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Integration development processes in the wood industry based on clusterization

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Abstract. The research is aimed at substantiating a mechanism for the formation of interregional clusters. In order to identify the current state and development prospects for the Russian wood industry, we conducted an analysis of its functioning on the basis of official statistics. We substantiated the advantages of a cluster form of integration and made an assessment of the foreign and domestic clustering experience in the wood industry on the basis of an in-depth study of the related literature, analysis and synthesis of the data taken from certain specialized Internet portals of the Russian wood industry. To implement into practice our approach to the formation of interregional wood industry clusters in the Central Federal District (CFD), we carried out a research into these territories' resource potential for clusterization (a rating-and-score method, methods of localization and concentration, a method of territorial proximity, a method of formalization, etc.). The obtained results showed that is it possible to form 4 wood industry clusters in the CFD of Russia, allowing to concentrate a resource capacity of several territories for the purpose of strengthening the interregional interaction of the timber industry enterprises, to create opportunities for the implementation of large-scale innovative projects in the industry.

1. Introduction

The wood industry is one of the national economy branches, aimed art an effective use of forests as the most important renewable natural resource of the country. Russia, with its significant reserves of wood in the world, is able to complete a full load of its own processing facilities and also to make export supplies. However, in recent decades, the wood industry has been oriented not to the manufacture of wood products of the wood processing industry with high added value, but to the supply of raw materials (wood) or products of its primary processing (lumber) abroad. This situation prevents wood processing enterprises from developing effectively; it remains low-value, with an outdated material and technical base and a low level of attracting the investments. Among the problems that hinder the development of the wood industry, there is also a low level of innovative technologies for the integrated use of wood raw materials, technical, scientific and personnel support,

inefficiency of reforestation, imperfections in the legal and regulatory framework in the field of the wood processing complex and related industries.

The solution to these problems lies in the improvement of the organizational and management structure of the wood industry, the search for new mechanisms to stimulate a sustainable wood usage and the support of wood processing manufactures, and the formation of tools to increase the effective use of its human, logistical and scientific potential. This will make it possible to change a trajectory of the development of the country's wood industry to provide the domestic market and increase export opportunities in terms of supply of paper, plywood-tile products, furniture and wooden house construction.

A cluster approach is proposed to be used as a mechanism to raise the effectiveness of the wood industry potential. In view of a serious differentiation of the Russian regions in terms of the socio-economic development level, a significant territorial distance between timber processing centers and potential markets for their products (regions with high density of population), interregional clusters can be successfully developed in the wood industry.

Methods for identifying clusters in the territorial economic space were described by various foreign scientists [1-4]. Among the variety of these methods we shall note the most significant ones. The first is a method, based on calculating the localization and concentration coefficients [5], which enables to determine significant economic characteristics of the branches (number of employees, sales volumes, etc.) to assess their clustering potential. The second is a method, based on revealing the effects of territorial concentration of the potential cluster participants [6, 7]. Then comes M. Porter's method of competitive advantage analysis, which is based on the approach which can be expressed in allocation of certain industries, concentrated on the territory and having high export potential, for clustering.

Among the Russian scientists, we have to note an original methodology of Kovaleva T Y [8], which involves the determination of a Regional Cluster Index (RCI), based on a system of criteria used to determine the effectiveness of cluster development of the economy (a number of indicators characterizing the institutional, organizational and managerial, economic, innovative and social aspects of cluster participants). However, this methodology is characterized by complexity and insufficiency of the empirical basis for RCI calculations. A methodology of Kazakov B.A., Luchnikov A S [9], based on the analysis of a territorial-sectoral and integral-spatial structure of the wood industry of the region and a concept of energy production cycles, seems interesting when we speak about wood clusters. A complex approach is inherent with a methodology of Rezanov V K and Rezanov K V [10], this methodology involves the phased formation of a cluster model of the region's forest complex: the outlining of competitive advantages, including those related to the quantity and quality of forest resources, a clear definition of the chains where the timber-processing industry product is produced, a scenario analysis of the directions of cluster formation, based on a system of balanced indicators, the substantiation of growth points as core elements of will-be clusters, based on an integrated assessment of investment attractiveness and competitiveness of the forest sector.

At the same time, although a problem of the interregional interaction development between Russian subjects is rather acute, it is worth noting that incredibly little research has been conducted in the sphere of forming the interregional clusters in the timber industry in order to counter international competition in the context of globalization and to increase the efficiency of the regional resources usage. The research is aimed at substantiating a mechanism for the formation of interregional clusters as a way to increase the efficiency of timber processing complexes in the regions of Russia under the conditions of the increasing competition in the domestic and foreign timber product markets.

2. Methods and materials

To research into how thoroughly the problem of forming of interregional clusters in the wood industry we used general scientific methods, such as generalization, synthesis and analysis of the accrued scientific results in terms of identifying clusters in the territorial economic space. The methodological basis of the research was the general methods of analysis and a comparative analysis, aimed at revealing certain trends and prospects for the wood industry development in Russia. The substantiation

of the advantages of a cluster form of integration and the evaluation of foreign and domestic experience in the field of wood industry clustering, which demonstrates the best opportunities for introducing certain innovative technologies for advanced processing of forest raw materials and for raising the efficiency of industry enterprises, were based on an in-depth study of literature, analysis and synthesis of data obtained from some specialized Internet portals of the Russian wood industry, the European Cluster Cooperation Platform, the Russian Cluster Observatory and the Geoinformational System of Industrial Parks, Technology Parks and Clusters of the Russian Federation.

