



Formation and development of industrial clusters in the regional economy

Formación y desarrollo de clusters industriales en la economía regional

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ABSTRACT:

In the current environment, the economic clusterization, which contributes to closer interrelations between the businesses operating within this system and promotes development of the involved regions, represents one of the key factors relating to competitive ability improvement of the active businesses. Identification and assessment of regional clusters is actually regarded as an insufficiently studied issue, which fact, first of all, is linked to complexity of the region as an economic system on the whole having rather a diversified profile. This paper deals with a study of theoretical and methodological aspects pertaining to formation of clusters in the industrial sector of the region. The methodological approach as devised by the authors of the present paper is based upon determination of localization coefficients, per capita production in the relevant sector, region's specialization in manufacturing of products falling within the scope of a specific industrial sector, and integral index of clusterization potential. As a result of the calculations, several industrial sectors were identified that displayed the highest degree of clusterization reasonability, in particular, chemical, petrochemical and fuel industries. Formation and development of a petrochemical cluster, in opinion of the authors, eventually will result in scoring a number of

RESUMEN:

En el entorno actual, la agrupación económica, que contribuye a una mayor interrelación entre las empresas que operan dentro de este sistema y promueve el desarrollo de las regiones involucradas, representa uno de los factores clave relacionados con la mejora de la capacidad competitiva de las empresas activas. La identificación y evaluación de los clusters regionales se considera en realidad como un tema insuficientemente estudiado, hecho que, en primer lugar, está vinculado a la complejidad de la región como un sistema económico que en su conjunto tiene un perfil bastante diversificado. Este artículo trata de un estudio de aspectos teóricos y metodológicos relacionados con la formación de conglomerados en el sector industrial de la región. El enfoque metodológico diseñado por los autores del presente trabajo se basa en la determinación de los coeficientes de localización, la producción per cápita en el sector relevante, la especialización de la región en la fabricación de productos dentro del ámbito de un sector industrial específico y el índice integral de potencial de agrupación. Como resultado de los cálculos, se identificaron varios sectores industriales que mostraron el mayor grado de razonabilidad de agrupación, en particular, industrias químicas, petroquímicas y de combustibles. La formación y desarrollo de un clúster petroquímico, en opinión de

advantages for the regional economics, including new job formation, manufacturing new product lines, development of region infrastructure, upgrading the research and technology along with increasing the degree of their implementation efficiency etc.

Keywords: Cluster, potential clustering, region, industry.

los autores, eventualmente dará como resultado una serie de ventajas para la economía regional, incluida la formación de nuevos empleos, la fabricación de nuevas líneas de productos, el desarrollo de la infraestructura de la región, la actualización de la investigación y la tecnología junto con aumentando el grado de su eficiencia de implementación, etc.

Palabras clave: Clúster, agrupamiento potencial, región, industria.

1. Introduction

The continuously growing competition makes it vital to seek new ways to promote a faster development and better competitive ability of the regional economic systems. One of the advanced forms of such development is a clusterization.

From the systematic approach perspective, a cluster represents a combination of businesses running in the interconnected industry sectors amalgamated into a single organizational structure the elements of which are intrinsically interrelated and interdependent and jointly functioning for a definite purpose. Formation of highly effective technological chains out of a number of separate business entities is a strategically important step that requires certain long-term investments into the implementation process, and perhaps the idea is realizable only by way of self-organization of these chains as a result of an interaction between the prerequisites formed both inside and outside of these potential systems. Such interaction must bring additional benefits for each of the involved business units, and create a motivation for setting up a unified functioning system, while ensuring its integrity.

The new form of arrangement of industrial production systems brings a variety of significant advantages for the businesses, through which the clusters may influence the competitive struggle. In the first place, a better performance of the firms and industry sectors making part of the cluster; in the second place, increasing opportunities for an innovative and industrial growth; and in the third place, encouragement of new businesses expanding the cluster boundaries.

