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Identification of Regional Clusters in the Russian Far East

Natalia Yurevna Titova[1], Mihail Aleksandrovich Pervuhin,
Georgij Gennadevich Baturin

Abstract:

Decision-making in the regional economy from the point of view of the cluster approach is gaining increasing popularity in Russia. Clustering contributes to the effectiveness of regional development, and, in turn, necessitates the development of a cluster policy that would increase the benefits of the region and the national economy. The paper presents the results of the study of regional clusters of the Far East of the Russian Federation.

The aim of the paper is to develop a methodology that allows identifying clustering processes and its approbation (case study of the Far Eastern Federal District). The developed methodology makes it possible to determine the stage of the life cycle of an identified cluster, as well as to find the problem factors that impede its development. The study is based on the methodology of the European Cluster Observatory, supplemented by indicators of investment in fixed assets and the sectoral structure of gross value added, as well as a method for analyzing the structural shifts in the economy. The criteria for assessing the stage of the operation of clusters based on the introduced scale are proposed.

Because of the calculations, it was revealed that most identified clusters are at the stage of cluster initiatives' formation, except for the fishery cluster of the Sakhalin Region, which is defined by the authors as formed. Other identified clusters belong to the following economic activities: "mining", "production and distribution of electricity, gas and water", "public administration and ensuring military security", "transportation and communications" and "health and social services".

At the same time, there is practically no cluster development in processing types of economic activity and service sectors. The presented results testify to the high share of raw materials' production in the economy of the Far East, which reduces the likelihood of implementing the current state policy for the development of an innovative economy.

Keywords: *regional cluster, cluster identification, clusterization, European cluster observatory methodology, shift-share analysis, average annual number of employees in the economy, fixed capital investments, sectoral gross value added, the Far East of Russia.*

JEL Classification: *O10, O18*

[1]*Vladivostok State University of Economics and Service, 690014, Russia, Vladivostok.*

1. Introduction

Clusters are now becoming one of the key areas of discussion and analysis in the current debate on regional economic development (Feldman, 2000; Mindlin, *et al.,* 2017; Petruk, *et al.,* 2016; Vorozhbit and Pristup, 2015; Vorozhbit, Terentyeva, T.V. & Titova, N.Yu., 2016; Frank, *et al.,* 2016; Ryzhkova and Prosvirkin, 2017; Liapis *et al.,* 2013; Tyaglov *et al.,* 2017). The cluster concept is of interest to scholars, consultants and politicians interested in stimulating the growth of national competitiveness in the growing global economy (Faizova *et al.,* 2015). As Steiner points out (1998), due to the widespread dissemination of the view that increasing the degree of specialization leads to an increase in the level of employment and productivity, clusters have become an effective way to improve competitiveness for industries in many cities and regions. Cluster strategies have been adopted in several organizations working at different geographical levels, including regional development agencies of several European and North American countries, as well as government bodies such as the UK Department of Trade and Industry and supranational bodies such as the Organization for Economic Cooperation and Development.

At the same time, the formation of industrial clusters in the Russian Federation does not find proper application and effective functioning. As a rule, initiatives to create clusters in Russia in most cases come from state federal bodies. In this case, clustering acquires a vivid politicized shade, and the natural processes of self-organization of enterprises locally are launched artificially. Meantime, the Government's conclusions on the support of certain industries do not carry a real basis, comprising an integrated system analysis of the environment under which a potential industrial cluster should form. This problem is aggravated by the fact that in the present scientific environment the problem of identifying potential clusters in Russian business conditions has conflicting approaches that, when applied, make it difficult to make managerial decisions on supporting key industries.

Thus, the task of identifying clusters is highly relevant, since algorithms for accurately stating the presence of clusters and their parties in a certain territory are not sufficiently studied at present. In this regard, the purpose of this study is to develop a methodology that allows identifying clusters and its approbation using the case study of the Far Eastern Federal District of Russia, based on the study of the methods proposed by contemporary researchers.

In the present economic literature, special attention is paid to the identification of industrial clusters in the region. To date, the cluster definition, given by Michael Porter, is understood as a group of geographically localized interconnected companies, suppliers of equipment, components, specialized services, infrastructure, and research institutes complementary to each other and enhancing the competitive advantages of companies and the cluster (Porter, 1990).

An analysis of the works by leading economists has made it possible to specify two groups of methods for identifying regional clusters. The characteristic underlying the group we have found is the number of branches of the cluster being identified. Thus, the first group of scientists proposes to identify inter sector (poly-sector) clusters, while the second group is oriented toward the identification of mono-sector clusters.

The first group of quantitative methods for identifying poly-sector clusters can also be divided into several approaches. The first of these is the analysis of input-output tables. The first studies in this direction appeared in the works by Izard and Schuler (1959), Roepke, *et al.* (1974), and Campbell (1974). Similar problems with reference to industrial complexes were also dealt with by such Russian scientists as Aganbegyan (1969), Granberg (1969), Lavrovskiy (1983). However, for the present Russian conditions, the method of analyzing the input-output tables is difficult to implement because the sectoral balances are not drawn up at the country level or at the regional level (Vovchenko and Panasenkova, 2013; Pociovalisteanu and Thalassinos, 2008).

The second approach for identifying inter sector clusters involves the use of multidimensional data analysis (factors, discriminant and statistical cluster analysis). These approaches explore common inbound and outbound connections (resource and product markets), thereby integrating industries into clusters. The third approach of methods uses graphs as a means of visualizing the analysis of direct links, identified based on the analysis of input-output tables. The basis of this group of methodical guidelines is the construction of the adjacency matrix, a binary matrix the unit elements of which represent certain "essential" connections between branches.

Analyzing the possibility of practical application of methods for identifying inter sector clusters, the authors concluded that their implementation is fraught with a lot of technical difficulties, which include the lack of necessary statistical data, as well as the complexity of interpreting the results.

