Artículo de investigación

Development of competitive advantage evaluation technique for industrial clusters on the basis of m. porter's national competitiveness model "Rhombus" transformation

Desarrollo de una ventaja competitiva para la industria de los clusters en la base de m. porter de la competitividad nacional "Rhombus"

Desenvolvimento de técnica de avaliação de vantagem competitiva para clusters industriais com base em m. O modelo de competitividade nacional de Porter, a transformação "Rhombus"

Recibido: 20 de abril de 2018. Aceptado: 10 de mayo de 2018

Written by:
Olga Yur'evna Vorozhbit [49]
Natalia Yur'evna Titova [50]
Irina Aleksandrovna Kuzmicheva [51]
Marina Vladimirovna Borovitskaya [52]

Abstract

One of the most important tasks of the current stage of development is the achievement of competitiveness at all levels, the preservation of the previously accumulated resource potential and the all-round increase of production capital in the main industries. World practice showed that the development of industrial clusters is one of the most effective ways to enhance national competitiveness. At the same time, the development of clustering processes requires significant investments both from the state, creating a certain cluster policy, and from the cluster initiators. In this regard, the issue arises concerning most effective support measures at each stage of an industrial cluster life cycle. The purpose of this article is to develop the methodology that allows us to formulate support measures for an effective development of industrial clusters based on a quantitative assessment of their competitive advantages. The theoretical basis of the study is the model of M. Porter's national competitive advantages "rhombus", the critical analysis of which allowed

Resumen

Una de las tareas más importantes de la etapa actual de desarrollo es el logro de la competitividad en todos los niveles, la preservación del potencial de recursos previamente acumulado y el aumento integral del capital de producción en las principales industrias. La práctica mundial demostró que el desarrollo de clusters industriales es una de las formas más efectivas de mejorar la competitividad nacional. Al mismo tiempo, el desarrollo de los procesos de agrupamiento requiere inversiones significativas tanto del estado como de la creación de una determinada política de clúster y de los iniciadores del clúster. A este respecto, se plantea la cuestión de las medidas de ayuda más eficaces en cada etapa del ciclo de vida de un clúster industrial. El propósito de este artículo es desarrollar la metodología que nos permita formular medidas de apoyo para un desarrollo efectivo de clusters industriales a partir de una evaluación cuantitativa de sus ventajas competitivas. La base teórica del estudio es el modelo de las ventajas competitivas

[49] Federal State Budget Educational Institution of Higher Education «Vladivostok State University of Economics and Service», 690014, Russia, 41, Gogolya St., Vladivostok
[50] Federal State Budget Educational Institution of Higher Education «Vladivostok Stat University of Economics and Service», 690014, Russia, 41, Gogolya St., Vladivostok
[51] Federal State Budget Educational Institution of Higher Education «Vladivostok State University of Economics and Service», 690014, Russia, 41, Gogolya St., Vladivostok
[52] Federal State Budget Educational Institution of Higher Education «Togliatti State University» Russia, 445020, Samara region, Tolyatti, Belorusskaya str., 59

the authors to propose the division of production factors into basic resource and infrastructural, which is especially important for Russian business environment. This transformation served as the basis for the developed methodology, which includes an integral indicator of clustering factor development. The analysis of each of its components on the developed scale allows to reveal the degree of cluster initiative implementation, as well as to determine the most effective support measures based on the state of the cluster competitive advantages. The determination of cluster competitive advantages is carried out by the method of focus group conduct among experts, and their quantitative assessment is carried out using the questionnaire method, which gives the assessment of implementation and importance. The developed methodology can be used to develop normative and strategic programs for the formation and the functioning of industrial clusters, the development of which corresponds to the implementation of import substitution processes and the transition of Russia to an innovative type of development.

Keywords: industrial cluster, national competitiveness, competitive advantages, cluster policy

nacionales de M. Porter "rombo", cuyo análisis crítico permitió a los autores proponer la división de los factores de producción en recursos básicos e infraestructura, lo que es especialmente importante para el entorno empresarial ruso. Esta transformación sirvió de base para la metodología desarrollada, que incluye un indicador integral del desarrollo de factores de agrupamiento. El análisis de cada uno de sus componentes en la escala desarrollada permite revelar el grado de implementación de la iniciativa del clúster, así como determinar las medidas de apoyo más efectivas basadas en el estado de las ventajas competitivas del clúster. La determinación de las ventajas competitivas de los conglomerados se lleva a cabo mediante el método de conducta de los grupos focales entre los expertos, y su evaluación cuantitativa se lleva a cabo utilizando el método del cuestionario, que proporciona la evaluación de la implementación y la importancia. La metodología desarrollada puede utilizarse para desarrollar programas normativos y estratégicos para la formación y el funcionamiento de clusters industriales, cuyo desarrollo corresponde a la implementación de procesos de sustitución de importaciones y la transición de Rusia a un tipo de desarrollo innovador.

