaders consists of two regions: Nizhny Novgorod Oblast and the Republic of Tatarstan. They are specifically distinguished by their active formation of the platform and prerequisites for technological development. High potential for the technological development is indicated in these regions. The second group is represented by Ulyanovsk Oblast, Penza Oblast and Perm Krai, the potential of their technological development is assessed above average. The group with an average potential for technological development includes the Chuvash Republic, Samara Oblast, the Republic of Bashkortostan and Orenburg Oblast. The Udmurt Republic is characterised by a potential below the average, and the potential for technological development of the Mari El Republic can be identified as low.

3.2. Process-based characteristics of technological development of regions

The analysis of the technological development of territories in terms of the process-based approach involves diagnostics of transforming resources into a result, the key indicator of which is the availability of appropriate technical and technological support. Since 2010, there has been a decrease in the share of local operating costs for the equipment in the total amount of internal expenditures both in Russia as a whole (from 3.45% to 1.91%) and in the regions of the Volga Federal District (from 5.48% to 1.66%). The Mari El Republic (6.51%), the Chuvash Republic (3.85%) and Samara Oblast (3.39%) are the leaders in terms of the share of local operating costs for equipment in the total amount of internal expenditures among the regions of the Volga Federal District. According to the results of the analysis, the share of costs for equipment is less than 3% in the regions of the Volga Federal District, which demonstrates negative dynamics for the period under review.

At the same time, positive growth rates over 9 years are observed in four regions: the Chuvash Republic (by almost 3 times), the Udmurt Republic (by more than 1.5 times), Orenburg Oblast (30.26%), Ulyanovsk Oblast (2.68%). High growth rates, on the

Table 2. Ranking of the regions in the Volga Federal District according to their potential for technological development

	Research and Development	Technologies	Facilities	Staff acquisition	Innovations	Sum of the ranking places	Final ranking according to the potential for technological development
Nizhny Novgorod Oblast	1	2	9	1	1	14	**1**
Republic of Tatarstan	6	1	1	5	2	15	**2**
Ulyanovsk Oblast	2	12	3	3	4	24	**3**
Penza Oblast	3	8	8	2	3	24	
Perm Krai	4	7	6	4	7	28	**4**
Chuvash Republic	7	5	10	9	5	36	**5**
Samara Oblast	5	14	11	6	6	42	**6**
Republic of Bashkortostan	10	6	7	8	11	42	
Orenburg Oblast	13	3	4	13	9	42	
Republic of Mordovia	11	10	2	11	12	46	**7**
Kirov Oblast	8	9	12	10	8	47	**8**
Saratov Oblast	9	13	5	7	13	47	
Udmurt Republic	12	4	13	12	10	51	**9**
Mari El Republic	14	11	14	14	14	67	**10**

one hand, can be explained by a low initial level, and, on the other hand, allow drawing a conclusion about the focus on improving the quality of research and development, which ensures a positive direction of technological development. The indicator under consideration has almost halved in Nizhny Novgorod Oblast, Penza Oblast and the Republic of Mordovia. The negative dynamics of the share of local operating costs for equipment in the total amount of internal expenditures is associated with the renewal of fixed assets in the period 2010-2014 and a decline in overall funding for research and development.

At the same time, the degree of depreciation of fixed assets in the regions of the Volga Federal District is more than 51%. In the Republic of Tatarstan, Kirov Oblast, Penza Oblast and Ulyanovsk Oblast, the degree of depreciation has decreased, which indicates the timely replacement of the facilities in use. The most depreciated is the facilities of Perm Krai (63.5%) and Orenburg Oblast (56.5%). It should be noted that statistical data reflect the level of physical depreciation, while for technological development, obsolescence is of greater importance and rapidity than physical depreciation. Therefore, in terms of the state of the facilities, technological development processes in the regions of the Volga Federal District cannot be considered adequately provided.

An analysis of the proportion of the advanced technologies used and the advanced technologies developed reveals a certain technological dependence in all the regions under consideration (The number of used advanced technologies are 289 times more than the number of developed technologies being). Notably, this dependence is based on intercountry interaction and does not contribute to the development of interregional integration. In the context of the fourth technological revolution, this fact should be considered as constraining the technological development.