2. Literature Review

Fundamentals of the cluster approach were set up by the US school of new forms of production process management, which was represented by theoretical and applied investigations carried out by M. Porter, M. Larenzen, P. Maskell, S. Rosenfeld, M. Storper, M. Enright etc. The founder of the cluster approach M. Porter created a theory of industrial clusters which was based on the following conclusion from the theory of the Diamond Model of Competitive Advantages: conditions for giving rise to a competitive advantage for the involved regions become better when the firms functioning in one particular industry sector are geographically concentrated (Porter, 2005). According to the theory of regional clusters developed by M. Enright, competitive advantages resulting from performance of clusters emerge at the regional level rather than at the national one (Enright, 1992). Regional clusters represent the specific objects where the cluster policy can be implemented. It is the regional clusters that require the state authorities' attention and support for R&D organizations. From this point of view, the basic determinants for development of the regional clusters are the four sides of the rhomb of competitive advantages as defined by M. Porter.

Another foreign scientist S. Rosenfeld further developed the theory of regional clusters and investigated the communication channels between the firms (members of the cluster) and related organizations. M. Rosenfeld considered such communication channels as a significant element of the clusters (Rosenfeld, 1997). According to his approach, a regional cluster is more than just a geographically outlined concentration of interdependent firms. The firms also should have channels designed to facilitate production related transactions, dialogues and communication between middle and small size enterprises. This idea was further explicated by P. Maskell and M. Larenzen in the conclusion that setting up a networking cooperation between the firms based on a trust in the partner principle is the main

prerequisite for formation of a competitive regional cluster and enhancement of the competitive ability of the firms being members of the cluster (Maskell et al., 2003). French scientists J. Tolenado and D. Soulie defined a cluster as «draw dies», or an interdependence between different economic sectors in terms of technological complexity levels, which is based upon a necessity of creation of technological links between industrial and economic sectors for proper realization of their potential advantages (Tolenado, 1978; Soulie, 1989). A Swedish scientist E. Dahmen defined a cluster as a combination of sectors, or «development blocks» where a prerequisite for progress is availability of a linkage between an ability of one sector to develop and its ability to contribute to progress in another sector (Dahmen, 1950). In such conditions, development should take place on a phased basis, or along «a vertical line of actions» within one industry sector connected with other sectors. Such a method may help achieving competitive advantages. According to V. Feldman's point of view expressed in his later theory, a cluster is a diversified group of industries interconnected by the supply and purchase correlations based upon a «cost – output» matrix (Feldman, 1999). A benefit of such an approach is that it proceeds from extensive empirical studies of diversification forms in different countries.

3. Methodology

The cluster related technologies have found quite a wide application in the world. Most of European countries worked out the most adoptable cluster strategies for their economic and industrial development. In doing this, governments of the involved countries focus on supporting the existing clusters and setting up new networks of the companies which never dealt with each other. The state not only assists in creation of clusters but per se becomes a member of the networks. As an example, in 1995 Germany launched the Bio Regio program that was aimed to contribute to creation of biotechnological clusters in the country. In the United Kingdom, the government defined the districts around Edinburgh, Oxford and Southeastern England as the main regions for location of biotechnological firms. In Norway, the government provides incentives for cooperation between the firms being members of the marine clusters. Finland has a very well-developed wood industry cluster comprising wood production and wood products manufacturing, papermaking, furniture fabrication, printing machinery and related equipment manufacturing sectors.

The global clusterization experience shows the following:

First, the cluster-oriented structuring of the economy has a substantial influence on the entire national economic policy. It is primarily associated with a support to the science, risk-bearing innovations, export activities, creation of required infrastructure, and educational background.

Second, the cluster-oriented policy leads to enhancement of the competitive ability at the national level. For example, the economic policy of Finland based upon a clusterization. As a result, during the recent years the country has been at the top of global current and future competitiveness ratings.

Third, clusterization provides new opportunities for the businesses, contributes to better soundness of small entrepreneurship, improves environmental responsibility of enterprises, and leads to expansion of voluntary environmental activities carried out by the enterprises.