To implement the proposed approach to form interregional wood industry clusters in the Central Federal District of Russia into practice, we carried out a study of the resource potential of these territories by the author's method, which consists in determining the possibilities for clustering, based on calculating the indicators that allow to determine the core-region for the cluster (based on the rating-and-score method which takes into account certain characteristics: where the labor resources are located and what is the rate of concentration of timber processing manufactures and forest resources), the regions participating in the cluster (based on the establishment of an optimal range of cluster boundaries), the potential of the wood processing industry products (defined by method of territorial concentration of consumers). An idea of setting up some cluster associations on the territory of the Central Federal District is that clusters can be created in the following 4 quadrants: in the northwest, northeast, southwest and southeast of the territory under consideration, in which a core-region of an interregional wood industry cluster is supposed to be defined. We used the rating-and-score method for this purpose. When counting the points scored by each region, the following indicators are taken into account: the number of employees and the number of organizations, specializing in the 'Timber stockpiling' type of activity, the acreage of the forest fund, the total stock of wood, the volume of shipped products by a type of economic activity (wood processing and wood products, paper manufacture and paper products, manufacture of furniture; production of other finished products from the wood raw materials).

The assignment of points is done in accordance with a share that a particular region occupies in the structure of the federal district, by each indicator. An example of the criteria for assigning the points is presented in table 1, an indicator here is the number of employees and the type of activity is 'Timber stockpiling'.

Table 1. Criteria for assigning the score points by indicators, used for the assessment of core-regions of interregional timber clusters.

A ratio of employees, occupied in the 'Timber stockpiling' organizations		
Maximum value of the indicator among the regions	0.2348	
Bottom value of the indicator among the regions	0.0012	
Calculation step	0.0467	Points
Indicator limits for assigning the points		
Lower limit	Upper limit	
0.0012	0.0480	0.2
0.0481	0.0947	0.4
0.0948	0.1414	0.6
0.1415	0.1881	0.8
0.1882	0.2348	1

A cartographic method was used to demonstrate the locations of the potential clusters. In addition, method of formalization was applied for the creation of a phased algorithm needed for the formation of wood industry clusters at the interregional level.

3. Results and discussion

In the territory of the Russian Federation, the geography of forest distribution and development of the wood industry is non-uniform. The Siberian and North-West federal districts have the richest raw material base. The total land area of the Russian Wood Fund is 1,146,124.3 thousand hectares, of which the Central Federal District accounts for 2.01%. The leader in this indicator is the Siberian Federal District, in which the total land area of the wood fund is 26.08%, of which the Krasnoyarsk Territory accounts for 13.85% or 158,742.9 thousand hectares.

The main objectives of the strategy for the Russian wood industry development by 2030 have certain targets (table 2).

According to the basic scenario of the country's wood industry development by 2030, the area of deforestation is forecasted to be 1396 thousand hectares, which will increase revenues to the budget for the use of forest resources up to 56.6 billion rubles. While planning the wood industry development, special attention was paid to the volumes of exports and imports, by 2030 the imports of products is forecasted to be worth 215 billion rubles, and exports - 874 billion rubles, which will increase by four times a surplus of the foreign trade balance of the wood industry complex.

Research results of a number of foreign scientists [11-13] indicate that clusters have a positive impact on firm productivity, sales revenues, size, and export performance. Cluster members also have a higher probability of becoming high growth firms and they offer higher wages to their employees. These findings support the view that clusters are an important driver of firms' growth and competitiveness and support the existence of cluster policies.

Characterizing the current state of the wood industry development in Russia (figure 1), we present a share of domestic products on the world market.

Table 2. Key indicators of the Russian wood industry in accordance with the basic development scenario, in billion rubles.

Criteria	2020	2021	2022	2023	2024	2025	2030
Criteria of the forest complex development							
Area of cut forests, ths ha	1192	1221	1245	1259	1267	1272	1396
Payment to the budget for the usage of forests	44.7	46	47.1	47.7	48.1	48.5	56.6
Criteria of the wood industry development							
Wood products import	195	197	199	201	203	205	215
Export of processed products of the wood industry	637	684	712	729	742	755	874
Added value, created by the wood industry	674	714	742	762	778	796	946
Tax revenues from the wood industry enterprises	113	117	121	124	127	133	157
Manufacture of wood products on 1 area of merchantable forests, rbl/ha	1075	1138	1183	1215	1240	1268	1508

According to the survey of representatives of the companies of the wood industry of Russia, the most promising segments of the industry are cardboard for packaging, tissue paper, corrugated cardboard, plywood, oriented strand board (OSB), wooden pellets, chipboard, medium and high density fiberboard (MDF and HDF), cellulose.
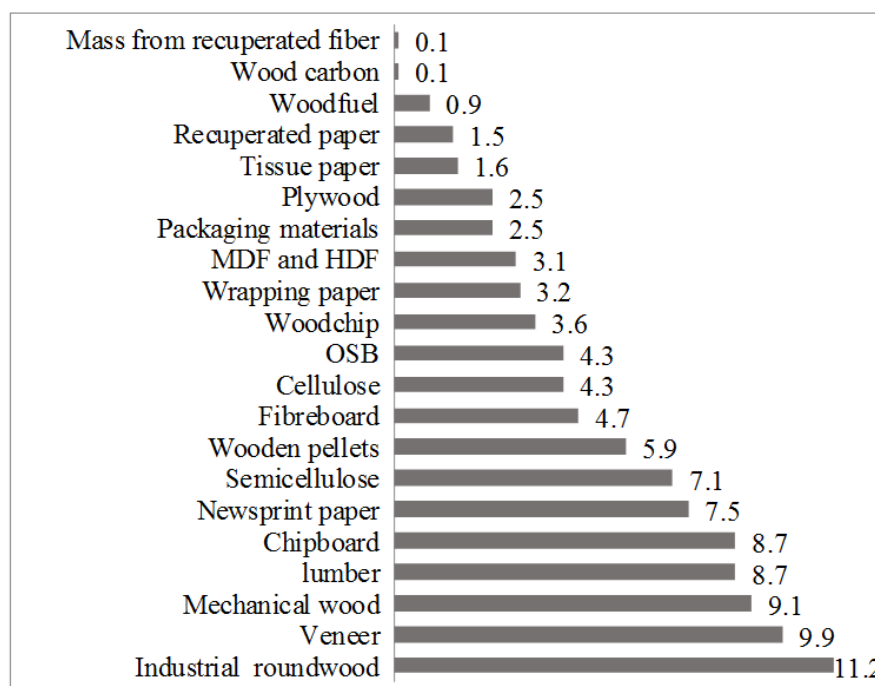
Figure 1. Share of Russia in the world market of wood production in 2018, %.