Palabras clave: luster industrial, competitividad nacional, ventajas competitivas, política de clusters

Resumo

Uma das tarefas mais importantes do atual estágio de desenvolvimento é a realização de competitividade em todos os níveis, a preservação do potencial de recursos anteriormente acumulados e aumento de capital integrado de produção em grandes indústrias. A prática global demonstrou que o desenvolvimento de clusters industriais é uma das formas mais eficazes de melhorar a competitividade nacional. Ao mesmo tempo, o desenvolvimento dos processos de cluster requer investimentos significativos do estado e da criação de uma política de cluster específica e de iniciadores de cluster. A este respeito, coloca-se a questão das medidas de auxílio mais eficazes em cada fase do ciclo de vida de um cluster industrial. O objetivo deste artigo é desenvolver a metodologia que nos permita formular medidas de apoio ao desenvolvimento efetivo de clusters industriais a partir de uma avaliação quantitativa de suas vantagens competitivas. A base teórica do estudo é o modelo de vantagem competitiva nacional de M. Porter "diamante", cuja análise crítica permitiu aos autores a propor a divisão dos fatores de produção em infra-estrutura básica e recursos, o que é especialmente importante para o meio ambiente Negócio russo. Essa transformação serviu de base para a metodologia desenvolvida, que inclui um indicador integral do desenvolvimento de fatores de agrupamento. A análise de cada um dos seus componentes na escala desenvolvida pode revelar o grau de implementação da iniciativa de cluster e determinar as medidas de apoio mais eficazes com base no estado das vantagens competitivas do cluster. Determinando a vantagem competitiva de aglomerados é levada a cabo pelo método de grupos de foco de conduta entre os especialistas, e a sua avaliação quantitativa, é levada a cabo usando o método questionário, que fornece a avaliação da aplicação e importância . A metodologia desenvolvida pode ser usada para desenvolver programas estratégicos para a formação e operação de clusters industriais, cujo desenvolvimento corresponde ao processo de implementação de

substituição de importações e de transição da Rússia para um tipo de desenvolvimento inovador e de política.

Palavras-chave: brilho industrial, competitividade nacional, vantagens competitivas, política de cluster

Introduction

Modern political and economic realities are such that nowadays the formation of a competitive industry is a paramount task of the national level. At present, the Government of Russian Federation declares that it is important to ensure the transition of Russian economy from the export-raw material to the innovative type of development.

International experience shows that the most effective way to increase innovation activity and national competitiveness is to use the cluster approach in the development of the country industry. At the same time, the founder of national competitiveness theory Michael Porter stressed that the competitive advantages of a company in the modern economy depend not only on the internal strategy and the tactics of its development, but also on the level of national competitiveness. In this regard, the state develops the environment, the quality of which is conditioned by the existence of the necessary conditions.

An important condition for the development of clusterization is the existence of a regulatory and legal framework that regulates the issues of state support for industrial clusters. Thus, in accordance with the Federal Law # 488-FL "On Industrial Policy", issued on December 31, 2014 the formation of industrial clusters and industrial parks is currently one of the main tools for a competitive industry provision. According to Russian Federation Government Decree # 41 issued on January 28, 2016, the state will also provide the subsidies to the participants of industrial clusters for cost recovery during the implementation of joint projects to manufacture the industrial products for import substitution purposes. Thus, the state is an important participant for cluster production activity initiation in Russian economy.

Since the resources of cluster development initiator are limited, it is important to determine which support measures will be most effective and demanded for further sustainable development of the industrial cluster. This requires the most complete study and the quantification of the competitive advantages of the formed or functioning industrial cluster, as well as the factors that contribute to and impede their effective development. Therefore, the purpose of this study is to develop the methodology that allows us to formulate support measures for an effective development of industrial clusters based on a quantitative assessment of their competitive advantages (Shashlo et al., 2017). At that our research is based on the works by M. Porter, the founder of the cluster theory. To achieve this goal, it is necessary to solve the following tasks:

1) to analyze the advantages and the disadvantages of M.Porter's model of national competitive advantages "rhombus" from the standpoint of leading economists;
2) to adapt M. Porter's model to the Russian conditions of management;
3) to develop the methodology in order to quantify the competitive advantages of an industrial cluster using modern economic and mathematical methods;
4) to identify the measures of cluster policy that enhance the competitive advantages of industrial clusters.