Considering the second group of methods for identifying mono-sector clusters, it should be noted that a common feature of such techniques is the calculation of the localization coefficients. To identify significant cluster sectors, different researchers use different threshold values, as well as calculation bases. The fundamental methodology in this group is the methodology of the European Cluster Observatory (European Cluster Observatory, n.d.). It involves the calculation of 3 indicators:

1) "specialization" – the localization coefficient, the value of which should be ≥ 2:

$$LQ = \frac{Emp_{ig} / Emp_g}{Emp_i / Emp} = \frac{Emp_{ig} / Emp_i}{Emp_g / Emp}, \quad (1)$$

where LQ is the localization coefficient;
Emp_{ig} is the number of employees in the sector of economy i in the region g;
Emp_g is the total number of employees in the region g;
Emp_i is the number of employees in the sector of economy i nationwide;
Emp is the total number of employees nationwide.

2) "size" of the cluster group, which is the share of the region in the total employment in the cluster group nationwide. The significance of the "size" indicator takes place when the region falls into leading 10% in this indicator.

3) "focus" of the cluster group, which is the share of employment in the cluster in the total employment of the region. It is considered significant if it belongs to 10% of clusters of the same category, which account for the largest share of the total employment in the region (Rastvortseva and Cherepovskay, 2013).

For compliance with each of the three criteria, the region under study receives one "star". Thus, significant cluster sectors are placed on the map, ranked by the number of stars from 1 to 3. Despite the successful application of this technique around the world, it is subject to active academic criticism. The main drawback of the European methodology, according to many authors, is that it is based only on one indicator – the analysis of labor resources potentially involved in a regional cluster (Levchenko and Chiposakaya, 2015). However, other important for effective economic development indicators are not considered. In this regard, there is an extensive amount of research aimed at complementing the indicators that underlie the calculation of the localization coefficient.

Kudryavtseva proposes to supplement the analysis with the coefficients of the number of enterprises and their turnover by the types of economic activity (Kudryavtseva and Yamschikova, 2012). Based on the calculated individual indicators by the types of economic activity, scholars need to calculate the integral index. In the authors' opinion, the indicator of the number of enterprises does not reflect the real contribution to the economy of a potential cluster, since the duration of the market operations of enterprises is not analyzed.

According to the research of Pechatkin, it is necessary to evaluate not only the contribution of the type of economic activity to the gross regional product, but also to fixed assets, as well as investments (Pechatkin, 2012). The authors opine that rational in this methodology is the inclusion in the analysis of a cluster's investment in fixed assets, since the most important condition for the competitiveness of any enterprise is its technical improvement.

According to Filippova, the methodology should include an analysis of such indicators as the contribution of enterprises of the potential cluster to GRP (gross regional product), the level of employment, the presence of cluster products in the regional, national and world markets, the dynamics of its growth and the profitability of the market segment (Filippova, 2011). Somewhat different, but at the same time even more extensive system of indicators within the methodical approach, based on

the case study of the Volga Federal District, is offered by Afonina (2012). This system is based on the properties of the cluster being created, namely: location of companies in a compact area, labor productivity, innovative activity, universities and research institutions, the degree of development of foreign economic activity and attractiveness of the regional economy. In our opinion, the drawbacks of this methodology include the lack of data in the public domain about organizations and the number of personnel employed by them, performing research and development.

Thus, the authors concluded that the detailing of the indicators underlying the calculation of the localization coefficients is certainly necessary, since it makes the analysis more complex. Meantime, an excessively detailed methodology complicates calculations and their interpretation. It is important that the data characterizing the development of a regional sector are publicly available, because firstly, it simplifies data collection, and secondly, makes the analysis results transparent and easily verifiable. In this regard, the authors offer to take no more than three indicators as the calculation base that are in the public domain and are compiled by the Federal State Statistics Service. In addition, a significant disadvantage of the above-mentioned techniques is their static nature.

In the authors' opinion, like any economic process, clustering in a region's sector occurs in the case of its sustainable development. Therefore, it is important to analyze the indicators in dynamics. From this point of view, the algorithm proposed by Kovaleva is more perfect, because it is based on the analysis of several time periods (Kovaleva, 2011).

2. Methods

Regarding the above-mentioned position, the authors supplemented the calculation basis of indicators. It should be noted that the set of indicators included in the methodology is of fundamental importance, since the introduction of indicators that are not capable of reflecting the cluster development of an area can lead to distortion of the real prerequisites for the clusterization of regional sectors. This will be a catalyst for making incorrect management decisions aimed at increasing the competitive advantages of the studied area (Shekhovtsov *et al.*, 2017.

At the stage of formation of clusters and identification of the prerequisites for their formation, the development of production factors in the region is of the greatest importance. The most important of them are labor resources, as well as the provision of sectors with basic production assets. Among the publicly available statistical indicators, such indicators as "average annual employment in the economy" and "investments in fixed assets" most fully reflect these trends.

In addition, the specificity of clustering is to increase the concentration of enterprises in the region types of economic activity. In this regard, it is assumed that as such concentration is growing, the share of such a sector in the gross regional product

increases. This is reflected by the indicator "sectoral structure of gross value added". Thus, the indicators "average annual employment in the economy", "investment in fixed assets", "sectoral structure of gross value added" are the core indicators used in the methodology developed.

At the first stage, it is offered to calculate the localization index for identification of potential clusters as per the following formula:

$$LQ = \frac{l^i / l}{L^i / L} \quad (2)$$

where l^i is the average annual employment in the economy (investments in fixed assets, sectoral structure of gross value added) in the sector i in the region; l is the average annual employment in the economy (investments in fixed assets, sectoral structure of gross value added) in the region; L^i is the average annual employment in the economy (investments in fixed assets, sectoral structure of gross value added) in the sector i in the country; L is the average annual employment in the economy (investments in fixed assets, sectoral structure of gross value added) in the country.

For each parameter selected for each region under study, the calculation results are input in the following table. Table 1 displays an example of the calculated localization index for some sectors of the Khabarovsk Region's economy (the Far Eastern Federal District; FEFD) within the research period.