Assessing the export of Russian products of the wood industry, it should be noted that an indicator has been steadily increasing since 2015; according to the data of 2017-2018, the growth rate was about 20%. According to the results of 2018, the value of the indicator amounted to $13.395 mln. China, Kazakhstan, Azerbaijan, Uzbekistan, Belarus, Germany, Italy and others can become promising partners for export growth.

The investment projects are often implemented in the field of forest exploitation and the development of wood production, and 18 projects worth 55 billion rubles were implemented in 2018 and the first half of 2019. These projects were implemented in the territory of 9 regions of the Russian Federation. The Vologda region implemented 7 investment projects with a total sum of financing equal to 5.385 million rubles. The highly financed is the project on the low-grade wood processing and pellet production, implemented on the basis of limited liability company 'Ustyan Forest Processing Company' in the Archangel region. The amount of financing for his project made 16,684 million rubles. The Arkhangelsk region also implemented a large-scale investment project with 12,996 million rubles of financing for the reconstruction of cardboard production.

Figure 2 shows the information on promising projects, which will be implemented and planned in the period of 2019-2023. In this period, 131 investment projects with the volume of financing of 958 billion rubles are planned to be implemented in the wood industry of the Russian Federation. The largest number of projects is envisaged in the field of woodworking, there are 66 of it with a total sum of financing of 84 billion rubles. During the analyzed period, it is planned to allocate 518 billion rubles for the development of pulp and paper production. However, in order to solve the problems of strategic development of the wood industry of the country, it is required to have large volumes of investments, which will make it possible to carry out an economic and technological breakthrough in the industry. For this purpose, it is advisable to focus efforts on identifying some points of economic growth in the industry, on the strengthening of the processes of integration and the establishing of inter-industry economic ties.
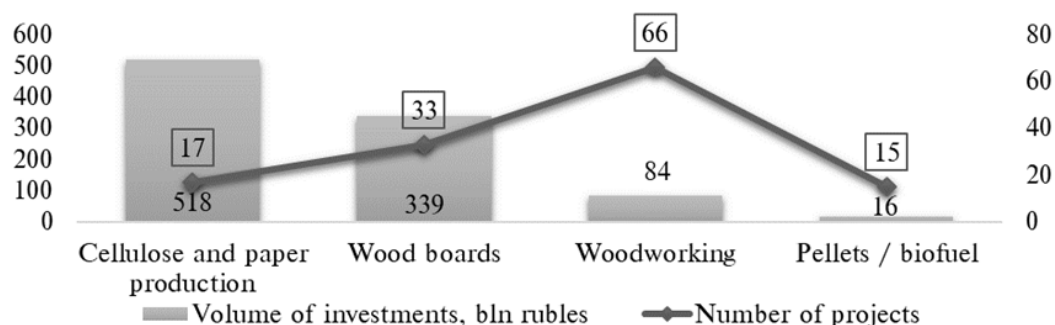
Figure 2. Wood projects in the period of 2019-2023.

The use of various forms of interaction between economic entities in practice has become widespread abroad. Integration processes are essential elements of economic development.

Integration processes change the level of interaction between enterprises, forming new organizational and legal mechanisms; the higher adaptation capabilities help achieve a synergetic effect, increase the competitiveness and have impact on the innovative development and the creation of knowledge-intensive production.

The formation of integration forms of interaction allows you to effectively use various types of resources, ensure that the participants of the integrated structure receive many advantages.

The integration of economic entities occupies a certain place in the system of economic relations and performs a number of important functions, including the following: organizational, stimulating, resource, regulating, coordinating, controlling and prognostic.

The economic integration is based on a number of fundamental principles. According to Topoleva T [14], the key principles are: scientific and economic validity; social and economic orientation; democratic framework of an integrated structure; regulation and prevention of market monopolization; coherence of activities; elimination of economically impractical intermediation; ensuring of mutually beneficial cooperation.

In the conditions of increasing competition, instability of the economic environment and the development of science and technology, many scientists identify clusters among the most effective forms of integration [9, 15, 16].

In Russia, the clustering processes in the economy are actively underway. Currently, there are about 140 clusters in the country, most of which are at the initial level of development. The first cluster was formed in St. Petersburg in 1999, with its key specialization in information and communication technologies. There are 295 participants in this structure; the level of development is estimated as high. The best part of clusters operating in Russia was formed in the period of 2012-2015. A distinctive feature of Russian clusters is that almost all of them are sector associations of organizations. Clusters have various key specializations; there are totally about 28 of them. Among the most common specializations are the following: production of equipment (including machine tools, special equipment, vehicles) – 27% of clusters; microelectronics and instrument manufacture, as well as pharmaceuticals – 13% of clusters function in each specialization; new materials and information and communication technologies, the medical industry and nuclear and radiation technologies, as well as agriculture and the food industry – 12 per cent of clusters in each specialization; wood industry clusters account for 5%.

In the foreign countries, clusters have 66 specializations; the following specializations have become widespread: information and communication technologies, the food industry, pharmaceuticals and medical equipment, auto industry, chemical industry, electricity production, textile industry.

Cluster associations have a number of advantages, compared to other integrated entities. The functioning of clusters is oriented at realization of interests of the participant and the territories of its location.

