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## **System of Control of Effectiveness of Enterprise Cooperation in Industrial Cluster**

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**Abstract:**

*The article is devoted to development of methodological instrumentarium for solving the problem of negative aspects of clustering. For this purpose, special proprietary methodology and system of control of effectiveness of cooperation of enterprises in industrial cluster were developed. The advantages of the developed system of control are simple use, quick results of evaluation, accessibility of initial data for calculation, and possibility for its use not only for existing clusters but the ones that are planned, which allows preventing possible negative aspects of clustering. The authors also conducted approbation of the developed system of effectiveness control of cooperation of enterprises of existing industrial cluster by the example of Volga automobile cluster and the planned metallurgical cluster in Russia.*

**Key Words:** *Cluster, Enterprise, production, Industry, System of Control*

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**JEL Classification :**

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## 1. Introduction

Cluster development is a priority of many economic systems (Popkova *et al.*, 2015). The most popular form of economic clusters is economic clusters – associations of industrial enterprises, their suppliers, R&D centers, etc. (Popkova and Tinyakova, 2013b) Despite the growing popularity of industrial clusters, the instrumentarium for their control is not sufficiently elaborated. In particular, the very creation of cluster does not always lead to economic development – in some cases, long-term consequences of clustering could be recession and stagnation of economy (Popkova and Tinyakova, 2013c).

Timely recognition and prevention of negative consequences of clustering and maximization of its advantages require special system of control for effectiveness of cooperation of enterprises in industrial cluster, as its self-administration is the main reason for such phenomena. This research is devoted to the development of such system of control which would allow not only studying the existing clusters but forecasting possible scenarios of development of clusters before their creation, for the purpose of minimization of negative aspects of clustering and maximization of effectiveness of functioning of industrial clusters.

## 2. Materials and Method

A large number of works by modern scientists are devoted to study of the notion, sense, and peculiarities of functioning, development, and influence on economic system of economic clusters. Among them it is possible to distinguish the studies of positive aspects of clustering by such authors as (Reveiu & Dârdală, 2015), (Xavier Molina-Morales *et al.*, 2015), (Gallié *et al.*, 2013), (Popkova & Tinyakova, 2013a) and studies of negative aspects of clustering by (Emmoth *et al.*, 2015), (Aragón *et al.*, 2014), (Nica, 2010), (Vanka *et al.*, 2012), (Popkova *et al.*, 2013a).

Nevertheless, despite a large number of publications of theoretical nature, practical aspects of formation and functioning of clusters are not studied enough. In particular, methodological foundations of evaluation of effectiveness of enterprises' cooperation in industrial cluster are not sufficiently elaborated. That's why this research offers to use proprietary methodology of evaluation of effectiveness of cooperation of enterprises in industrial cluster:

$$E = ((\Delta Q + \Delta P) * V + PE) / (I + NE) \quad (1)$$

where E – effectiveness of enterprises' cooperation in industrial cluster  
 $\Delta Q$  – change of product quality as a result of creation of industrial cluster;  
 $\Delta P$  – change of product price as a result of creation of industrial cluster;

PE – positive externalities emerging as a result of creation and functioning of industrial cluster;

V – volume of product sales of enterprises of industrial cluster;

I – investments into creation of cluster;

NE – negative externalities emerging as a result of creation and functioning of industrial cluster.

Change of quality of products as a result of creation of industrial cluster is found by the following formula:

$$\Delta Q = Q_{\text{cluster}} - Q_{\text{market}} \quad (2)$$

where  $Q_{\text{cluster}}$  – average quality of product of enterprises of industrial cluster;

$Q_{\text{market}}$  – average quality of product of enterprises from outside of industrial cluster in the market

These indicators are measured in points according to 10-point scale. Change of product price due to creation of industrial cluster is calculated by the following formula:

$$\Delta P = P_{\text{cluster}} - P_{\text{market}} \quad (3)$$

where  $P_{\text{cluster}}$  – average price of products of industrial cluster enterprises;

$P_{\text{market}}$  – average price of enterprises' products outside of industrial cluster in the market;