Methods

At present, M. Porter is rightly recognized as the founder of the cluster theory. The scientist has developed the model "rhombus" to study the national competitive advantages, which includes the following four components (Porter, 1990).

1. Production factors: basic - natural, demographic, territorial resources; developed - financial resources (capital) (Belanovsky, 996); informational resources; the qualification of human resources; infrastructure; life quality factors;
2. Demand conditions: volume, quality and the compliance with the trends of demand development in the world market;

3. The presence of specialized and auxiliary industries: related and serving industries: the areas of receipt and the use of raw materials, semi-finished products, equipment and technology;
4. The conditions for strategic development and competition: objectives, the methods of organization and the strategy of enterprises, business environment state.

As Figure 1 shows, these four blocks interact with each other and thereby create those competitive advantages that ensure the competitiveness of the country or industry.

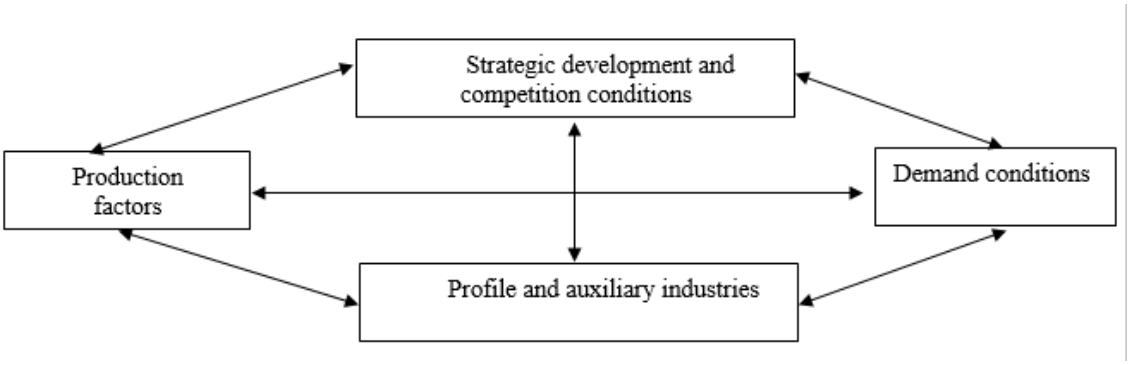

Figure 1 – M. Porter "rhombus" model for the study of national competitive advantages. Source: (Porter, 1990)

Having considered the rhombus of competitiveness, M. Porter comes to the conclusion that the conditions for regional competitive advantage are better when the firms operating in one particular industry are concentrated geographically. In essence, the state of industry concentration in the state demonstrates one of four determinants of the model - the state of related and auxiliary industries. The more supporting links in the industry of the country between sectors that help to distribute productive potential evenly, the more concentrated the production, and if this concentration is observed in a certain territory, then this phenomenon should be defined as a cluster. According to Porter, cluster is "a group of geographically neighboring interconnected companies and related organizations operating in a certain sphere and characterized by commonality of activities and mutually complementary ones" (Porter, 1990).

The theory of competitiveness is often criticized. At the same time, the critics of scientist and economist model can be conditionally divided into two categories. The first category of scientists does not fully agree with M. Porter's concept of competitiveness. The criticism of the second category of economists concerns to some extent the modification of national competitiveness rhombus determinants.

P. Krugman can be attributed to the first category. He subjects the concept of national competitiveness to doubt. First, the scientist believes that competitiveness is an unnecessary term, since it almost always means the same as productivity (Krugman, 1996). Secondly, in his opinion, it is fundamentally wrong to identify the competitiveness of a nation with the competitiveness of corporations. If the states competed between each other as well as the companies, this would lead to protectionism and trade wars. In modern economy, states are major markets and at the same time important importers to each other (Dorzhieva, 2012).