The use of cluster approach by the state is seen as an instrument for the economic development of certain territories and as a 'growth point'. According to the first approach, the functioning of clusters is characterized by budgetary, economic and social efficiency, and the result of clusters is the social and economic development. When considering cluster formations as 'growth points', specialists highlight some functional, structural, institutional and dynamic effects.

For the enterprises included in a cluster, the main effects of integration interaction are the following: agglomeration effect, self-learning effects, inter-firm cooperation and innovation effect. The effect of clusters on the regions is to ensure social development, create new jobs, and create new standards for life quality of the population.

Many competitive advantages of clusters are due to information openness of the participants, the development of exchange forms between it, the readiness of participants to interact and implement solutions, in accordance with common interests [6].

Nevertheless, certain obvious benefits of clusters do not always meet expectations of their participants. This is confirmed by large-scale studies conducted by the Croatian scientists I Anich, N Korrocher, A Morrison and Z Aralik [17], who demonstrated that heterogeneity, inherent with cluster members, forms different expectations from interaction in the cluster. Some cluster participants expect to receive state support, others hope to extend business ties, while the third group of participants wishes to develop innovative opportunities and exchange technologies. There is also a clear industry structure: representatives of traditional industries hope to have their interests lobbied and hope to obtain the state support, while young companies in high-tech sectors are looking for some opportunities for networking and innovation. The research that the scientists conducted shows clear directions in the development of clusters: the drawing-up of a cluster development program that satisfies the interests and expectations of its participants and the creation of a solid management structure that can further these interests.

In addition, in 2017, we undertook a study in terms of identifying the problems connected with the functioning of clusters and the estimating of their management system, the study was based on a questionnaire survey of 48 participants from 3 regional clusters. The results of the cluster management system study, according to the general assessment, are presented in figure 3.

The results of the questionnaire survey demonstrate that for many positions that relate to management in the cluster it is necessary to draw up certain measures to strengthen the interaction among the participants and coordinate their activities, in order to increase effectiveness.
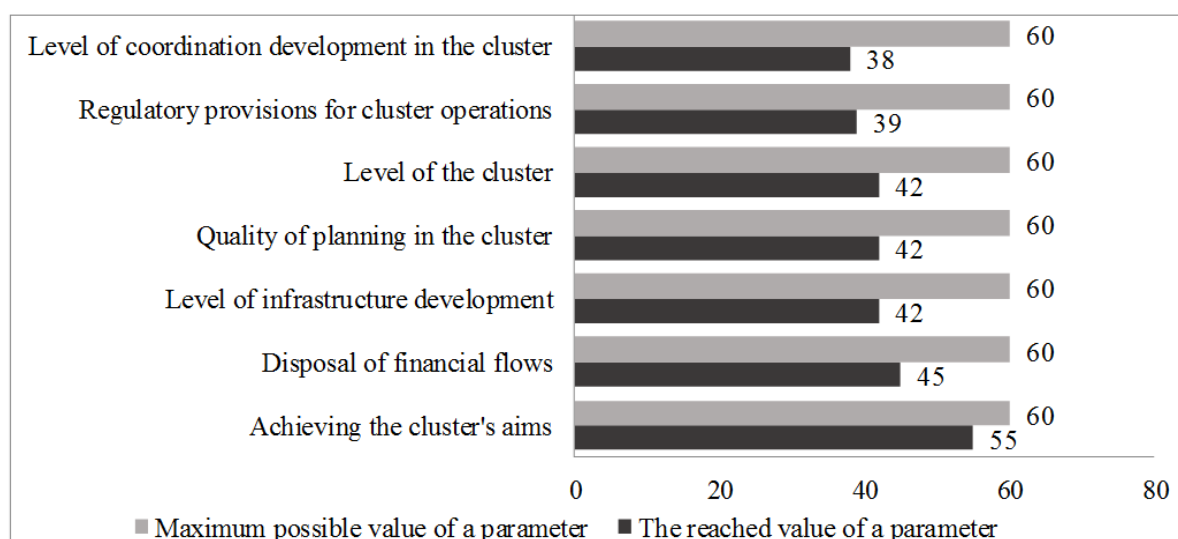

Figure 3. Results of the questionnaire survey on the cluster management system.

Figure 4 shows the most significant problems, sorted out during the study, in cluster functioning.

The data presented in the survey confirm that the issues of how to improve management in clusters are very acute and need to be solved. Coordination, motivation, financing and performance assessment are particularly problematic areas for cluster participants in the region [18].

The examples of successful functioning of cluster structures in the wood industry can be found in the foreign and domestic practice. The formation and activity of cluster organizations in the wood industry has become widespread in Finland, Sweden, Canada, Austria, and USA.

The high results of the development of the wood industry in a number of foreign countries is linked by scientists to the implementation of a cluster approach to wood management based on the integrated innovative use of wood, with the usage of environmentally-friendly technologies.