Technological development is directly related to the acceleration of the labour productivity growth rate; therefore, the increase in highly productive jobs in the region should be considered as one of the process characteristics. In 2018, 2383.7 thousand high-productivity jobs were created in the Russian Federation, therefore, an increase accounted for 13.9%. In the regions of the Volga Federal District, the increase was 15.1%. At the same time, certain positive dynamics is observed in the context of individual regions. The leader in creating highly productive jobs is Penza Oblast with 24.1%. The average for the region and Russia as a whole is exceeded in Saratov Oblast, the Chuvash Republic, the Mari El Republic, the Republic of Tatarstan, Samara Oblast, Ulyanovsk Oblast, the Republic of Mordovia, and Perm Krai. In the Republic of Bashkortostan, the increase in highly productive jobs is equal to the average Russian level. In other regions, the increase in high-productivity jobs is lower than the national average, however, its positive dynamics reflects the formation of preconditions for accelerating the technological development in the regions. It should be noted that the growth of the indicator under consideration is

Table 3. Ranking of the regions in the Volga Federal District according to process characteristics of technological development

	Research and Development	Technologies	Facilities	Staff acquisition	Innovations	Sum of the ranking places	Final ranking according to the potential for technological development
Chuvash Republic	2	1	7	3	1	14	**1**
Republic of Tatarstan	6	12	1	5	2	26	**2**
Penza Oblast	12	11	3	1	3	30	**3**
Saratov Oblast	4	4	9	2	12	31	**4**
Mari El Republic	1	10	10	4	8	33	**5**
Nizhny Novgorod Oblast	8	5	6	12	5	36	**6**
Republic of Bashkortostan	11	3	5	10	7	36	**7**
Samara Oblast	3	8	8	6	13	38	**8**
Republic of Mordovia	9	7	11	8	4	39	**9**
Orenburg oblast	5	2	13	11	11	42	**10**
Ulyanovsk Oblast	7	13	2	7	14	43	**11**
Kirov Oblast	13	14	4	13	6	50	**12**
Udmurt Republic	10	6	12	14	9	51	**13**
Perm Krai	14	9	14	9	10	56	**14**

characterised by unstable dynamics. Both positive and negative bursts are determined by the diffusion of technological innovations in the real economy.

Innovative activity in the District, determined on the basis of the share of organisations that carried out innovations, showed an increase until 2012, and then only a decline, amounting to 9.1% at the end of 2017, which exceeded the average Russian level (8.5%). In the context of regions, only a positive trend was observed in Penza Oblast (an increase of more than 2 times), the Chuvash Republic (an increase of more than 1.5 times), the Republic of Tatarstan (from 14.9% in 2010 to 22.2% in 2017). Kirov Oblast and the Republic of Mordovia managed to maintain the positive dynamics of innovation activity. In other regions, the main reason for the decline in innovation activity was investment outflow. Innovative activity in Perm Krai, Samara Oblast, Orenburg Oblast, and Ulyanovsk Oblast decreased by more than half.

Thus, the analysis of the process characteristics of technological development showed a high level of territorial differentiation, which necessitates ranking to generalise the position of the region (Table 3).

The generalised positioning of regions according to the rating of process characteristics of technological development confirmed the conclusion about a high level of differentiation of technological development. The formed groups turned out to be heterogeneous in terms of their quantitative composition. So, the leader in the ranking is the Chuvash Republic with an overall position above the average, outpacing the Republic of Tatarstan. The most numerous is the group of "mediocre" regions, the development indicators of which fit into the general trends but do not mean the outperformance. Among the regions with low process characteristics of technological development, there are three territories: Kirov Oblast, the Udmurt Republic and Perm Krai.

3.3. Effectiveness of technological development of regions

The potential and the active course of processes are not yet indicators of technological development; the achievement of the set goals or a certain state can only be judged from the standpoint of effective characteristics.