The next object for criticism is the fact that the rhombus of competitive advantages is the synthesis of many previously developed theories of territorial and sectoral concentration (the theory of "life growth" by P. Romer, the theory of the relationship consumer-producer by B. O. Lundwall, the model of network development by A. Marshall and the theory of "pole" growth by F. Perru) (Marshall, 2013). In this regard, the economist W. Catwright made a rather tough summary, stating that the scientist paraphrased the abovementioned ideas (Catwright, 1992). It should be noted that M. Porter always mentions what was the basis of his fabrications. In our opinion, M. Porter's role remains high, as he unified the existing concepts, having formed an accurate model that takes into account the diverse aspects of economic and social analysis

that were in the focus of attention among economists, regionalists and the scientists from other fields of science.
R. Martin and P. Sanli characterized the "Porter's cluster" as the "Porter's brand", which was quickly "bought" by both scientists and functionaries, making it more popular (Martin & Sunley, 2003). But, in their opinion, the "cluster" will be out of fashion soon like all fashionable things (Semak, 2010). Indeed, the worldwide popularization of the cluster phenomenon leads to the fact that the clusters become the object of state propaganda. Often clusters inconsistent and completely contrary to an original concept. But, in our opinion, this should not be an object of M. Porter's criticism, but of those who interpret his theory.

A number of scientists questions M. Porter's thesis that it is necessary to create clusters in order to increase competitiveness. Thus, E. Reinert explains that there are the ways to improve this indicator beyond cluster development (Wignaraha, 2003). In our opinion, criticism is justified in this matter, as there are many examples of successful companies in the economy operating without any obvious type of interaction in business processes. At the same time, the economist D. Robinson supplements that in case of cluster formation, there is a high risk that not all its firms will be competitive (Semak, 2010). Dutch economists F. Van Den Bos and A. Van Proyian noted that not enough attention is paid in Porter's rhombus to the factors reflecting the unique national characteristics of the state (Van den Bosch & Van Proijen, 1992). The Norwegian researcher R. Narula noted that the Porter's concept of competitive advantage research needs to specify the time factor, since it is not determined which type of the economic system state is subjected to analysis - static or dynamic one (Narula, 1993). It should be noted that the abovementioned criticism is quite justified. However, as E.V. Dorzhieva rightly notes, the most serious limitation of the model is its orientation to the past (Privorotskaya, 2014). It explains the birth and growth of existing clusters, but it can not predict the way of their development in the future and what will be the centers of competitive advantages that have not been created yet.

The second group of scientists who criticize the model under study concerns the addition of other factors not taken into account by M. Porter to the rhombus determinants. Thus, J. Dunning was the first one who proposed to take into account the propensity for entrepreneurship and the influence of direct foreign investments (Dunning, 1993). Besides, the economist noted the importance of international business role for analysis, having described its impact on the determinants of competitive advantages (the state of demand, the conditions for factors, a sustainable strategy, the structure and the competition, related and supporting industries) in the context of foreign TNCs introduction to the local market.

The Canadian economist A. Rugman first questioned the effectiveness of M. Porter's model approbation on the economy of developing countries. According to the scientist the main shortcomings are the lack of factor consideration concerning the activities of multinational companies and state regulation (Rugman, 1992). Together with J.D. Cruz he developed an improved model of the "double rhombus", taking into account the above-mentioned aspects. Scientists advise to apply this model in the case when the economy should take into account the effect of multinational activities (for example, the economy of Singapore and Canada).

South Korean researcher D. Cho focused on the clarification of human capital role in the creation of competitive advantages, which allowed him to develop a nine factor model (Cho & Moon, 2012). Later, the scientific community became aware of an even more perfect model of the "doubled double rhombus", introduced by H. Moon (Moon et al., 1998). It is distinguished from previously known ones by the synthesis of previous transformations proposed by scientists. The model allows to reflect the international business environment; to take into account the interactions between internal and external (foreign) factors affecting the competitiveness of the country.

Despite the abundance of criticism, the model of national competitiveness "rhombus" is the most demanded, complete and comprehensive nowadays. This theory is the fundamental one for the development of various methods to calculate international and sectoral competitiveness (Privorotskaya, 2014). In particular, the modern methods of national competitiveness calculation used by the International Forum on Management Development are based on the theory of "competitive rhombus", and the methods used by the World Economic Forum are based on the

theory of competitive advantage development stages (Shvandar, 2011). At the same time, the concept by M. Porter is systemic in character, and, as L.A. Alexandrova rightly notes, it "absorbed the achievements of other theoretical approaches, while acting as an umbrella model that sets the system of coordinates and the common basis for many studies" (Aleksandrova, 2005).

The research model of competitive advantage "rhombus" is applied not only in the determination of competitiveness for various countries, but also during the analysis of already created and functioning cluster development. In our study, this model interests us precisely in this context. The confirmation of this methodology effectiveness is the research of the Harvard Business School, which studied the development features of the following cluster competitive advantages: biotechnological in Israel, shipbuilding in South Korea, winemaking in Macedonia, fishery in Uganda, marine in the Baltic countries, textile in South Africa, etc. (Bell et al., 2006; Letica, 2006; Mindlin, 2017; Narula, 1993; Porter, 2009).