Table 1 *– Localization index for some sectors of the Khabarovsk Region's economy in 2008-2014*

Sectors	Localization index																				
	Average annual employment in economy							Investments in fixed assets							Sectoral structure of gross value added						
Years	2008	2009	2010	2011	2012	2013	2014	2008	2009	2010	2011	2012	2013	2014	2008	2009	2010	2011	2012	2013	2014
Agriculture and forestry, hunting	0.59	0.58	0.54	0.54	0.58	0.56	0.51	0.45	0.81	0.29	0.32	0.21	0.29	0.32	1.22	1.44	1.70	1.59	1.42	1.17	1.00

Sectors	Localization index																		
	Average annual employment in economy							Investments in fixed assets							Sectoral structure of gross value added						
Fish-catching, fish-farming	3.22	4.52	4.22	4.03	4.27	4.15	3.70	2.07	10.62	2.39	1.62	1.73	1.04	1.07	6.04	6.34	5.08	5.80	6.18	7.45	7.00
Mining	1.13	1.20	1.02	1.05	1.07	1.06	1.10	0.26	0.34	0.31	0.33	0.45	0.72	0.55	0.47	0.56	0.46	0.51	0.59	0.53	0.42
Processing	0.70	0.71	0.71	0.76	0.74	0.72	0.71	1.42	0.75	0.69	0.95	1.27	2.20	1.85	0.72	0.58	0.60	0.62	0.54	0.53	0.54
Transport and telecom	1.26	1.24	1.22	1.24	1.28	1.29	1.04	1.04	1.56	2.52	2.19	1.72	0.98	0.08	1.97	1.68	1.79	1.99	2.19	2.49	1.09
State government and military security	1.46	1.46	1.41	1.47	1.49	1.51	1.05	2.74	1.76	1.41	1.80	3.11	3.39	0.67	1.76	1.64	1.48	1.62	1.65	1.61	0.63
Healthcare and social services	0.97	0.96	0.98	0.96	0.97	1.04	0.96	3.24	1.62	0.68	0.81	1.47	0.90	1.55	1.51	1.33	1.22	1.36	1.48	1.60	1.36

Source: *compiled by the authors as per (Federal State Statistics Service, 2017).*

If the calculation of the localization index at the first stage of the methodology is aimed at identifying the concentration of economic sectors by the selected parameters, the next stage of the developed methodology focuses on finding factors that contribute to or hamper the cluster development of an area.

So, at the second stage, for the selected types of economic activity in the region, the Shift-Share analysis method was applied. The purpose of this analysis is to identify the relationship between the economic growth of the region's industries with the national trends and the identification of regional advantages. The indicators used in the authors' methodology are presented in Table 2.

Table 2 *– Components of Shift-Share analysis*

Factors	Formula	Description
1. NS (National Share) is the factor reflecting the impact of national growth trends.	$NS = l^i_{t-1} * \left(\frac{L_t}{L_{t-1}} - 1 \right)$ (3)	l^i_{t-1} is employment (investments in fixed assets, gross value added) in the sector i in the region for the period $t-1$, L_t, L_{t-1} is employment (investments in fixed assets, gross value added) nationwide for the period t and $t-1$, l^i_t, l^i_{t-1} is employment (investments in fixed assets, gross value added) in the sector i in the region for the periods t and $t-1$, L^i_t, L^i_{t-1} is employment (investments in fixed assets, gross value added) in the sector i nationwide for the periods t and $t-1$.
2. IM (Industry Mix) is the factor reflecting the impact of sectoral growth trends.	$IM = l^i_{t-1} * \left(\frac{L^i_t}{L^i_{t-1}} - \frac{L_t}{L_{t-1}} \right)$ (4)	
3. RS (Regional Shift) is the factor reflecting the impact of regional growth trends.	$RS = l^i_{t-1} * \left(\frac{l^i_t}{l^i_{t-1}} - \frac{L^i_t}{L^i_{t-1}} \right)$ (5)	

Source: *compiled by the authors as per (Sambidi, 2008).*

After calculating the values of these factors, the total value of increment of the variable is calculated considering the influence of the national, sectoral and regional factors determined as follows:

$$TEC = NS + IM + RS \quad (3)$$

As per (Sambidi, 2008), the expected change as the sum of NS and IM components is also assessed:

$$EC = NS + IM \quad (4)$$

Comparing RS, EC and TEC allows concluding whether sectors have any significant impact of the regional factor on expected change of EC.

About the selected object and subject of research, the regional factor influence on the development of a sector is getting special importance. As Safiullina *et al.* (2013) notes, if the regional factor dominates in the growth structure of an indicator, it "allows assuming the presence of internal sources of competitive advantages that ensure the outstripping dynamics of economic activities of the area's industrial complex over macroeconomic and sectoral growth rates.

The increase in the structure of the growth of the territorial component serves as a target indicator of the effectiveness of regulatory influences to stimulate the competitiveness of such economic activities that form the basis of the area's competitive profile" (Safiullina *et al.*, 2013; Salimova and Makolov, 2016). In turn, this gives grounds to identify the processes of clustering in the area. Thus, industries characterized by high RS values have a significant cluster potential. Industries with stably negative values of the regional factor are outsiders of the economy.

Positive values of the RS regional factor for the industry in the region suggest that it has a competitive advantage compared to other regions. In addition, Sambidi suggests using the inequality RS > EC, which, together with the inequality RS > 0, means that the sector in the region is developing better than nationwide.

Thus, in the study for the types of economic activity of the regions of the Far Eastern Federal District selected at the second stage, the factors NS, IM, RS are calculated. Because of the calculations performed, a table is made in which the received indicators are recorded. Table 3 shows the regional factor RS for certain types of economic activity for the Republic of Sakha (Yakutia), FEFD.