In the field of research and development, the ratio between issued patents and received patent applications is considered as an indicator of the achieved result within the framework of this study. In the Russian Federation, this indicator grew from 79.03% in 2010 to 87.57% in 2018. In the Volga Federal District, this indicator reached almost 100% in 2018. It should be noted, however, that there are rolling applications where an application is filed in December and a patent is issued in January of the following year. Taking into account such a shift in 2018, the indicator of the ratio between issued patents and received patent applications turned out to be slightly lower and amounted to 95.58% in the Volga Federal District. The noteworthy feature here is the general dynamics of a decrease in the effectiveness of intellectual activity, which is manifested in a decline in the number of applications filed. The only region to post an increase was Orenburg Oblast, with an 11% increase in the number of applications filed from 2010 to 2018. The number of issued applications showed a fluctuating trend in all regions, which in 2018 provided the Republic of Tatarstan, Ulyanovsk Oblast, the Republic of Bashkortostan, the Mari El Republic and Kirov Oblast with a positive increase.

The leader among the regions of the Volga Federal District in terms of capital renewals is the Republic of Tatarstan (the share of annually renewed fixed assets is about 10%), which has recently slowed down the renewal rate. The processes of modernisation of the technical and technological park have become more active in the Republic of Bashkortostan, Kirov Oblast and Samara Oblast. In the other regions, the rate of capital renewals has slowed down, which is primarily due to a decrease in the volume of investments in fixed assets.

The main result of technological development should be considered an increase in labour productivity. According to the Rosstat data from 15/03/2019, the labour productivity index for the Russian Federation as a whole was 101.9; the increase is marginal and shows a significant lag behind the world leaders in technological development. However, the rate of increase in labour productivity implies an opportunity not only to maintain positions, but also to provide a significant breakthrough through the active use of advanced technological solutions. The consequences of the 2008 crisis manifested themselves with a certain time lag and revealed a decrease in the growth rate of labour productivity in the regions of the Volga Federal District in 2009-2010. The average annual growth rates of labour productivity are higher than the national average in almost all regions of the Volga Federal District, which is an indicator of incremental technological development. The undisputed leader in terms of labour productivity growth is the Mari El Republic, where the average annual rate has been slightly less than 5% over the past 10 years. Saratov Oblast, the Republic of Bashkortostan, the Republic of Mordovia, and Penza

Oblast, where the average annual growth rate of labour productivity ranges from 3.42% to 3.93%, are slightly inferior to it. In 2017, the highest growth rate of labour productivity was demonstrated by Perm Krai (6.3%) and Saratov Oblast (5.6%), which stems from the creation of high-tech industries and a significant increase in highly productive jobs in these regions and their effective use.

In terms of the share of high-tech and knowledge-intensive industries in the gross regional product, Ulyanovsk Oblast, with 34.8% in 2017, is the leader among the regions of the Volga Federal District. The Chuvash Republic (31.2%) and Nizhny Novgorod Oblast (30.8%) slightly lag behind the leader. The highest rates of increase in the share of products of high-tech and knowledge-intensive industries in GRP since 2010 have been demonstrated by the Mari El Republic (23.58%), Ulyanovsk Oblast (20.83%) and the Republic of Bashkortostan (19.02%). Of note is a relationship between the share of products of high-tech and knowledge-intensive industries in the GRP and the industry specialisation of territories. Noting the overall positive dynamics, one should pay attention to a slight decrease in the growth rate of the share of high-tech and knowledge-intensive industries in such regions as the Republic of Mordovia, the Republic of Tatarstan, the Udmurt Republic, Orenburg Oblast, Penza Oblast and Samara Oblast. On the one hand, this may be due to the limited production capacity in high-tech industries and the saturation of the domestic market, and, on the other hand, to an increase in production in other industries, which entailed a decrease in the share of high-tech industries.

An important effective indicator of technological development is the share of delivered innovative products in the GRP. Analysis of the values of this indicator for 2010-2018 reveals a high differentiation between the regions of the Volga Federal District and unstable dynamics due to both the specifics of statistical accounting and the lack of incentives to master innovative products, the discrepancies between consumer preferences and advanced technological trends. The Republic of Mordovia (24.3%) and the Republic of Tatarstan (20.9%) take the lead in this indicator among the regions of the Volga Federal District, significantly exceeding the average Russian indicator of 6.5%. In 2018, 10 out of 14 regions of the District exceeded the national average, and only four regions – the Republic of Bashkortostan (6.3%), Orenburg Oblast (3.2%), the Mari El Republic (2.8%), Saratov Oblast (2.4%) – have not reached the average level in the Russian Federation. The largest increase in the indicator since 2010, from 4.0% to 12.6%, has been observed in the Udmurt Republic, significantly outnumbering Perm Krai with an average annual growth rate of 7.6%.