So, the wood cluster operating in Finland is a single production chain from the processing of forest raw materials to the production of high-quality wood products. The main products, manufactured by this cluster, include: cellulose, paper, cardboard, lumber, wooden boards, carpentry [19]. A cluster is characterized by the balanced development of the main and additional industries, high internal competition, intensive intra-cluster interaction, strong innovative potential [20].
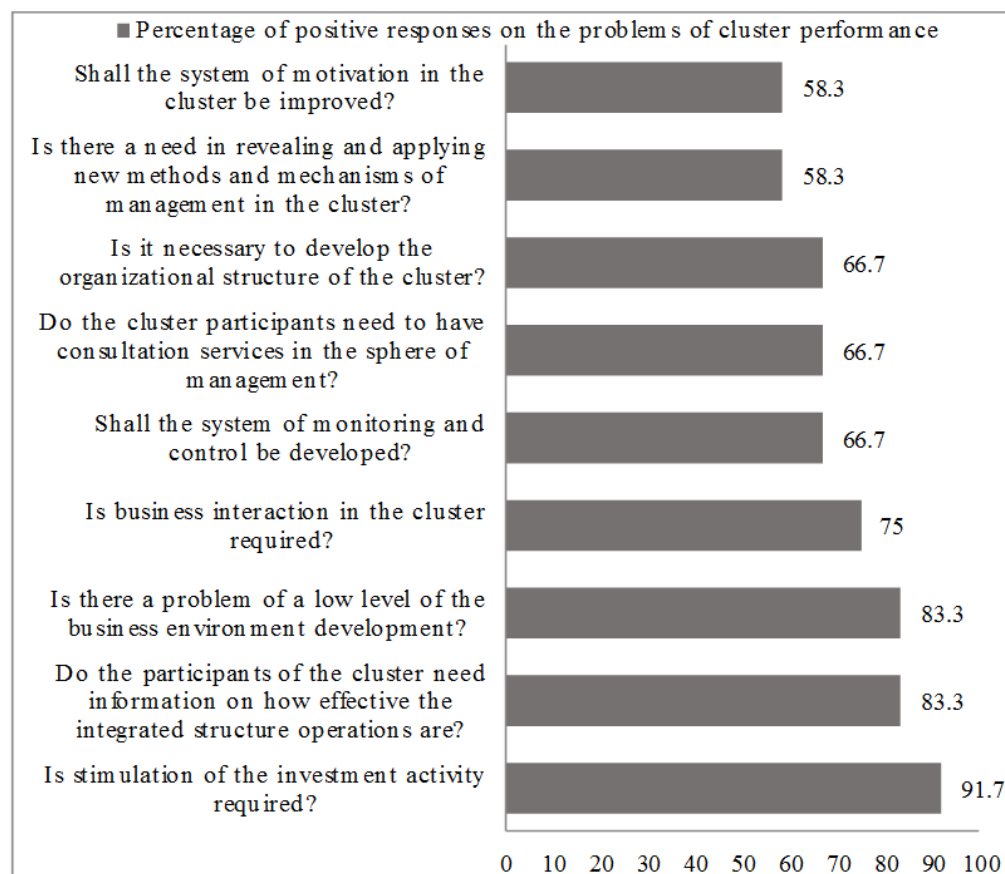
Figure 4. Results of the questionnaire survey on key cluster performance problems.

According to the data of the Institute of Natural Resources of Finland, in 2018, the total value of exported products of the wood industry of the country made over 13.17 billion Euros, or 20.6% of the total export volume. Products of the wood processing industry were exported for 2.89 billion Euros, pulp and paper products - for 10.28 billion Euros. The main areas of wood products supply from Finland are Germany (accounts for 14% of export revenues), China (10%) and Great Britain (7%). 74% of total shipments to China come from cellulose, with paper having the largest export share in

Germany and the UK. 2.10 million cubic meters of wood were exported. Main areas of supply: Sweden (72%), Germany (6%), Poland (5%) [2].

According to 2018, Finland is one of the five leading countries, exporting packaging materials and cellulose (the share in world exports is 8% each). Finland's wood industry accounts for about 5% of the country's GDP.

The formation and development of Finland's wood clusters took place with the support of the State in the implementation of two programs: the 'National Cluster Programme' (financing of study in the field of wood production, practical developments and technology) and the 'Centers of Expertise' (stimulating innovation, subsidizing the training costs and creating new jobs) [21].

The experience in the development of Finland's wood industry makes it possible to conclude that the high level of competitiveness of its wood industry in the world market is caused by the process of concentration of production at the account of creation of the integrated structures, such as clusters, the introduction of innovations, which allowed to develop the manufacture of products with high added value. Studies by foreign scientists show that the most pressing problems for the timber industry complexes in many European countries in modern conditions are the transition to a sustainable circular economy based on the integrated use of forest raw materials and reforestation [22, 23].

In Russia, there are 6 cluster structures in the wood complex, the key specialization of which is forestry, woodworking, pulp and paper production, and 1 cluster specializes in manufacture of furniture. Characteristics of the clusters are shown in table 3.

Table 3. Characteristics of the wood industry clusters of Russia by specializations.

Cluster's name	Region of location	Year of set up	Number of participants	Number of employees	Availability of support
Cluster of furniture manufacturers, woodworking and related sectors	Sakha Republic (Yakutia)	2009	11	78	▲
'Wood industry cluster of the Khanty-Mansi Autonomous District – Yugra'	The Khanty-Mansi Autonomous District	2013	18	2,923	▲
Furniture cluster of the Voronezh Region	The Voronezh Region	2013	13	6,075	▲
Cluster of wooden house-building and woodworking of the Vologda Region	The Vologda Region	2014	19	3,034	▲
Wood industry cluster 'PomorInnovaLes' of the Arkhangelsk Region	The Arkhangelsk Region	2014	31	20,110	■
Industry cluster of the Pestovsky District of the Novgorod Region	The Novgorod Region	2014	28	510	▲
Wood industry cluster of Komi Republic	Komi Republic	2015	15	3,300	■

▲ - Supported by the Center for Cluster Development within the framework of the program of the Ministry of Economic Development of Russia, focused on the support of small and medium-sized enterprises

■ - Included in the list of industrial clusters, approved by the Ministry of Industry and Trade of Russia

In Russia, the first cluster in the area of wood production was formed in the territory of the Sakha Republic (Yakutia) in 2009; it has 11 participants and 78 employees. The main products manufactured by this cluster include: cabinet furniture from laminated chip board and wood massif, soft furniture, polygraphy, folk art crafts and others. Despite the long period of this cluster's work, the level of its organizational development is primary.

The most successful is the Innovative Territorial Wood Cluster of the Arkhangelsk Region 'PomorInnovaLes', set up in 2014. The cluster is characterized by a medium level of organizational development and has the largest number of participants and workers, compared to other clusters in the field of wood production. Related specializations of this integrated structure are: new materials, furniture manufacture, construction, urban economy, architecture and technical tests, etc.