Table 3 *– RS indicator for the Republic of Sakha (Yakutia).*

Sectors	Average annual employment in economy						Investments in fixed assets						Sectoral structure of gross value added					
Years	2009	2010	2011	2012	2013	2014	2009	2010	2011	2012	2013	2014	2009	2010	2011	2012	2013	2014
Mining	5.90	-5.40	-0.15	-1.82	0.90	1.38	5475.06	-13830.06	-2041.69	17033.01	3370.70	-9.64	-5002.44	31416.85	4987.38	-9569.52	-2117.44	48 034.40
Electric power, gas and water production and distributio	1.45	-0.83	-0.08	-0.05	-0.43	0.65	1802.53	829.00	15711.30	12006.51	-19069.22	-6.77	-853.20	728.03	-138.99	1429.14	-505.92	2 232.56

n																		
Transport and telecom	0.10	0.90	1.68	-0.43	0.79	0.40	28788.26	-68842.4	-5.57	-19476.3	638.86	0.75	9343.01	399.63	-2477.3	6136.9	-6785.6	6 052.00
Education	-1.85	-1.39	0.15	0.40	-0.17	-0.29	-280.12	1164.81	620.95	-41.45	-180.00	0.40	-394.03	-1717.43	303.64	1057.43	5747.21	-1 396.66

Source: *compiled by the authors as per (Federal State Statistics Service, 2017).*

The interpretation of the obtained indicators is determined as follows. In the beginning, the localization index is evaluated. For each of the parameters characterizing types of economic activity (employment, investment in fixed assets, gross value added), the number of periods in which the localization index is greater than 1 is calculated. The data are recorded in the corresponding table (Table 4). Meantime, types of economic activity, in which, for each of the three indicators, the localization index is less than 1 in more than half of the periods studied, are excluded from further analysis. To assess the dynamics of localization, the ratio of the index of localization of the first period to the latter is also considered, and recorded in the table. This makes it possible not only to identify in which sectors of the region the greatest concentration of production activity is observed, but also to track whether these processes have somewhat positive dynamics.

The comparison of the regional factor RS and the current value of the indicator "average annual employment in the economy", "investment in fixed assets", "labor productivity" and "gross value added") is also necessary for our study. We believe

that if the contribution of the regional factor RS in l_t^i is more than 10% (RS > $0.1l_t^i$), the regional factor may have great influence.

Thus, for each economic activity by all three indicators, it is necessary to calculate the following assessment criteria:

I. Number of periods (years) in which LQ > 1;
II. Ratio of LQ in the base period to the current period's LQ;
III. Number of periods (years) in which RS > 0 and RS > EC;

IV. Number of periods (years) in which RS > 0 > $0.1l_t^i$ (l_t^i is current value of employment). Table 4 displays the final calculations: case study of the Primorsk Region.

Accordingly, the higher the results of the above criteria in each of the indicators, the greater the probability of existence of a cluster in the selected sector in the

investigated area. However, since there are several stages of a cluster's lifecycle, it is necessary to distinguish the level of identifiable integrations. In this connection, based on the criteria found, it is proposed to introduce the following scale, displayed in Table 5, which allows relating the lifecycle stage of the identified cluster depending on the results obtained.

Table 4 *– Calculations for identification of clusters in the Primorsk Region in 2008-2014*

Indicator	Average annual employment in economy				Investments in fixed assets				Sectoral structure of gross value added			
Economic activities	Assessment criteria*											
	I	II	III	IV	I	II	III	IV	I	II	III	IV
Agriculture and forestry, hunting	0	1.0	4	0	0	1.6	2	3	6	1.1	2	2
Fish-catching, fish-farming	7	1.3	2	1	7	1.1	4	4	7	0.7	2	1
Mining	0	0.8	1	1	0	1.9	1	1	0	1.1	3	3
Processing	0	1.0	3	0	2	1.9	4	4	0	1.2	2	2
Electric power, gas and water production and distribution	7	1.0	2	1	5	0.9	4	4	7	0.8	1	1
Construction	0	1.0	2	2	1	1.0	3	2	4	0.9	4	3
Wholesale and retail; repairs	7	1.0	2	0	0	1.2	2	3	4	0.9	3	0
HoReCa	7	1.0	2	2	0	5.6	5	5	4	1.4	4	4
Transport and telecom	7	1.0	3	0	7	0.5	3	2	7	1.0	2	1
Finance	0	0.9	1	0	5	0.1	1	1	0	4.6	4	4
Real estate, hire and services	0	1.0	2	0	0	1.3	1	1	0	1.1	2	2
State government and military security	7	1.0	2	1	5	5.2	3	3	7	0.9	1	1
Education	0	1.0	4	0	7	1.0	3	3	5	0.8	1	1
Healthcare and social services	0	0.9	2	0	2	1.9	3	3	7	0.8	0	0
Other services	2	0.9	3	1	4	1.6	2	2	0	1.6	3	3

Source: *compiled by the authors as per (Federal State Statistics Service, 2017).*

** I is the number of periods (years) in which LQ was more than 1; II is the ratio of the base period's LQ to the current LQ; III is the number of periods (years) in which RS > 0 and RS EC; IV is the number of periods (years) in which RS > 0 > 0.1l_t^i (l_t^i is current value of employment).*

It should be noted that the degree of development of the relevant criteria and indicators also relates to the identifiable cluster's specifics. So, with a low number of periods in which the indicators for certain criteria take acceptable values, problem blocks are formed. The account of such blocks helps to reveal what factors of production the cluster lacks to achieve a more perfect form of its development.

Table 5 *– Criteria scale for assessing the type of the cluster identified (x is the score obtained from the calculation, t is the number of time periods in which the criteria take valid values.*

Points interval	Characteristic
$0 \le x < 5t$	ω-cluster (omega-cluster) is absence of enough features enabling to suggest the existence of a cluster in the area.
$5t \le x < 6t$	δ-cluster (delta-cluster) is emerging cluster at the stage of cluster initiatives. If there are no trends to self-organization of entities in the selected type of economic activity, it may turn into a gamma-cluster subject that respective actions are taken to eliminate problem blocks.
$6t \le x < 7t$	γ-cluster (gamma-cluster) is operating cluster, experiencing a few problems hampering occupying a more stable market position.
$7t \le x < 8t$	β-cluster (beta-cluster) is operating cluster, needing adjustment of management decisions seeking to make competitive products.
$8t \le x \le 9t$	ά-cluster (alpha-cluster) is successfully operating cluster, making competitive products nationwide.

Source: *compiled by the authors.*

The presented scale does not include the criterion II, which is the ratio of the localization index LQ of the base period to the current LQ. In the authors' opinion, this ratio should be viewed as an indicator of the general trend showing the growth (decline) of clusterization.