Results

In this regard, the rhombus transformations we studied for the national level allowed us to identify the need to modify M. Porter's model for its application in the development of methodological approaches to the formation of industrial clusters in Russian economic environment.

First, when they apply the model of competitive advantages, it is impossible to quantify the potential that exists in an industrial cluster. All the determinants of rhombus operate with qualitative indicators that can not be estimated and determined. Therefore, we will propose the methodology set out below to quantify the competitive advantages of the cluster.

Secondly, we are of the opinion that the use of rhombus in its original form is possible only during the analysis of economies or clusters in developed countries, for example, in the USA. Like F. Van Den Bos, we believe that it is necessary to take into account their national characteristics in each country (Van den Bosch & Van Proijen, 1992). In particular, if we consider Russia, then there are two unique features for our state - the abundance of natural and territorial resources. According to M. Porter's concept, they are referred to the basic factors of production, that is, those that were not created by man. In comparison with these basic factors, the developed factors (infrastructure, capital) constitute a much smaller part of the developed factors. When you analyze the competitive advantages of an industrial cluster that is being formed or already created, especially at its quantitative assessment, it is important to understand which of production factors are the default (basic) ones and which were created in the process of socio-economic human activity (developed).

In this regard, the authors came to the conclusion that the rhombus model by M. Porter should be transformed into a "star", dividing the basic and infrastructural factors, as shown on Fig. 2.

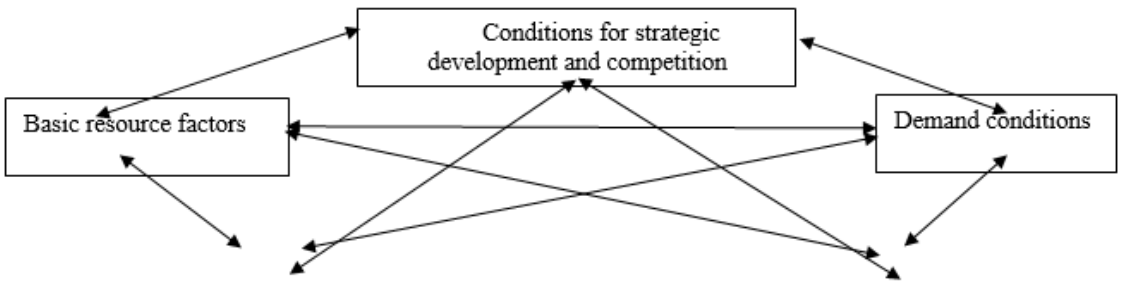

Figure 2 – Transformed model of M. Porter's competitive advantage study
Source: compiled by the author

In fact, the proposed transformation does not contradict M. Porter's initial model. However, since we developed a quantitative assessment model, then during the analysis of numerical values it is important to

understand which competitive advantages they formed, and that is why we propose the transformation described below.

Let us dwell in more detail on the interpretation of each group of factors of the transformed model. The basic resource factors are the conditions that are natural and basic for a given region. In other words, these factors were not the result of human labor, but were formed under the influence of external natural factors. These may include climatic conditions, geographical location, the availability of natural and human resources.

Unlike basic factors, infrastructure factors include the development of administrative, transport, social, engineering information, market, research and innovation infrastructure directly used to develop the production potential of the regional economy. The next set of factors is the "demand conditions", characterized by the availability of high-quality and extensive sales markets that correspond to the development trends of not only domestic but also global demand. During the analysis of these factors, it is also worth paying attention to the degree of consumer culture development, their requirements for the quality of goods sold in a region. The analysis of "strategic development and competition conditions" is formed from institutional rules and incentives governing natural competition. The last block of the model "profile and auxiliary industries" characterizes the degree of interaction between suppliers, as well as within the technological chain of product creation. The analysis of this block helps to understand which supporting sectors can be developed in order to achieve a synergistic effect and increase the competitiveness of prospective clusters (Porter, 1990).

The contribution of each group of factors to the process of industrial clustering can be found rationally by economic and analytical methods. Economic-analytical methods are inherently subjective, as the results are obtained through the generalization of the expert opinions. The opinion of each expert is certainly subjective and is formed on the basis of his knowledge and an object personal perception. In this regard, economic and analytical methods have also received the name of expert assessment methods. The general principles of expert assessment methods are based on subjective consideration of many factors and represent the expert assumptions about the development of research object in present and future. Expert assessments can be carried out individually, for example, using scenario methods, interviews, analytical notes, etc. Collective expert assessments can be carried out using the focus group method or by collection, processing and summarizing the results of individual peer reviews.