Investigation of a possibility to form clusters in the region calls for sizing up its clusterization potential. The clusterization potential lies in availability of competitive advantages with the industry sectors, enterprises, and infrastructure organizations functioning in the region as well as a possibility of combining these advantages into one group for further application aimed to improve competitiveness of the region (Melnik et al., 2014). It should be noted that to date no unified methodology has been worked out for clusterization potential evaluation. At the same time, some studies of this issue are already available. They are generally based upon determination of the geographic concentration indices, per capita production indicators, specialization of industry sectors etc.

Using the above mentioned concept as guide, we decided to adapt it with a view to address the issue of clusterization potential identification in different geographic areas. The areal

clusterization potential evaluation algorithm includes a numbers of stages as follows:

1) Calculation of specific clusterization potential indicators:

- location ratio based on the scale of output (L1) is calculated as a ratio of the specific weight of this industry sector in the regional production structure to the specific weight of the same industry sector in the national production structure;
- location ratio based on the number of operating organizations (L2) is calculated as a ratio of the specific weight of operating organizations of this industry sector in the overall number of operating organizations in the regional industry to the specific weight of operating organizations of the same industry sector in the overall number of operating organizations in the national industry;
- location ratio based on the number small businesses (L3) is calculated as a ratio of the specific weight of small businesses of this industry sector in the overall number of small businesses in the regional industry to the specific weight of small businesses of the same industry sector in the overall number of small businesses in the national industry;
- location ratio based on the fixed assets value (L4) is calculated as a ratio of the specific weight of the fixed assets value of this industry sector in the overall fixed assets value in terms of the regional industry to the specific weight of the fixed assets value of the same industry sector in the overall fixed assets value in terms of the national industry;
- location ratio based on the fixed capital investments (L5) is calculated as a ratio of the specific weight of the fixed capital investments in this industry sector in the overall volume of fixed capital investments in terms of the regional industry to the specific weight of fixed capital investments in the same industry sector in the overall volume of fixed capital investments in terms of the national industry;
- location ratio based on the balanced financial results (L6) is calculated as a ratio of the specific weight of the balanced financial result of this industry sector in the overall volume of balanced financial result in terms of the regional industry to the specific weight of the balanced financial result of the same industry sector in the overall volume of the balanced financial results in terms of the national industry;
- location ratio based on the average monthly wage (L7) is calculated as a ratio of the average monthly wage in this regional industry sector to the average monthly wage in the national industry sector;
- per capita industry sector output ratio (CI) is calculated as a ratio of the specific weights of the regional sector output in the same national industry sector output and the regional population percentage in the national population;
- specialization ratio of the region in a particular industry sector (S) is calculated as a ratio of the specific weights of the regional industry sector output in the same national industry sector and the regional gross domestic product in the national gross domestic product.

2) Determination of an integrated index showing the clusterization potential level of the geographic area. The integrated index will be calculated as follows:

$$I = (L1 + L2 + L3 + L4 + L5 + L6 + L7 + CI + S) / 9. \quad (1)$$

In case that a value of the integrated index is over 1, the industry sector in question displays a potential for clusterization. When considering the clusterization processes and choosing among the most preferred clusters it is required also to evaluate dynamics of the obtained integrated index because any increase in its value may suggest cluster growth prospects, while any decrease in the integrated index value may suggest lack of such prospects.

4. Results

For the purpose of experimental approval of the devised methodological approach, a clusterization potential evaluation of an area was carried out with respect to the Republic of Tatarstan as an example. Tables 1 – 4 show the results of the calculations which were made

Construction materials	0.86	0.98	0.92	1.35	1.23	0.61	0.91	0.01	0.92	0.87
Consumer goods	0.68	0.81	0.74	1.08	1.01	1.09	0.15	0.02	1.19	0.75
Foodstuff	0.61	0.69	0.65	0.81	0.53	1.25	1.50	0.23	1.00	0.81

Table 3
Specific clusterization indicators of the regional industrial complex
(Case Study: Republic of Tatarstan, 2017)