3. Results

Based on the calculations performed in accordance with the developed methodology, Table 6 is displayed, in which the best results of economic sectors are fixed, making it possible to identify clusters in FEFD.

Table 6 *– Calculations using the methodology for identifying clusters in FEFD in 2008-2014*

Indicator	Average annual employment in economy				Investments in fixed assets				Sectoral structure of gross value added			
Economic activities	Assessment criteria											
	I	II	III	IV	I	II	III	IV	I	II	III	IV
The Amur Region												
Electric power, gas and water	7	1.0	3	0	7	1.2	3	3	7	0.9	2	2

Indicator	Average annual employment in economy				Investments in fixed assets				Sectoral structure of gross value added			
Economic activities	Assessment criteria											
	I	II	III	IV	I	II	III	IV	I	II	III	IV
production and distribution												
Agriculture and forestry, hunting	7	1.0	3	1	0	1.7	4	4	7	1.0	2	3
Healthcare and social services	7	1.1	4	0	5	3.6	3	3	7	0.9	0	0
The Kamchatka Region												
State government and military security	1.1	3	0	7	1.3	4	3	7	1.0	1	1	21
Fish-catching, fish-farming	1.0	2	2	7	1.0	3	3	7	0.6	1	1	21
The Magadan Region												
Mining	7	1.3	1	2	7	2.2	5	5	7	0.9	2	1
The Primorsk Region												
HoReCa	7	1.0	2	2	0	5.6	5	5	4	1.4	4	4
Fish-catching, fish-farming	7	1.3	2	1	7	1.1	4	4	7	0.7	2	1
State government and military security	7	1.0	2	1	5	5.2	3	3	7	0.9	1	1
Electric power, gas and water production and distribution	7	1.0	2	1	5	0.9	4	4	7	0.8	1	1
The Republic of Sakha (Yakutia)												
Mining	7	1.0	3	1	7	1.2	2	2	7	1.1	2	2
The Sakhalin Region												
Fish-catching, fish-farming	7	0.9	2	0	7	3.2	4	4	7	0.9	4	3
Mining	7	0.8	0	0	7	1.5	4	4	7	1.2	2	2
The Khabarovsk Region												
Transport and telecom	7	1.1	4	0	6	1.1	2	2	7	1.4	3	3
State government and military security	7	1.0	3	0	7	1.7	3	4	7	1.0	1	1
The Chukotka Autonomous District												
Mining	7	1.4	2	2	7	0.9	3	3	7	1.3	2	2

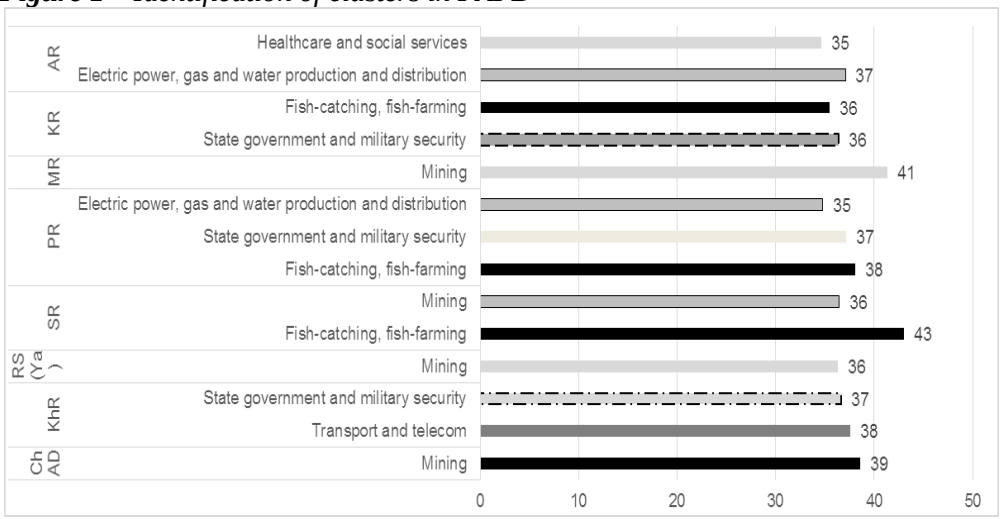
Source: *compiled by the authors as per (Federal State Statistics Service, 2017).*

Since the study covers the time from 2008 to 2014, that is, 7 periods, the maximum final score, sufficient to identify the alpha-cluster, falls within the interval from 56 to

63. Figure 1 more graphically summarizes the points by kinds of economic activities in FEFD's regions, obtained after calculations.

Based on the calculations and analysis according to the developed methodology of the sectors of the economy of the Far Eastern regions in 2008-2014, it is evident that no alpha- and betta-clusters were found in the whole area. The only cluster that is of the gamma type is the cluster of fishing and fisheries in the Sakhalin Region. All other clusters are of the delta type, that is, they are identified as being formed. It should be noted that not all regions are represented in this list, since at the stage of the analysis of the localization index, no type of economic activity of the Jewish Autonomous Region has shown results that are within acceptable values.

Figure 1 *– Identification of clusters in FAFD*



Source: *compiled by the authors.*

4. Discussion

As the analysis showed, the calculation of the localization index by the three indicators makes it possible to more accurately determine the set of industries for further research in each of the regions. For example, if the calculations of the localization index were made by two indicators - "average annual employment" and "investment in fixed assets", then in the Magadan Region, the list of sectors for research would include "finance", and in the Jewish Autonomous Region it would include "electric power, gas and water production and distribution" and "transport and telecom". Thus, an increase in the number of indicators for the calculation of LQ leads to a reduction, within each region, in the number of sectors that require verification of the cluster potential.

Analyzing the general dynamics of cluster development in the Far East, it should be noted that this macro-region is strategically important for the development of the

mineral and energy sector of the Russian Federation. Delta clusters for mining were identified in the Magadan (41 points) and Sakhalin (36 points) Regions, the Chukotka Autonomous District (39 points) and the Republic of Sakha (Yakutia) (36 points). At the same time, there are no clustering effects in manufacturing, which characterizes the macro-region as mining-dependent. This trend contradicts the strategy of the socio-economic development of the Russian Federation until 2020, declaring the transition to an innovative development path (Oleinik 2016; Masyuk, Karantseva and Bushueva, 2015).