The general conclusion about the effectiveness of the technological development of the regions may be drawn from the rating of the territories according to the indicators under consideration, presented in Table 4.

In terms of the effectiveness of technological development, the regions were arranged into 4 groups,

Table 4. Ranking of the regions in the Volga Federal District according to process characteristics of technological development

	Research and Development	Technologies	Facilities	Staff acquisition	Innovations	Sum of the ranking places	Final ranking according to the potential for technological development
Ulyanovsk Oblast	1	1	5	10	6	23	1
Samara Oblast	3	7	3	7	5	25	2
Perm Krai	7	5	9	1	3	25	3
Chuvash Republic	4	2	13	4	8	31	4
Republic of Bashkortostan	2	9	2	8	11	32	5
Nizhny Novgorod Oblast	8	3	7	14	4	36	6
Republic of Tatarstan	9	13	1	12	2	37	7
Saratov Oblast	5	8	10	2	14	39	8
Penza Oblast	6	10	8	5	10	39	9
Republic of Mordovia	11	11	11	6	1	40	10
Kirov Oblast	12	6	4	13	9	44	11
Mari El Republic	13	4	14	3	13	47	12
Udmurt Republic	10	12	12	11	7	52	13
Orenburg Oblast	14	14	6	9	12	55	14

while none of the regions demonstrated absolute leadership. Three regions were among the regions with above average results: Ulyanovsk Oblast, Samara Oblast and Perm Krai. The group with average indicators consists of 6 regions. The group of outsider regions in terms of the effectiveness of technological development in the Volga Federal District includes two regions: the Udmurt Republic and Orenburg Oblast. In general, it should be noted that the regions are close in their effectiveness, which indicates a reduction in the imbalance between them.

4. CONCLUSIONS

The analysis of technological development from the standpoint of the proposed approach enables us to draw the following conclusions and distinguish several groups of regions. The first group is made up of the regions with high results of technological development through the use of the existing potential, despite the low level of process characteristics. Their effectiveness is explained by the synergies emerging when determining the key points of growth, which act as locomotives of the technological development of the territory. This group includes Ulyanovsk Oblast, Perm Krai and Samara Oblast.

The next group consists of regions with a sufficiently developed potential for technological development. However, the use of this potential is ineffective. Such regions should adjust the strategic directions of using capacity at hand to achieve better results of technological development. This group includes Nizhny Novgorod Oblast, the Republic of Tatarstan, Penza Oblast and the Chuvash Republic.

It is reasonable to set a separate group of regions with an average level of potential development, indicators of its use and achieved results. This group includes the Republic of Bashkortostan and Saratov Oblast. To increase the effectiveness of technological development, these regions should intensify using the potential at hand for technological development, adjust the priorities for applying efforts to improve performance indicators.

Orenburg Oblast, Kirov Oblast and the Republic of Mordovia represent a group in which the result of using the potential at hand is incomparable with its level due to insufficient efforts.

In the Mari El Republic, despite the active application of efforts, the insufficient level of potential development did not result in significant effectiveness of technological development. The Udmurt Republic is characterised by a low potential, its inactive use and low indicators of technological development. These regions should primarily pay attention to strengthening the potential for technological development.

It should be noted that there are no regions with a high level of potential development, high characteristics of its use and the achieved results in the Volga Federal District.

The study has proved a high level of differentiation between the regions of the Volga Federal District in terms of technological development, identified controversial points and key guidelines for the strategy of regional development. At the same time, the noteworthy feature here is the boundedness of the conducted analysis since the presented ranking does not allow assessing the level of technological development of the territory from the standpoint of resource-, process- and efficiency-based approaches. In this regard, the study is to be continued with developing an approach to determining the level of technological development of the region, taking into account the proposed research methodology.

AUTHORS' CONTRIBUTIONS

Development of a methodology for analysing technological development of regions – Oxana Kazakova, Natalia Kuzminykh; literature review – Natalia Kuzminykh; collection and primary processing of information data for the regions of the Volga Federal District of the Russian Federation for 2010-2018 – Liliya Valinurova; evaluation of indicators and rate setting – Venera Timiryanova; interpretation of the results obtained – Oxana Kazakova.

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