In order to determine the specific weight of clustering factor groups, we propose to conduct a questionnaire among the experts on the studied types of economic activity. The following qualitative structure of experts is proposed: the heads of the largest industrial organizations in the region - 60%, the representatives of research institutes and authorities - 40%. The issues of the developed questionnaire should cover all the above-mentioned groups of factors. In this case, it is required to indicate the significance of the factor considered by an expert according to 5-point scale, where 1 is the most important, and 5 is the least important. At that, the number of experts should not be more than 12.

The course of the questionnaire processing involves the following analytical procedures. First of all, the matrix presented in Table 1 is compiled. The results of questionnaire processing are entered in this matrix. The obtained results should be checked without fail for consistency of expert opinions.

Group of factors, m_i	Experts, n_j										Sum of ranks, x_{ij}	Square deviations of ranks, S_i
	1	2	3	4	5	6	7	8	9	10		
Basic resource factors	…	…	…	…	…	…	…	…	…	…	…	…
Infrastructural factors	…	…	…	…	…	…	…	…	…	…	…	…
Related and auxiliary industries	…	…	…	…	…	…	…	…	…	…	…	…
Demand conditions	…	…	…	…	…	…	…	…	…	…	…	…
Conditions for strategic development and competition	…	…	…	…	…	…	…	…	…	…	…	…

Table 1 – The matrix of expert assessments concerning the contribution of clustering factor groups

For this, the M. Kendall coefficient of concordance is used traditionally (Jyotiprasad, 1992). In order to calculate this coefficient after filling the rows and columns of the matrix, it is necessary to perform a series of calculations. First, it is necessary to find the S-sum of the square deviations of ranks, which is calculated by the following formula:

$$S = \sum_{i=1}^{n} (\sum_{j=1}^{m} x_{ij} - \frac{n(m+1)^2}{2})^2 \text{ , where:} \quad (1)$$

S – the sum of rank square deviations,
N – the number of experts,
m – the number of factor groups,
x_{ij}- the sum of ranks assigned to the i-th object by the j-th expert.
Then it is necessary to calculate the concordance coefficient using the following formula:

$$W = \frac{12S}{n^2(m^3 - m)} \text{ , where} \quad (2)$$

W – M. Kendall's concordance coefficient,
n– the number of experts,
m – the number of factor groups,
S– the sum of rank square deviations.
It is important to emphasize that the value of the coefficient should be greater than 0.7. Otherwise, the results of the questionnaire can not be applied in the study because of the large degree of discrepancy between the opinions of experts.
In order to develop an integrated indicator of economic activity clusterization, it is necessary to calculate the significance of each factor for its impact on the final indicator. Thus, it is necessary to calculate the weight coefficients for each group of factors. First we need to calculate the final rank r_i, which is calculated by the following formula (Jyotiprasad, 1992):

$$r_i = \frac{\sum_{i=1}^{n} x_{ij}}{n} \text{ , where:} \quad (3)$$

r_i– the final rank of a group of factors,
n – the number of experts,
x_{ij}- the sum of ranks assigned to the i-th object by the j-th expert.
Then, you need to calculate the total weighting factor Gi for each group of factors, which is calculated as follows:

$$G = \frac{(m+1) - r_i}{\sum_{i=1}^{m} r_i}, \quad \text{where: (4)}$$

G_i - the final weight ratio;
m – the number of factor groups,
r_i– the final rank of factor group.
Having calculated the weight factors for each group of factors, it is necessary to start the development of an integral clusterization indicator for a specific type of economic activity. This integral indicator characterizes the overall degree of cluster initiative implementation. The higher its value, the more factors contributing to the processes of industrial clustering, and accordingly the more favorable the cluster environment. However, the integral indicator gives the greatest characteristic during the analysis of each of its components - that is, the identified groups of clusterization factors. Thus, the following form of the integral indicator is proposed:

$$C = G_i B + G_i I + G_i R + G_i D + G_i S, \text{ , where:} \quad (5)$$

G - the weight coefficient of the corresponding group of factors;
C – the integral index of industrial clustering degree;
B – basic resource factors;
I – infrastructural factors;
R – the factors of profile and auxiliary industries;
D – demand factors;

S – the factors of strategic development and competition.
In order to identify single factors in each group by the type of economic activity, the focus group method is the most appropriate one (Belanovsky, 1996). In the authors' opinion, experts should be among the representatives of industrial organization heads belonging to the type of economic activity under study, regional authorities in charge of this activity, as well as research workers who carry out their activities in this professional profile. A list of factors that make up the group is developed as the result of the focus group performance by experts.