Because under current conditions of industrial stagnation, domestic demand for minerals is increasing, this objectively means the importance of a cluster approach for mining, as it can become a catalyst for the development of the industry. Due to the remoteness of the territories, the production of minerals is far from domestic sales markets, which requires exporting the mineral wealth (Shelomentsev *et al.*, 2015; Terentyeva *et al.*, 2016; Mazelis *et al.*, 2016; Nechaev and Antipina, 2016). The price rent received needs to be invested in modernizing the processing and reprocessing and increase the competitiveness of the products.

In the context of the regions, the mining sector shows the following cluster development. The highest number of points is in the Magadan Region, which is due to the growth of localization indexes in employment (an increase from 6.9 in 2008 to 8.7 in 2014), and a twofold increase in the IFA index (from 1.7 in the base period to 3.8 in the current). In addition, the growth within the studied period of investments due to the regional factor is 16.38 billion rubles, which is the best result in FEFD. However, despite the large investments in fixed assets, the gross value-added level is declining, which indicates a trend in the share of production in GRP. A promising investment project capable of forming a mining cluster includes the development of the Kunarevskaya prospective area with "China Nonferrous Metal Industry's Foreign Engineering Corporation" (NFC) (Far-Eastern Mining Sector is Dying Slowly, 2013).

The formation of petrochemical and fuel-energy cluster in the Sakhalin Region is caused by the growth of IFA and gross value added, as evidenced by the high number of periods in which the growth due to the regional factor exceeds the growth in the sector. The situation in employment in the sector was unfavorable (localization index fell from 3.1 to 2.5 for the period under study). In this case, the basis of the cluster may be the deposits located on the west coast of Sakhalin Island. The identifiable delta cluster in the Chukotka Autonomous District is caused by the region's high specialization in the development of this sector. Negative trends include the decline in the level of investments in fixed assets by 2.96 billion rubles due to the regional factor in the period under review.

A favorable situation for cluster development is observed in the Republic of Sakha (Yakutia). Calculations for the first and second stages of the developed methodology show the growth of indicators. It is noteworthy that, since 2013, the Center for

Cluster Development (Center for Cluster Development "Yakutia", n.d.) is functioning locally, established in the form of a joint-stock company in accordance with the joint order of the Ministries of business and tourism development and property and land relations of the Republic of Sakha (Yakutia). At the same time, the center supports projects of tourist-recreational and furniture cluster. However, the core participant enterprises are unprofitable, which impedes full integration (Fedorova and Dyachkovskaya, 2016). At the same time, manufacturing is a promising point of economic growth in the region, which requires additional state support and development.

Thus, industrial organizations of gold, diamond, oil and gas industries have real prerequisites for clustering (Nikiforova & Kovrov, 2015). In the republic, cluster initiatives were taken by the formation of the diamond mining cluster of "AK ALROSA", the gold mining and metals mining clusters of "GK Petropavlovsk" and "GMK Timir". In this study, the authors agree with the opinion of Arkhipov, who notes that these clusters are only provisional as they currently represent "a structured set of enterprises of one company that arise and develop in time, depending on external conditions initially subordinated to the same goal and having no competitors in this territory, organized primarily on a vertical basis" (Arkhipov, 2014).

In addition to the clustering of the mining sector, in the Far East, two delta clusters in "electric power, gas and water production and distribution" were identified in the Amur Region (37 points) and the Primorsk Region (35 points). Speaking about the Primorsk generating industry, it should be noted that there is a decrease in the regional factor for employment and gross value added (only 2 and 1, respectively, of 7-time periods take positive values). It can tell about the development of enterprises and the use of new technologies that help to automate processes and therefore reduce the number of personnel. In terms of investment in fixed assets, somewhat negative dynamics is observed in the localization index. In the Amur Region, the development of this type of economic activity is characterized by stable positive dynamics.

This is due, firstly, to the fact that Amur is a region with a high energy potential, occupying the first place in FEFD by the level of power generation. Secondly, the industry is characterized by the presence and successful functioning of important strategic facilities. Electricity production is concentrated in three municipalities of the region: Zeya, Bureya and Raichikhinsk, in the territories of which there are two hydroelectric power stations in the absence of energy-intensive industries. The production potential of the region's electric power industry is formed by "RusHydro", "Zeyskaya HPP", "Bureyskaya HPP", "Amurskaya Generation", and "Raichikhinsk State Local Power Station".

At the same time, the following investment projects are being implemented in the industry: the construction of Nizhne-Bureysk HPP and the second stage of the Blagoveshchensk TPP. Despite this, the values of localization coefficients for

investments in fixed assets have decreased by 40% over 5 years, which indicates a decline in investment activity in these types of economic activity.

If the sector is broadly in line with the historical way of the Amur economy, the development of public health shows a steady growth of investment and the volume of gross value added. At the same time, the industry has the highest rates of labor productivity: 1.55 in 2013. The prospects of clusterization of "healthcare and social services" are not as obvious as those for the previous economic activities because it takes a smaller share in the GRP, and has negative trends of the regional factor of sectoral gross value added.

However, there is a positive trend in investments in fixed assets (an increase in the localization index in 2014, 3 times compared with 2008). The above trends are caused by the implementation of large-scale investment projects such as the reconstruction of the plant to produce pharmaceutical substances arabinogalactan in Blagoveshchensk, the construction of medical and health complex based on Ignashinsk mineral water deposit, as well as the construction of the second stage of biopharmaceutical plant in Blagoveshchensk (List of Investments Projects and Offers of the Amur Region as on March 15, 2015). For better development of the healthcare cluster, it is necessary to attract more labor resources and enhance the sector's contribution in GRP.

Referring to the Amur Region, it should be noted that the number of points obtained in the course of calculation could allow for the identification in the region of a delta-cluster in "agriculture and forestry". However, it appeared that the level of investments in fixed assets' index is less than 1 when considering the localization, that being the reason for excluding "agriculture and forestry" from the list of delta clusters. The situation in that sector highlights the need for encouraging investment and that is the main condition for further effective development of the region's agricultural enterprises.

