

Research on the development mode selection of Yulin energy chemical industry cluster

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Abstract. The development of Yulin energy chemical industry cluster is now under the influence of economic fluctuation, environmental destruction, waste of resources and so on. It is very important to adjust the structure of industrial clusters in the development of science. Based on the characteristics of Yulin energy chemical industry cluster, the development mode of industrial clusters is analyzed, and the selection indexes system of industrial cluster development mode is constructed. Using entropy weight-TOPSIS method to establish the optimal model of industrial cluster development, The optimal development mode can be obtained by real calculation.

1. Introduction

Yulin energy and chemical industries which rely on the abundant resources endowment, policy support and scientific educational advantage has been basically formed the energy chemical industry cluster that based on coal and oil and other resources, and produce good economic and social benefits. However, with the overall downward pressure on the economy, society is more and more concerned about the environment pollution problem. The problems of Yulin energy chemical industry cluster such as short industry chain, excess capacity energy raw materials, low conversion efficiency, pollution and high energy consumption are gradually exposed, which lead to a decline in the economic efficiency and competitiveness of the cluster. Therefore, how to scientifically choose the development mode of industrial cluster in order to adjust the industrial structure has become the key issue of Yulin energy chemical industry to grasp the market initiative to enhance their competitiveness.

At present, the domestic and foreign scholars on the development mode of industrial clusters have already had a more systematic and in-depth study. But the research about the cluster development mode in specific industries or areas is less^[1]. The paper is based on this background, from the perspective of energy and chemical industry cluster, combined with the analysis of industrial cluster development mode, using of entropy weight-TOPSIS method to establish evaluation mode, to optimize the development mode of Yulin energy chemical industry cluster, and provide scientific suggestions for the development of the cluster.

2. Comparative analysis on the development mode of industrial cluster

In this paper, the industrial cluster mode is divided into five kinds which are the Satellite-platform mode, the Satellites-center mode, the large enterprise mode, the chain mode and the Virtual space style mode^[2]. Five modes of development are as follows:

Table 1 Comparison of industrial cluster modes

	Satellite-platform	Satellites-center	Large enterprise	Chain	Virtual space
Key features	In the majority with small and medium-sized enterprises	Auxiliary enterprises and core enterprises form the industry value chain	The origin of the new enterprise is the core enterprise	Existing enterprises are linked to the industrial value chain	There are no geographical restrictions on the business of the enterprise
Key benefits	great potential of innovation,dynamic R&D platform	The solid technical support,strong brand	External competitiveness	Perfect industry value chain	Optimizing resources distribution
Key weakness	Monopolistic competition is more intense	Inefficient resources allocation	The survival of new enterprise depends on the core enterprise	Entrepreneurial talents affect the development of the enterprise	Virtual space mode is an ideal state
Typifier	high and new techd evelopment zone	Aviation	High-tech industries	Silicon Valley	None

3. Constructing indexes system of Yulin energy chemical industry cluster selecting and development mode

As the industry cluster development mode is influenced by industry, region, environment and so on, the choice of the development mode of industrial cluster is not entirely the same^[3].The composition of the index system is shown in Table 2.

Table 2. The evaluation index system of Yulin energy chemical industry cluster development mode

Yulin Energy chemical industry cluster selection indexes	Primary indexes	Secondary indexes
	Industrial Agglomeration	
		Enterprises Agglomeration
		Resources Agglomeration
Competitive cooperation within the cluster		market share
		the growth rate of enterprise
		Cooperation between enterprises
Sustainable development capacity		economic development Sustainability
		social development Sustainability
		eco-environmental development Sustainability
Economic contribution degree		Contribution degree of regional employment rate
		Contribution degree of regional GDP value
		Contribution degree of regional economy

4. The establishment of entropy weight -TOPSIS mode

The basic idea of entropy weight -TOPSIS mode is to evaluate the weights of the evaluation index, and then to make use of the TOPSIS mode to define the positive and negative ideal solutions for the evaluation scheme,The distance between the different modes of the positive and negative ideal solutions are calculated, and the close degree of the evaluation scheme and the optimal scheme are calculated. The optimal scheme is determined by the order of the close degree.

The decision-making process of the entropy weight -TOPSIS mode is as follows:

(1) To express the judgment matrix $X=(X_{ij})_{m \times n}$. Among them X_{ij} is the J evaluation indicator for the I mode.

(2) To normalize the matrix X , and then we can get the Normalized matrix Y

$$y_{ij} = \frac{x_{ij} - \min_j x_{ij}}{\max_j x_{ij} - \min_j x_{ij}} \quad (j = 1, 2, \dots, m) \quad \textcircled{1}$$

(3) To determine the entropy value of each evaluation index:

$$H_j = -k \sum_{i=1}^n f_{ij} \ln f_{ij}, \quad (i = 1, 2, \dots, n) \quad \textcircled{2}$$

In the preceding formula, $k = \frac{1}{\ln n}$, $f_{ij} = \frac{y_{ij}}{\sum_{i=1}^n y_{ij}}$.

When $f_{ij} = 0$, $f_{ij} \ln f_{ij} = 0$.