The main program events of the cluster development include: development of a study and development sector, including the cooperation in the scientific and technical sphere (10 joint cluster projects); development of the system of training and advanced training of scientific, engineering and managerial human resources (2 joint cluster projects); development of productive capacity and cooperation (3 joint cluster projects); development of the personnel potential; cluster infrastructure development (5 joint cluster projects); organizational development of the cluster; measures to improve state support and create favorable conditions for cluster activities.

'PomorInnovaLes' cluster's distinctive feature is realization of a large number of cluster projects, stipulated by the program of an integrated structure development. For 2020, it is planned to fulfill the projects on the creation of equipment for waste recycling in the logging area and creation of complex equipment for the production of black pellets.

In addition, quite a large cluster by the number of employees is the Furniture Cluster of the Voronezh region. The main products of this cluster are: office furniture with a facade of massive wood, MDF and chipboard, coated with natural veneer or decorative films; massive wood furniture; upholstered furniture; table-tops; facades and other things. According to the estimates of the Center for Cluster Development of the Voronezh region, the Furniture Cluster is in the 3d place in the rating of cluster structures of the region.

The clusters, operating in the field of wood industry in Russia, are provided with state support measures (2 clusters – according to the programs for industrial clusters of the Ministry of Industry and Trade of Russia, 5 clusters – according to the programs of the Ministry of Economic Development of Russia, aimed at the support of small and medium-sized enterprises).

The experience of forming clusters in the wood industry should be extended to different regions of the country, which have an appropriate resource potential. Special attention should be paid to clustering processes in this industry in the Central Federal District, which has a high potential of domestic market of wood processing products consumption.

The largest area of the forest fund lands among the regions of the Central Federal District is noted in the Kostroma and Tver regions. In the country as a whole, the permissible volume of wood outtake (an estimated logging area) is 729,031.4 thousand square m. The Central Federal District accounts for 6.57% of Russia's rated wood cutting. The largest permissible amount of outtake is noted in the Kostroma, Tver, Smolensk, Moscow regions. The following regions of the Central Federal District are characterized by low indicators: the Orel, Belgorod, Lipetsk, Kursk Regions. The key activity of the wood complex of this territory is the production of plywood, wooden boards, and furniture.

Many regions of the Central Federal District, among its strategic tasks of socio-economic development set the creation of wood clusters. However, up till now, no major success has been achieved by any region. Despite the limitations in the resource base on the territory of the district, it is possible to organize the production and development of high-end products, furniture industry.

In order to eliminate this problem, it is necessary to improve the directions of cluster policy in the regions of the Central Federal District in terms of its orientation towards the creation of interregional clusters in the wood complex.

An interregional cluster should be understood as the integration of economic entities from several regions with a purpose to achieve a common goal (complex and effective exploration of natural

resources and raw materials, the set-up of joint scientific and innovative centers, the increase in export opportunities, etc.). In the Russian reality, many regional authorities support the formation of interregional clusters, inserting such a goal into the strategy for the development of territories.

The basis of such a policy should be a model of 'smart specialization' in the spatial development of the country and its regions. The functioning of interregional clusters in contemporary conditions is ensured by a rapid spread of information technologies, which contribute to effective interaction of cluster participants and management of complex integrated formations, improvement of transport and logistics infrastructure. Accordingly, the boundaries of modern clusters without significant losses can expand beyond the regions. Interregional interaction of wood industry enterprises ensures a greater efficiency of its economic activity, creates an opportunity for implementation of large-scale innovative projects, the rational use of forest resources, an increase in entrepreneurial activity [24].

An idea of setting up some cluster associations on the territory of the Central Federal District is that clusters can be created in the following 4 quadrants: in the northwest, northeast, southwest and southeast of the territory under consideration, in which a core-region of an interregional wood industry cluster is supposed to be defined. We used the rating-and-score method for this purpose.

The results of the calculations are presented in table 4, which depicts that in the northeastern quadrant of the Central Federal District, the Kostroma region occupies the leading positions among the regions and a sufficient potential needed for the formation of the cluster core is concentrated just in this region. In the northwestern quadrant, the Tver region demonstrates strong positions, in the southwestern – the Smolensk region, in the southeastern – the Voronezh region, on the territory of which a furniture cluster operates, consequently, it is possible to raise the Voronezh region to a new level and organize its interaction with other regions.

In determining the regions, with which it is advisable to organize interaction, the distance between them and their resource potential were taken into account. The organized clusters have to be provided with a resource base, a material and technical base, personnel, besides, they shall have market channels.

Assessing the aggregate potential of the regions in points according to the presented methodology, it is worth mentioning that almost all of the presented interregional clusters have fairly good starting positions (table 5).

Proceeding from the principles of territorial proximity, concentration and intra-industry specialization of the cluster associations' participants, we recommend to form 4 interregional wood industry clusters on the territory of the Central Federal District (figure 5):

1) The South-West cluster will cover the territories of the Smolensk, Kaluga and Bryansk regions. The resource potential of these regions is almost equal, as for transboundariness of the regions, it is sure to increase the concentration and the existing reserves of forest raw materials and capacities for the manufacture of high value-added products from forest raw materials will be conductive to competitiveness of the cluster. The location quotient and growth rate of timber production volumes, calculated in terms of the cluster, show that certain opportunities for clustering exist;

2) The North-West cluster can be located on the territory of the Tver and Moscow regions. Forest resources and manufactures for these resources primary processing in the Tver region, in conjunction with enterprises, manufacturing high value-added products from forest raw materials, and investment opportunities of the Moscow region, will increase the competitive advantages of the cluster. The location quotient shows that opportunities for clustering are available and interaction will accelerate the development of the industry;

Table 4. Rating of the regions which are potential participants of interregional wood industry clusters.