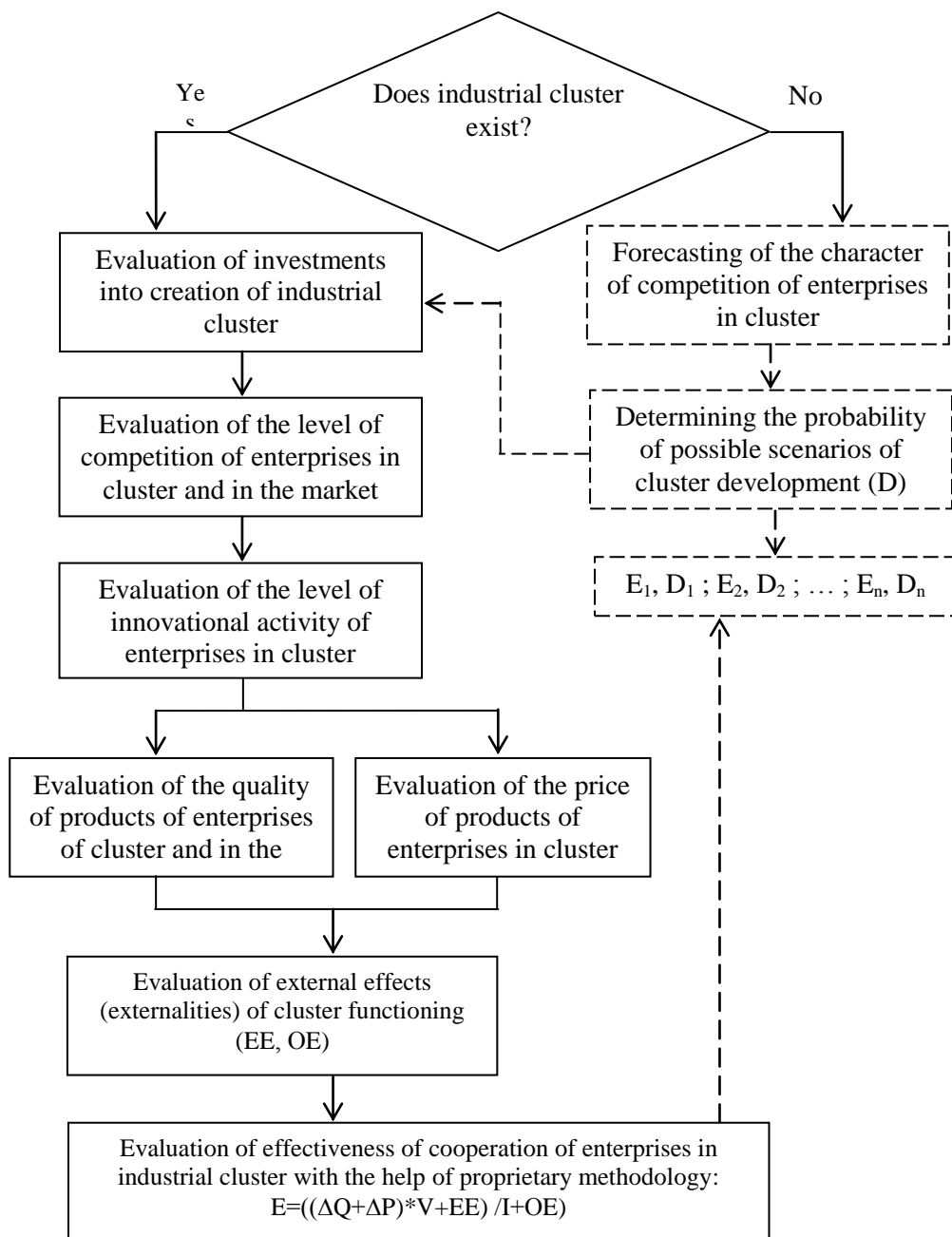
The higher the indicator of effectiveness (E), the more effective the cooperation of enterprises of industrial cluster is. Value of effectiveness indicator that is less than 1 shows its low level and necessity for cluster dissolution. Effectiveness indicator value that is equal to 1 shows inexpediency of cluster existence. If effectiveness indicator exceeds 1, cluster existence is expedient. Consequently, effectiveness of cooperation of enterprises of industrial cluster is influenced by the following main factors:

- investments into cluster creation, which, according to the plan, should be returned by means of increase of competitiveness of enterprises of the cluster;
- level of competition in cluster, which determines the level of innovational activity of enterprises;
- innovational activity of enterprises in cluster, which determines reduction of product prices and its quality increase;
- external effects (externalities), which determine positive or negative influence of cluster on society.

### 3. Results

It is advisable to use in this research the proprietary system of control for effectiveness of cooperation of enterprises of industrial cluster, built according to algorithm principle (Fig. 1).

Figure 1. System of control of effectiveness of enterprises cooperation in industrial cluster



As is seen from Fig. 1, sequence of actions within the developed system of control of effectiveness of cooperation of enterprises in industrial cluster supposes initial limitation of analysis of existing and planned industrial clusters. If a cluster already exists, a stage-by-stage evaluation of all main factors of effectiveness of cooperation of enterprises in industrial cluster is conducted, after which evaluation of cooperation of enterprises in industrial cluster with the help of proprietary methodology is conducted.