(4) To compute the information entropy of each evaluation index Q_j :

$$Q_j = \frac{1 - H_j}{m - \sum_{j=1}^m H_j} \quad \textcircled{3}$$

(5) To work out the weight of indicator set $A=(a_{ij})_{m \times n}$:

$$A = Y \times Q \quad \textcircled{4}$$

(6) According to A , the positive and negative ideal solutions (Z^+ and Z^-) are determined:

$$Z^+ = (a_1^+, a_2^+, \dots, a_m^+)^T, \quad Z^- = (a_1^-, a_2^-, \dots, a_m^-)^T$$

(7) The positive ideal solution and the negative ideal solution distance for each mode are calculated:

$$D_i^+ = \sqrt{\sum_{j=1}^m (a_{ij} - a_j^+)^2} \quad \textcircled{5}$$

$$D_i^- = \sqrt{\sum_{j=1}^m (a_{ij} - a_j^-)^2} \quad \textcircled{6}$$

(8) To measure the assessed mode how similar it is to the ideal solution C_i^+ :

$$C_i^+ = \frac{D_i^-}{D_i^- + D_i^+} \quad \textcircled{7}$$

The higher the C_i^+ , the better the mode.

5. Yulin energy and chemical industry cluster development mode selection based on entropy weight -TOPSIS method

Through the expert scoring method, the preliminary judgment matrix X of the development mode for Yulin energy chemical industry cluster is obtained. Experts should consider characteristics of Yulin energy chemical industry cluster development, respectively rate evaluation index scores of the above five kinds of industrial cluster development mode with Evaluation scheme by 1-10 points (10 points is full marks). The score of the five programs is as follow table 3.

Table 3. The evaluation table of Yulin energy and chemical industry cluster development mode

Indexes	Satellite Platform mode	Satellites center mode	Large enterprises mode	Chain mode	Virtual space mode
Industrial Agglomeration	9	6	8	7	6
Competitive cooperation within the cluster	7	8	8	9	9
Sustainable development capacity	6	7	7	9	8
Economic contribution degree	7	7	9	8	6

(1) The entropy weight method is used to determine the index objective weight

First of all, using the formula ① to normalize the matrix X, we can get the matrix Y; Secondly, according to the formula, ②, ③, calculate H_j and Q_j of each index in the entropy matrix Y. The calculation results are shown in Table 4.

Table 4. Q_j, H_j calculation results of matrix table

indexes	industrial agglomeration	competitive cooperation	sustainable development capacity	economic contribution degree
	P_1	P_2	P_3	P_4
H_j	0.6284	0.8262	0.7935	0.7935
Q_j	0.3877	0.1814	0.2155	0.2155

From table 4: the Entropy weight of evaluation indexes is $P_1 > P_3 = P_4 > P_2$, This shows that the impact of industrial agglomeration on the development pattern of Yulin energy and chemical industry cluster is the most important.

(2) TOPSIS method for optimum selection of development model

The standardization matrix A of standard matrix Y plus entropy weight Q_j is computed by the formula, it is shown in the table 5.

Table 5. Weighted normalized matrix

<i>indexes</i>	Satellite platform	Satellites center	Large enterprises	Chain	Virtual space
industrial agglomeration	0.3877	0	0.3877	0.1292	0
competitive cooperation	0	0.0907	0.0907	0.1814	0.1814
sustainable development capacity	0	0.0718	0.0718	0.2155	0.1437
economic contribution degree	0.0718	0.0718	0.0718	0.1437	0

From table 5:

Positive Ideal Solution is $Z^+ = (0.3887, 0.1814, 0.2155, 0.2155)^T$

Negative Ideal Solution is $Z^- = (0.3887, 0.1814, 0.2155, 0.2155)^T$

Finally, according to formula ⑤、⑥、⑦, we can calculate not only The distance between each development and positive or negative ideal solution D^+_i, D^-_i , but also the proximity of the development pattern and the ideal solution C^+_i . The results are shown in table 6:

Table 6. the calculated result of the distance and proximity of development pattern

<i>indexes</i>	satellite platform	Satellites center	Large enterprises	chain	Virtual space
D_i^+	0.3162	0.4470	0.1699	0.2682	0.4493
D_i^-	0.3943	0.1362	0.4584	0.3416	0.2314
C_i^+	0.4450	0.2335	0.7296	0.5601	0.3399

The results show that: the order of proximity is Large enterprise mode(0.7296) > chain mode (0.5601) > Satellite platform mode(0.4450) > Virtual space mode(0.3399) > Satellites center mode (0.2335). According to the results of the evaluation, the large enterprise is more suitable for the development of Yulin energy and chemical industry cluster.

6. Summary

In this paper, we use the development mode of the existing industrial clusters, and establish the evaluation index system of the model selection. Using the entropy weight -TOPSIS method to make the choice of Yulin energy chemical industry cluster development model, it is more suitable for Yulin energy chemical industry cluster by the calculation of the large enterprise industrial cluster mode and the other four modes. It should be noted that the process of Yulin energy chemical industry cluster development is a complex system with time, the market environment and the impact of the changing factors of the cluster. This determines that the cluster development mode is not static. Therefore, we need constant information feedback and market research to improve the selection evaluation index system, increase the scientificity and accuracy of mode selection in the process of cluster development.

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