Region	Number of employees	Points	Number of organizations	Points	Forest fund land size, in ths. acres	Points	Total volume of wood, in mln. m³	Points	Volume of shipped products, in mln. rubles	Points	Total number of points by all indicators
The Belgorod region	101	0.2	5	0.2	230.4	0.2	50	0.2	11.165	0.2	1.0
The Bryansk region	509	0.4	34	0.2	1,208.7	0.4	220.6	0.4	17.261	0.2	1.6
The Vladimir region	475	0.4	37	0.2	1,463.4	0.4	271.6	0.4	33.377	0.6	2.0
The Voronezh region	43	0.2	18	0.2	464.8	0.2	68.1	0.2	10.095	0.2	1.0
The Ivanovo region	144	0.2	64	0.4	1,042.7	0.2	170.2	0.2	11.967	0.2	1.2
The Kaluga region	167	0.2	30	0.2	1,253.7	0.4	263.3	0.4	30.710	0.6	1.8
The Kostroma region	1438	1.0	185	1.0	4,632.4	1.0	763.9	1.0	63.321	1.0	5.0
The Kursk region	68	0.2	3	0.2	237.1	0.2	42.4	0.2	8504	0.2	1.0
The Lipetsk region	225	0.2	12	0.2	180.5	0.2	35.1	0.2	13.392	0.2	1.0
The Moscow region	161	0.2	84	0.6	1,930.9	0.4	394.9	0.6	237.888	1.0	2.8
The Oryol region	8	0.2	4	0.2	173.1	0.2	27	0.2	1619	0.2	1.0
The Ryazan region	327	0.4	34	0.2	931.1	0.2	168.1	0.2	11.242	0.2	1.2
The Smolensk region	241	0.2	75	0.4	1,991.4	0.4	333.5	0.6	32.121	0.6	2.2
The Tambov region	529	0.4	11	0.2	374.7	0.2	69.2	0.2	6544	0.2	1.2
The Tver region	1503	1.0	113	0.8	4,876.9	1.0	739.6	1.0	32.897	0.6	4.4
The Tula region	22	0.2	8	0.2	282.7	0.2	74.7	0.2	40.217	0.6	1.4
The Yaroslavl region	440	0.4	54	0.4	1,688.3	0.4	279	0.4	21.976	0.4	2.0
Total for the Central Federal District	6401		771		22,962.8		3,971.2		584.296		

Table 5. Score assessment of the interregional clusters' development potential.

A	B	C	D	E	F	G
The South-West cluster	The Bryansk region	1.6	5.6	1.341	119.59	119.21
	The Smolensk region	2.2				
	The Kaluga region	1.8				
The North-West cluster	The Moscow region	2.8	7.2	1.961	104.68	112.99
	The Tver region	4.4				
The South-East cluster	The Voronezh region	1.0	5.8	0.723	119.55	113.50
	The Lipetsk region	1.0				
	The Ryazan region	1.2				
	The Tambov region	1.2				
	The Tula region	1.4				
The North-East cluster	The Vladimir region	2.0	10.2	2.442	114.24	113.16
	The Ivanovo region	1.2				
	The Kostroma region	5.0				
	The Yaroslavl region	2.0				

A – Interregional cluster; B – Participant regions of the cluster; C – Number of points scored by a region; D – Aggregate potential of the territories used for clusterization; E – Location quotient in terms of a potential cluster; F – Growth rate in terms of the shipped products (by sectors) in the regions of a potential cluster; G – Growth rate in terms of the shipped products (by the processing manufacture) in the regions of a potential cluster

3) The South-East cluster can be located in the Tula, Ryazan, Tambov, Lipetsk and Voronezh regions. The resource potential of these regions is basically represented by the enterprises producing high value-added products from forest raw materials (plywood, chipboard, furniture, paper, etc.), with a high growth rate of the industry. The Voronezh region is a scientific and educational center providing for innovations and personnel for the wood industry, these advantages will contribute to the growth of competitiveness of the cluster.

4) The North-East cluster will cover the territories of Kostroma, Yaroslavl, Ivanovo and Vladimir regions. The resource potential of these regions is the reserves of forest raw materials and some enterprises for primary processing of these reserves, the cluster's specialization in lumber production, house building and innovations in there sphere of utilization of wood leftovers will contribute to the cluster's competitiveness. This cluster has the best start-up capabilities: a high level of the location quotient and the industry development rate.

When determining the clusters' boundaries, we proceeded from an optimal transport accessibility (not more than 400 km), expressed in a distance at which the amount of transport costs will not lower the cluster members' efficiency below the efficiency of the timber industry entities which did not vest interest in participating in the cluster (figure 5).
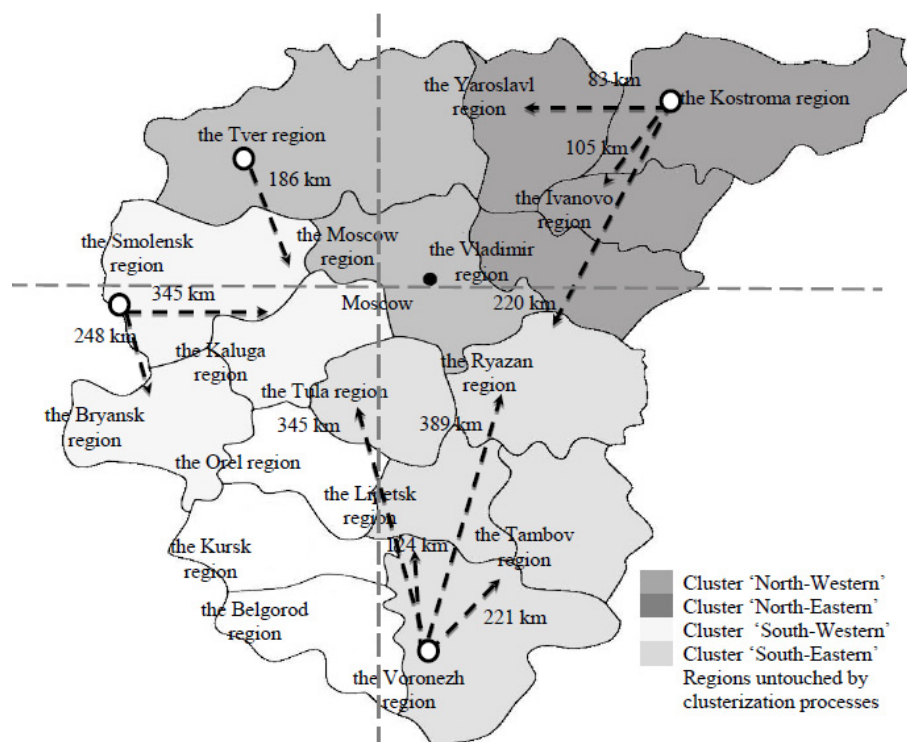
Figure 5. Cartogram of the potential wood clusters location on the Central Federal District territory.