However, in order to transfer the qualitative characteristics of each factor into quantitative ones, let's use the modified SWOT analysis technique by M.S. Rakhmanova, which makes it possible to identify the competitive potential of a facility through the systematization of available information about its strengths and weaknesses (Rakhmanova, 2009a).

According to this technique, it is necessary to evaluate each factor in 2 parameters: the implementation of the i-th factor and the importance of the i-th factor. The implementation of the i-th factor (Z_i) characterizes the presence and the degree of its development in the existing environment (Rakhmanova, 2009b). The evaluation of the i-th factor importance (N_i) reflects the importance of this factor for industrial clustering in RF subject.

The evaluation of implementation and importance is carried out by the method of expert assessments. For this, it is necessary to develop a questionnaire based on the results of the focus group. The questionnaire questions are distributed according to the identified factors in 2 types: closed ones, compiled according to the Likert scale (for factor evaluation) and open ones (in order to understand the importance of each factor influence). The values of implementation and importance degree evaluation correspond to the criterion scale presented in Table 2.

Table 2 - Criteria scale of competitive advantage implementation and importance assessments

i-th factor indicator	Criterion development degree					
	0	I	2	3	4	5
Implementation evaluation, Z_i	Absent	Very weak	Weak	Average	Strong	Very strong
Iportance evaluation, N_i	Absent	Very weak	Weak	Average	Strong	Very strong

The result of questionnaire processing is the final matrix of expert assessment implementation and importance. The final score for each factor is calculated using the formula of the arithmetic mean. Then, based on the calculations performed, it is necessary to find the rank corresponding to each factor. The rank of the i-th factor k_i determines the contribution of each factor to the competitive potential of the region, taking into account its importance and is found by the following formula:

$$k_i = N_i * Z_i \quad \text{, where:} \qquad (6)$$

k_i- the rank of the i-th factor;
N_i– the evaluation of the implementation for the i-th factor;
Z_i– the evaluation of the importance of the i-th factor.
Then it becomes possible to calculate the final value of the indicator for the entire group of identified factors. It will be equal to the average value of ranks according to the formula of the weighted average arithmetic:

$$B_i = \frac{\sum k_i f_i}{\sum f_i} \quad \text{, where} \qquad (7)$$

B_i– one of the indices of industrial clusterization factor group of the final integral indicator (in this case - the basic resource ones);
k_i– the rank of this factor;
f_i– the frequency of factor repetition;
i – the number of factors identified in the group.

The calculated final integral index of industrial clusterization of economic activity type, as well as each of its components is the indicator of a group of factors. It can have the following interval values, meeting the criteria of Table 3.

Table 3 - Criterion scale of competitive advantage evaluation for the integral indicator and its components

Indicator	The degree of competitive advantage development				
	Very weak	Weak	Average	Strong	Very strong
Clustering factor group	from 0 to 5	from 5 to 10	from 10 to 15	from 15 to 20	from 20 to 25
Total integral indicator	from 0 to 5	from 5 to 10	from 10 to 15	from 15 to 20	from 20 to 25

The higher the value of the integral indicator, the more favorable the environment of the industrial cluster in a subject, and, accordingly, there are fewer factors hindering the clustering processes. However, the most important is the evaluation of an integral indicator each component.

Discussion of results

The analysis of obtained results to assess the competitive advantages of an industrial cluster should be started with the development of the following matrix, presented in Table 4.

Table 4 – Summary matrix of identified competitive advantages

Group of factors	1-5	5-10	10-15	15-20	20-25
Basic resource factors			+		
Infrastructural factors		+			
Related and auxiliary industries				+	
Demand conditions				+	
Conditions for strategic development and competition			+		

"+" sign is placed in each group of range factors at the intersection of the obtained data. The interpretation of results is defined as follows. The more groups of factors are in the range from 20 to 25, the less state participation in industrial clustering regulation is required. If more than 3 groups of factors are in this range, this type of economic activity is at the final stage of clustering, and it is able to regulate the formation of clusters as the result of the formed favorable cluster environment independently.

If more than 2 groups of factors are in the range from 10 to 20, this indicates the state need to participate in the development of cluster policy. Cluster initiatives of this type of economic activity require active participation of the state. However, first of all, it is necessary to make efforts to eliminate the unfavorable factors from the range of 1 to 10, and secondarily from 10 to 15.

If more than 2 groups of factors are located in the first two columns of the matrix, the formation of clusters in this type of economic activity is impossible without a large amount of public investment.