If cluster is at the stage of design, forecasting of the character of competition of enterprises within cluster is performed, then probability of possible scenarios of cluster development is determined, and then the same sequence of actions, as with existing clusters, is conducted. Eventually, there are several possible scenarios with various levels of effectiveness of cooperation of enterprises in industrial cluster and probability.

Let us conduct approbation of the developed system of control of effectiveness of cooperation of enterprises in industrial cluster by the example of existing cluster. The object of the research is the Russian industrial cluster “Volga automobile cluster” (Samara). The members of Volga automobile cluster are (Volga automobile cluster ..., 2015):

- automobile assembly plant;
- suppliers of various levels;
- brand service and sales networks (services stations, dealers);
- network of scientific and educational establishments;
- financial institutes (banks, investment companies);
- federal and regional government structures;
- consulting companies;
- outsourcing companies;
- financial institutions (banks, investment companies, including foreign companies)
- foreign partners;
- Tolyatti industrial & technological park.

Investments into creation of cluster constituted RUB 17,000. The volume of products of enterprises of the industrial cluster constitutes 143,000 cars per year. The price for the cars of the cluster enterprises constitutes USD 8,300. Average prices of similar cars in the market – USD 8,500. The change of price of products as a result of industrial cluster creation is calculated in the following way:

$$\Delta P = 8,500 - 8,300 = 200 \text{ USD}$$

Quality of products of enterprises of industrial cluster does not differ from quality of products in the market, that is  $\Delta Q=0$ . As a result of cluster creation, the level of unemployment in the region reduced, which led to saving of assets of regional budget of USD 1,000 (PO=USD 1,000). At that, ecological damage from industrial production as a result of cluster creation constituted USD 3,000 (OE=USD 3,000). With the help of the received data, calculation of indicator of effectiveness of cooperation of enterprises of industrial cluster is conducted in the following way:  
 $E=((0+0.2)*143+1)/(17+3)=28.7/20=1.48$ .

The received value of indicator of effectiveness is positive, which shows high effectiveness of cooperation of enterprises in Volga automobile cluster. Let us view the use of the developed system for control of effectiveness of cooperation of enterprises in industrial cluster by the example of planned cluster. For that, let us view the market of metallurgical industry of Russia.

This market is peculiar for oligopolistic market structure. That's why, creation of metallurgical cluster in Russia will be probably accompanied by monopolistic deal, which will lead to greater reduction of innovational activity of enterprises, reduction of quality, and increase of prices for metallurgical products of enterprises of the cluster, as compared to market prices.

Together with large investments, required for creation of such cluster, this reflects low effectiveness and inexpediency of cluster creation. Results of evaluation of effectiveness of cooperation of enterprises of industrial cluster by the example of planned Russian metallurgical cluster are shown in Table 1.

**Table 1. Results of evaluation of effectiveness of cooperation of enterprises of industrial cluster by the example of planned Russian metallurgical cluster**

Scenarios	Level of competition	Probability of scenario (P)	Effectiveness indicator (E)
Optimistic scenario	high (striving for clean competition)	0,1	1.12
Realistic scenario	average (oligopolistic competition)	0.6	0.95
Pessimistic scenario	low (monopolistic deal)	0.3	0.73

As is seen from Table 1, the most probable realistic scenario (R=0.6) supposes oligopolistic competition, due to which the effectiveness of cooperation of enterprises in industrial cluster will be very low (E=0.95). According to the second probable pessimistic scenario (P=0.3), a monopolistic deal is forecasted, which will

lead to effectiveness of cooperation of enterprises in industrial cluster being lower ( $E=0.73$ ).

Probability of optimistic scenario is minimal ( $R=0.1$ ). This scenario supposes cluster enterprises' striving for clean competition, which leads to effectiveness of cooperation of enterprises in industrial cluster being more than 1 ( $E=1.12$ ). Taking into account that even within optimistic scenario, the value of indicator of effectiveness is minimal, and within other more probable scenarios the value of effectiveness indicator is lower than 1, creation of metallurgical cluster in Russia is not expedient.

#### **4. Conclusion**

The conducted approbation of the developed system of control of effectiveness of cooperation of enterprises of existing industrial cluster by the example of Volga automobile cluster of Russia and planned metallurgical cluster in Russia showed its high effectiveness.

This proves that the developed system of control of effectiveness of cooperation of enterprises of industrial cluster is a perspective instrumentarium for analysis of perspectives and possible problems of development of cluster. The advantages of the developed system of control are simple use, quick results of evaluation, accessibility of initial data for calculation, and possibility for its use not only for existing clusters but the ones that are planned, which allows preventing possible negative aspects of clustering.

Results of the conducted research are limited by development of the system for control of effectiveness of cooperation of industrial cluster enterprises. That's why creation of universal methodology, applicable for any types of clusters, is a perspective direction for further research in this sphere.

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