Industry sectors	Indicators									
	L1	L2	L3	L4	L5	L6	L7	CI	S	I
Electric power	1.56	1.35	0.86	1.22	1.16	1.05	1.60	1.35	2.18	1.37
Fuel	2.00	3.18	2.26	3.37	2.34	3.75	2.06	3.28	1.32	2.62
Ferrous metallurgy	0.01	0.02	0.01	1.09	2.00	0.06	0.01	0.02	0.15	0.38
Nonferrous metallurgy	0.01	0.01	0.01	0.15	0.21	0.01	0.01	0.01	0.89	0.15
Chemicals and petrochemicals	4.03	4.54	3.32	1.85	1.72	6.06	5.86	5.39	1.38	3.79
Machinery and metalworking	1.57	1.72	1.64	1.44	1.56	2.70	2.96	1.62	2.09	1.92
Forestry and woodworking	0.40	0.44	0.42	0.54	0.56	0.72	0.07	3.23	1.27	0.85
Construction materials	0.90	1.32	0.94	1.32	1.18	0.61	0.97	0.44	0.87	0.95
Consumer goods	0.62	0.77	0.68	1.11	1.07	1.08	0.06	0.02	1.19	0.73
Foodstuff	0.55	0.59	0.57	0.86	0.36	1.21	1.49	0.15	0.98	0.75

Table 4
Integrated index of clusterization in the regional industrial complex
(Case Study: Republic of Tatarstan)

Industry sectors	2015	2016	2017	Trends
Chemicals and petrochemicals	3.35	3.48	3.79	↑
Fuel	2.02	2.28	2.62	↑
Machinery and metalworking	1.57	1.81	1.92	↑
Electric power	1.00	1.13	1.37	↑
Construction materials	0.92	0.87	0.95	↓↑

Forestry and woodworking	0.87	0.84	0.85	↕
Foodstuff	0.83	0.81	0.75	↓
Consumer goods	0.77	0.75	0.73	↓
Ferrous metallurgy	0.42	0.41	0.38	↓
Nonferrous metallurgy	0.15	0.16	0.15	↕

Note: ↓ – downtrends, ↑ – growth trends.

Proceeding from the clusterization potential evaluation results as shown in Tables 1 – 4, all industry sectors operating in the Republic of Tatarstan can be structured into 3 groups, where Group 1 will consist of the industry sectors displaying a higher development level than on average in Russia. Group 1 includes chemical and petrochemical, fuel, machinery, metal processing, and electric power sectors. The coefficients over 1 as specifically calculated for these industry sectors manifest the growth trend.

Group 2 will consist of the industry sectors displaying a slightly lower development level than on average in Russia. Group 2 includes forestry, woodworking, pulp and paper making, construction materials, consumer goods, and food industry sectors. The integrated index value here varies between 0,5 and 1.

Group 3 consist of the industry sectors that did not evolve in the Republic of Tatarstan. These are ferrous and nonferrous industries. The calculated integrated index value does not exceed 0,5.

The dynamics of the integrated index of the clusterization potential suggests that the integrated index value for the regional industry sectors in Group 1 displays an uptrend. For enterprises falling under Group 2 and 3 it appears impossible to determine any development trend because the dynamics of the values is characterized by a differently-directed movement: now upwards, then downwards.

However, despite the identified peculiarity, the integrated index values for the industry sectors Group 2 appear to be relatively high. Such a dynamics, in our opinion, may result from the fluctuations on the industrial markets. The situation around the industry sectors Group 2 calls for further studies in order to identify the basic enterprises being of great importance for the region, determine main and allied suppliers that can be included into the cluster, and requires a further investigation into the production factors necessary (Dyrdonova, 2016) for carrying on a competitive struggle.

5. Conclusions

Thus, application of a cluster-oriented approach is a naturally determined stage in the development of the regional economic systems. Formation and development of clusters within the region will contribute to creation of new job places for the local population, increase tax deductions into the budget, manufacture new types of products, increase both quality and quantity of the output products, replace imported goods by domestic products owing to the use of science-driven, resource-saving and environmentally friendly technologies, considerably increase the role of science, education, R&D centres, design and engineering organizations, academic institutions and higher schools, increase both a transfer level of technologies and R&Ds and effectiveness of their implementation.

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