Three delta clusters are recorded for "state government and military security" – in the Primorsk (37 points), Khabarovsk (37 points) and Kamchatka (36 points) Regions. This is due to the high role of the defense industry. The dynamics of indicators in the regional industry characterize the steady growth of localization indices, as well as the influence of sectoral and regional factors on employment, investments in fixed assets and the volume of sectoral gross value added.

High indicators of economic activities "state government and military security" in the Khabarovsk Region are caused by the successful development of the aircraft cluster. This cluster receives state support via the Ministry of Economic Development. The largest participants of this industrial association are OAO "Komsomolsk-on-Amur Aviation Production Association named after Yu.A. Gagarin" ("KnAAPO") and ZAO "Sukhoi Civil Aircraft", where high-quality Su-27 combat aircrafts and their modifications are manufactured (The Strategy for

development of the Khabarovsk Region, 2010). Important is the fact that the region implements its cluster policy that is based on the real regulation in effect – Khabarovsk Act No. 317 of October 30, 2013 "On State Support of Innovative Activity in the Khabarovsk Region" (hereinafter – Act No. 317), which defines such terms as "innovative territorial cluster", "cluster project", "cluster member", "cluster partner".

However, the investment strategy of the Khabarovsk Region for 2014-2020 provides for the development of "transport and telecom" as well. Perhaps, this result is influenced by the modernization of the regional transport system, including the formation of a large transport and industrial hub that provides for the interlinked development of the port capacities of Vanino and Sovetskaya Gavan, the port and railway infrastructure, the construction of highways, and the creation of an international air hub in Khabarovsk airport.

The tendency of positive dynamics of clustering is characteristic for this period in fishing, too. Two delta clusters in the Primorsk (38 points) and Kamchatka Regions (36 points) and one gamma cluster in the Sakhalin Region (43 points) were identified in "fishing and fish farming". The study of the characteristics of fishing clusters of the Far East is more fully reflected in the previous study on the identification of cluster-type integration associations of this sector in the territory of the Russian Federation (Titova *et al.*, 2016).

5. Conclusion

Thus, based on the analysis and synthesis of the best practices of researchers, the authors developed and tested the methodology for identifying regional clusters. Unlike the existing ones, the authors' approach assumes the identification of territorial-sectoral clusters by analyzing not only the localization of the average annual number of employees in the region, but also the investments in fixed assets and the volume of gross value added. The calculation of the indicators over a few years makes it possible to reveal the dynamics of the cluster's development in the region, and the application of Shift-Share analysis makes it possible to find the stage of lifecycle of the identified cluster. The subject of further research by the authors is the approbation of this methodology on the level of the Russian Federation and its further improvement.

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References:

Afonina, A.G. 2012. Cluster Initiatives and Projects, 4, 35-39.

Aganbegyan, A.G. and Kazakevich, D.M. 1969. Optimal Territorial and Production Planning. Novosibirsk: Nauka, p. 348.

Arhipov, G.I. 2014. Corporate-Territorial Arrangement of Mining Industry and Cluster Projects in an Area with Mineral Wealth Economy Type. Regionalnaya ekonomika: teoriya i praktika, 8(335), 16-29.

Campbell, J. 1974. Selected Aspects of the Interindustry Structure of the State of Washington, 1967. Economic Geography, 50(1), 35-46.

Federal State Statistics Service. 2017. Uniform Interagency Information and Statistics System (UIISS), from http://www.fedstat.ru.

Fedorova, N.A. and Dyachkovskaya, N.N. 2016. Problems of Industrial and Transport Infrastructure Development in the Republic of Sakha (Yakutia). Sovremennye tekhnologii upravleniya, 8(68), 50-60.

Feldman, M.P. 2000. Location and Innovation: The New Economic Geography of Innovation, Spillovers and Agglomeration. In G.L. Clark, M. Feldman and M. Gertler (Eds.), The Oxford Handbook of Economic Geography (pp. 373-394). Oxford: Oxford University Press.

Filippova, I.A. 2011. Activation of Innovative and Investments Actions of the Ulyanovsk Region Based on Cluster Formation. Regionalnaya ekonomika: teoriya i praktika, 14(197), 15-22.

Faizova, G., Kozhevnikova, N., Kashipova, G., Zinurova G. and Egorova, E. 2015. Factors of Functioning and Development of Tourist Clusters at Regional Level. European Research Studies Journal, 18(3), 91-102.

Frank, E.V., Mashevskaya, O.V., Ermolina L.V. 2016. Innovational Mechanism of Implementation of Cluster Initiatives in Business. European Research Studies Journal, 19(1), 179 -188.

Granberg, A.G. and Protsenko, O.D. 1969. Economic and Mathematical Analysis of Production and Consumption. Moscow, Ekonomika, p. 183.

Isard, W. and Schooler, E.W. 1959. Industrial Complex Analysis, Agglomeration Economies and Regional Development. Journal of Regional Science, 1(2), 19-33.

Kovaleva, T.Yu. 2011. Algorithm for Identification and Assessment of Clusters in Regional Economy. Vestnik Permskogo universiteta, 4, 30-39.

Kudryavtseva, V.A. and Yamschikova, I.V. 2012. Specifics of Development and Operation of Construction Materials Industry in a Region. Vestnik INZhEKONa. Ser: Ekonomika, 6, 261-264.

Lavrovskiy, B.L., Baryshnikov, N.N. and Valtukh, K.K. (Eds.). 1983. Analysis of the Balance of Production Facilities in the USSR's Industry. Novosibirsk, Nauka, p. 207.

Liapis, K., Rovolis, A., Galanos, C. and Thalassinos, I.E. 2013. The Clusters of Economic Similarities between EU Countries: A View Under Recent Financial and Debt Crisis. European Research Studies Journal, 16(1), 41-66.

Levchenko, T.A. and Chiposakaya, I.S. 2015. Innovative Economy: A Cluster Approach. Vestnik Dalrybvtuza, 4, 32-40.