In order to form interregional wood clusters at the interregional level as potential 'points of economic growth' of the territories, the following step-by-step scheme of actions should be proposed:

Stage 1 - to assess the condition of the wood industry and the efficiency of the existing clusters in the territory of the potential interregional wood industry clusters with the purpose to identify some economic entities, capable of forming the core of a cluster, to determine its motivation for establishing economic ties;

Stage 2 - to organize cooperation between economic entities, capable of forming the core of a potential interregional wood cluster, with participation of representatives of state structures - Centers for Cluster Development of the Regions, in order to outline a cluster initiative, form a collegiate cluster management body and a road map for its creation;

Stage 3 - to analyze the conditions, factors of external and internal environment, opportunities and threats of potential interregional wood cluster with the aim of outlining the cluster contour, to designate its production and scientific infrastructure (scientific and educational unit, innovation unit, logging unit, industrial wood processing unit, financial and investment unit, organizational and management unit);

Stage 4 - to draw out a strategy for the development of a potential interregional wood cluster in order to determine the purpose, mission, tasks of functioning, development targets, assessment of the current potential of the cluster and a required resource support, formation of mechanisms for attracting investments, the development of programs for obtaining state support, etc.;

Stage 5 - to develop (and in the future to improve) the production and technological chains for the creation of cluster products, measures to introduce innovative technologies for an advanced processing of wood raw materials, construction of transport and logistics chains, formation of a marketing strategy and promotion of the cluster brand;

Stage 6 - to develop cluster projects, to conduct an assessment of potential financial resources of the members of an interregional cluster and the territories of its location, this can be aimed at supporting its development, determination of a necessary amount of investment funds and ways of attracting it.

While forming interregional wood clusters on the basis of the algorithm proposed by us, it is necessary to focus on the available socio-economic potential in the regions, the territory of which will be included into the boundaries of the cluster.

4. Summary

The wood industry of Russia, with its huge natural-resources potential, faces many problems in its development that reduce its competitiveness and investment attractiveness. A need to cross the wood industry over to the complex advanced processing of forest raw materials requires large amounts of investments which makes it possible to achieve an economic and technological breakthrough in the industry. For this reason, it is advisable to focus efforts on identification of the economic growth points in the industry, to strengthen integration processes and establish inter-sectoral economic relations.

A rationale for this idea in the study was the evaluation of the foreign and domestic experience in managing the development of the cluster-based integration processes in the timber industry which demonstrates the best opportunities, required to introduce innovative technologies and to increase the industry enterprises' efficiency. Successful operations of the Finland's wood industry cluster help it account for 20.6 percent of the country's total exports and enjoy a wide geography of supplies in the world. Although the timber clusters of Russia are undergoing only an initial stage of development, they already show a successful implementation of innovative projects and attract investments and state financing.

Clusters have several advantages over integrated entities of other types. Functioning of clusters is focused on realizing the participants' interests and the interests of the territories where the clusters are located. For the enterprises that are part of the cluster, the main effects of integrated interaction are as follows: agglomeration and innovations, self-education and inter-firm cooperation. The clusters' effect on a region makes it possible to boost its social development, create new jobs and introduce new life quality standards for the population. However, the effects from clusters do not always correspond to expectations of their participants. Due to heterogeneity in cluster members, different expectations from interaction in the cluster are formed. Accordingly, in the process of creating a cluster development program and implementing it, these expectations should be taken into consideration. The results of our research confirm than a highly-experienced management team is crucial for the cluster. The questioning of the cluster participants showed that it is necessary to develop certain measures to strengthen interaction and coordination of their activities, as well as motivation for further cooperation.

Differentiation in the levels of socio-economic development of the Russian regions, the territorial remoteness of the timber-processing centers from the potential distribution markets for the wood industry products served as a basis for an idea to form interregional clusters. Our research suggests an approach to the formation of interregional wood industry clusters on the territory of a macro-region of the country, this allows to concentrate a resource potential of several territories in order to strengthen the interaction between the timber-producing enterprises and the cluster infrastructure organizations. The author's approach consists in determining the core-regions for interregional wood industry clusters on the basis of the rating-and-score method and the system of indicators characterizing the resource potential and volumes of the timber industry. When defining the trans-boundary regions, with which it is advisable for the leading regions to organize interaction, the optimal distances between them and also their resource potential were taken into account. To form the interregional wood industry clusters, this research suggests using the phased algorithm of actions that allows the entities, interested in forming an association, to organize work on a systemic basis, to form a full-fledged membership of the cluster and to determine certain objectives for its development

program, with orientation at the existing resource potential of the timber industry in the regions, the territories of which will be involved in the cluster.

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