Let us dwell in more detail on the exemplary measures of cluster policy depending on the unfavorable state of integral indicator for each group of factors.

In the case of negative evaluation of basic resource factors by experts, the state needs to look for the methods of missing resource active attraction to the region. For example, in the case of human resource insufficiency, it is necessary to adjust the demographic policy or to find profitable suppliers in the absence of natural resources, etc. It should be noted that this group of factors is the least significant for the clustering process, because it consists mostly of factors created by natural conditions.

If the group of infrastructural factors falls within the range from 1 to 10, the state needs to invest in the implementation of investment projects. It is necessary to carry out the measures to improve the investment climate, creating favorable terms for trade and taxation. They should also look for private domestic and foreign investors willing to finance the construction of necessary infrastructure facilities.

In the case of insufficient development of related and auxiliary industries, the formation of clusters can be also difficult in the region. The main measures of the cluster industrial policy to improve the situation are the implementation of complex state orders, which involve the suppliers of economic activity related types. If demand conditions fall within the range from 1 to 10, the state industrial policy should be focused on sales market expansion. One way to improve the situation is to create an auxiliary marketing structure for the cluster, which is looking for new markets, both in the country and abroad. Also, it is necessary to promote actively the promising products for cluster production, improving advertising, conducting campaigns, organizing sales points in the subject territory.

If the group of factors for strategic development and competition conditions fall within the range from 1 to 10, the state should be rooted actively in the regulation of industrial structure external microenvironment. State orders should be carried out on a competitive basis, and thus the most competitive organizations win. It is necessary to participate actively in the development of programs supporting industrial organizations. An important component is anti-corruption measures, the reduction of criminal situation, shadow activity and the monopolization in the industry.

A more complete list of cluster policy actions in the case of one of the groups of factors fall into the range from 1 to 10 is presented in Table 5.

Table 5 - The list of priority actions for the implementation of cluster policy measures

Group of factors	Measures
Basic resource factors	- the search for the most suitable suppliers of necessary resources; - the optimization of demographic policy; - the implementation of regional development programs.
Infrastructural factors	- the creation of a favorable investment climate; - the search for Russian and foreign investors to participate in necessary infrastructure investment; - the development of interaction mechanisms with scientific structures; - the organization of structures responsible for the introduction of developed scientific technologies in practice at universities and research centers; - the organization of state orders to conduct scientific research by economic activity type; - the implementation of state programs to attract senior students and graduates to work in cluster companies; - the update of educational programs of higher and secondary vocational education; - the co-financing of continuing education programs for the work collective of the cluster.
Related and additional industries	- the organization of government contracts involving the suppliers of related and auxiliary industries; - the promotion of vertical integration; - the implementation of government programs supporting the interaction with the leading organizations of related and auxiliary industries;

Demand conditions	- The carrying out of marketing researches on the search of new commodity markets; - The expansion of export links; - The organization of an advertising campaign for cluster products abroad and in the domestic market; - The support of product international certification; - The holding of international fairs, forums, the exhibitions of cluster products abroad; - The propagation of cluster products among local population;
Strategic development and competition conditions	- The optimization of tax policy in terms of privileges and preferences provision to the cluster participants; - The reduction of administrative barriers; - The restriction of similar product penetration into the domestic market (produced by foreign competitors); - The provision of subsidies and state guarantees on sureties; - The reduction of energy and transportation tariff impact on the formation of production costs; - The compensation of interest rates on loans received by industrial cluster participants; - The development and the adoption of normative and legislative acts regulating cluster interactions; - The development of electronic document management systems; - The intensification of anti-corruption measures.

Source: compiled by authors

It should be clarified that, depending on the position of the group of factors in the matrix cell, the initiator of the cluster creation regulates possible industrial policy measures. Since it is impossible to take into account all measures, it is proposed to use this list during priority procedure selection for the implementation of cluster policy.

Summary

Thus, many researchers base their theories on the formation of competitive advantages in the context of cluster development on the theory of M. Porter's national competitiveness "rhombus", despite its profuse criticism. Nevertheless, this model has proved its effectiveness around the world, which is confirmed by the successful development of industrial clusters of individual industries in many developed and developing countries. The modification of competitive advantage model allowed us to develop the methodology to quantify the prospects for an industrial cluster development, consisting of integral indicators that characterize the competitive advantages of cluster development. This methodology allows not only to determine the competitive advantages of the cluster, but also to identify which priority actions need to be applied to improve the cluster policy for the rational distribution of subsidies. The developed methodology will be tested on the example of the fishing industry complex at Primorsky Krai and will be outlined in the next article.

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