Masyuk, N.N., Karantseva, A.Ye. and Bushueva, M.A. 2015. The Russian Far East: Synergy of Clusters and Advanced Socioeconomic Development Territories. Nauchnoe obozrenie, 13, 182-187.

Mazelis, L.S., Solodukhin, K.S. and Lavrenyuk, K.I. 2016. Fuzzy Model of Development of the Organization's Human Capital at the Expense of the Investment Process. In

Proceedings of the 20th Eurasia Business and Economics Society Conference, Vienna, 88-89.

Mindlin, Y.B., Litvinenko, I.L., Zhangorazova, Z.S., Shichiyakh, R.A., Veselova, N.Yu. and Petruk, G.V. 2017. Formation and Development of Cluster Management in the Regional Economy of the Russian Federation. International Journal of Applied Business and Economic Research, 15, 201-212.

Nechaev, A. and Antipina, O. 2016. Analysis of the Impact of Taxation of Business Entities on the Innovative Development of the Country. European Research Studies Journal, 19(1), 71-83.

Nikiforova, V.V. and Kovrov, G.S. 2015. Assessment of Clusterization Potential of the Republic of Sakha (Yakutia). Ekonomicheskii analiz: teoriya i praktika, 34, 35-46.

Oleinik, Ye.B. 2016. On the Issue of Implementation of Advanced Development Territories in the Russian Far East: New Mechanisms of State Stimulation of Investment Activity and Their Results in the Mineral Wealth Sector of the Far East. Strategiya ustoichivogo razvitiya regionov Rossii, 36, 33-38.

Pechatkin, V.V. 2012. Formation and Development of Clusters in Russian Regions: Core Issues and Ways to Solve Them (Case Study of the Bashkortostan Republic). Ekonomicheskie i sotsialnye peremeny: fakty, tendentsii, prognoz, 1(19), 68-76.

Petruk, G.V., Shashlo, N.V., Klescheva, N.A., Vlasenko, A.A. and Stasenko, I.N. 2016. The Industrial-Educational Cluster Environment as a Tool of the Staff Capacity Forming of the Russian One-Company Towns. International Journal of Humanities and Cultural Studies, 3, 788-799.

Pociovalisteanu, M.D., Thalassinos, I.E. 2008. The beginning and some national particularities of liberalism. Metalurgia International, 13(2), Special Issue, 172-177.

Porter, M.E. 1990. The Competitive Advantage of Nations. New York: The Free Press, p. 580.

Rastvortseva, S.N. and Cherepovskaya, N.A. 2013. Identification and Assessment of Regional Clusters. Ekonomika regiona, 4, 123-133.

Roepke, H., Adams, D. and Wiseman, R. 1974. A New Approach to the Identification of Industrial Complexes Using Input-Output Data. Journal of Regional Science, 14(1), 15-29.

Ryzhkova, E. and Prosvirkin, N. 2017. Cluster Initiatives as a Competitiveness Factor of Modern Enterprises. European Research Studies Journal, 20(3) Part B, 530-538.

Safiullina, K.G., Safiullin, A.R., & Shinkevich, M.V. 2013. Identification of Structural Components of the Dynamics of Development of Economic Activities for the Purpose of Forming Innovative Territorial and Industrial Clusters. Vestnik Kazanskogo tekhnologicheskogo universiteta, 16(9), 323-328.

Salimova, T.A. and Makolov, I.V. 2016. Unused Potential of Quality Management Systems of the Russian Companies: An Empirical Study. European Research Studies Journal, XIX (3) Part A, 150-166.

Sambidi, P. 2008. Regional Industry Cluster Analysis for the Gulf Coast Economic Development District. Houston, Texas: Gulf Coast Economic Development District and the Houston-Galveston Area Council (H-GAC).

Shekhovtsov, V.R., Ponomareva, A.M., Yaroshenko, G.S., Khaibullin, R.L. 2017. Instruments of Investment Attraction in Order to Fulfill the Structural Priorities of Sustainable Regional Development (Study Based on the Rostov Region. European Research Studies Journal, 20(1), 337-349.

Shelomentsev, A.G., Kozlova, O.A., Bedrina, Y.B., Terentyeva, T.V. and Mingaleva, Z.A. 2015. Comparative Analysis of Regional Development of Northern Territories. Asian Social Science, 11, 349-356.

Steiner, M. 1998. The Discreet Charm of Clusters: An Introduction. In M. Steiner (Ed.), Clusters and Regional Specialization, 1-18, London: Pion.

Terentyeva, T.V., Varkulevich, T.V., Vasilenko, M.E., Shumik, E.G. and Smitskih, K.V. 2016. Methodical Review of the Social and Economic Development Rankings of the Region Based on Primorsky Krai. International Review of Management and Marketing, 6(4), 807-813.

Titova, N.Yu., Pervukhin, M.A. and Baturin, G.G. 2016. Development of a Methodology for Identification of Territorial and Sectoral Clusters: Case Study of the Fishing Sector of the Russian Federation. Vektor nauki Tolyattinskogo gosudarstvennogo universiteta. Seriya: Ekonomika i upravlenie, 4(27), 94-100.

Tyaglov, G.S., Kushnarenko, V.T., Khokhlov, A.A. and Qeropyan, A.M. 2017. The Development of Cluster Relations within the State and Business Structures in Terms of Strategy of Non-Primary Sector Import-Substitution. European Research Studies Journal, 20(1), 198-207.

Vorozhbit, O.Y. and Pristup, N.P. 2015. A Methodical Approach to the Assessment of Economic and Social Situation of the Regions of the Russian Federation. Mediterranean Journal of Social Sciences, 6(5), 49-56.

Vorozhbit, O.Y., Terentyeva, T.V. and Titova, N.Yu. 2016. Sustainable Development of Fishing Complex in Primorsky Krai Via Formation of Territorial-Sectoral Industrial Cluster. Azimuth of Scientific Research: Economics and Administration, T.5, 2 (15), 53-57.

Vovchenko, G.N., Panasenkova, T. 2013. Trends of Formation the Russia's Innovation Potential. World Applied Sciences Journal, 27(10), 1362-1366.