

The Cooperation of Industrial Clusters and Regional Logistics of Shaanxi Province: An Evaluation Research

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Abstract: As a middle organization between enterprise and market , industrial cluster is now the space industrial organization which gains the competition advantage and innovation advantage for a nation or a region. The cooperation of industrial clusters and regional logistics refers to improvement of industrial clusters' competitiveness and development of modern regional logistics. On the basis of reviewing the recent years' situation of Shaanxi Province's regional logistics and its industrial clusters , this paper analyzes positively about the supporting role of the regional logistics , builds gray relational model by choosing corresponding indicators , and carries out test of significance. Finally it brings out strategic recommendations to enhance the level of cooperation of industrial clusters and regional logistics.

Key words: industrial cluster; regional logistic; grey relational model

1 Introduction

'Guanzhong - Tianshui Economic Zone' industry development plan is approved by the State Council , is the country's newly identified key development areas , is the new economic growth pole of the west development , and is the strategy heights to stimulate and support the west development. Xi'an International Port District is the largest inland transshipment hub for integrated logistics and also is the first Chinese inland dry port which will become one of the biggest inland logistics center. Study in Guanzhong region of Shaanxi's cooperation model of regional logistics and industrial clusters have certain theoretical value and practical significance.

The cooperation of industrial clusters and regional logistics system , in essence , is the question of the relationship of logistics and industrial clusters^[1]. Com-

pared to other countries , the main weaknesses of our traditional logistics are decentralized operation , the low level of the industrial socialization and organization , unreasonable logistics layout , low technical content of logistics , and low degree of modernization. Some coastal cities have begun to establish regional logistics center and progressed to large-scale socialization and modernization. These practices are based on a consensus that industrial clusters can promote the development of regional logistics , and logistics development , in return , can boost the further development of industrial clusters.

2 Present condition analysis of guanzhong region of shaanxi

2.1 Regional logistics

Dong Qianli^[2] claimed that regional logistics is 'planning and building a logistics system in a certain area to achieve the best strategies which promote socio-economic , as well as its related activities concern-

ing logistics operations and monitoring. ’

In this article , we define regional logistics as logistics activities within the industrial cluster region , that is within the region where industrial cluster located , activities about the logistics needs are carried out concerning the upstream and downstream and similar enterprises of industrial clusters to provide integrated logistics services for the cluster and enterprises.

In recent years , under the scientific guidance and strongly support of governments at all levels , the speed of development of the logistics industry in Shaanxi is significantly accelerated. The rapid expansion of the overall size , the significant increase in the level of service , and the improvement of development environment and conditions laid a good foundation for further development^[3]. Logistics industry plays an important role in improving Shaanxi Province’s development environment and promoting economic development mode shifting. There are four major characteristics^[4]:

1) The rapid expansion of the scale. The total social logistics in 2009 reached 1.4 trillion Yuan , the logistics industry realized an added value of 65 billion Yuan , an average annual increase of 17.3% and 14% since 2005; logistics industry value added accounted for 25% of the service industry , accounted for 9% of GDP.

2) Standards have markedly improved. Traditional transportation , warehousing , freight forwarding companies implement functional integration and service extension to accelerate the transition to a modern logistics enterprises; manufacturing enterprises , commercial enterprises began to adopt the concept of modern logistics management , methods and techniques , and implemented process reengineering and service outsourcing; number of new logistics enterprises grew rapidly , forming a multi-ownership , multi-

service mode , multi-level logistics enterprises cluster.

3) Infrastructure conditions gradually improved. The rapid expansion of the size of the transport infrastructure provides good facilities for the development of the logistics industry. Three logistics park , Xi’an International Port District , Xianyang Airport and Baoji Chencang are constructed relatively smooth , continuously improve the level of modernization of warehousing and distribution.

4) The development environment is significantly improved. All levels of government have established the coordination mechanism to promote the development of the logistics industry , and also introduced plans and policies to support the development of modern logistics industry. Logistics statistical accounting , personnel training and technological innovation and other industries basic work achieved significant results.

Facing a good development situation , Shaanxi logistics industry also has good conditions for development itself , such as:

1) Good location advantage. Shaanxi Province is a transport hub connecting eastern and midland , the northwest and southwest of China , is the center of Asian section of the ‘New Eurasian Continental Bridge’ and the ‘gateway’ to access the northwest China. Moreover , the Xi’an Xianyang International Airport is an important domestic airport , an international scheduled airport and a regional center airport.

2) Rich in energy resources. The potential economic value of mineral resources is more than 42 trillion Yuan , ranking first in the country. Coal available reserves of 168.5 billion tons , oil proved reserves of 1.4 billion tons.

3) Abundant industrial base. Equipment manufacturing industry , energy and chemical industry , automobile industry , high-tech , iron and steel industry ,

nonferrous metal industry provide a huge market demand and support for the development of the logistics industry.

4) Hard-won policies. The State Council approved the ‘Guanzhong-Tianshui Economic Zone’ Development Plan. ‘The logistics industry restructuring and revitalization plan’ is approved at the State Council executive meeting in February 25, 2009. Xi’an is included as one of 21 national logistics nodes, and will receive necessary policy support to accelerate the development of the logistics industry in Shaanxi Province.

2.2 Industrial clusters

In this article, we define industrial clusters as follows: Industrial cluster is a collection of associated enterprises and institutions in a particular field linked by intercommunity and complementary to each other which are concentration geographically. In recent years, industrial clusters in Shaanxi developed rapidly. At this stage, the major types of industries are:

1) Equipment manufacturing industry. To speed up the development of industrial economy, Shaanxi Province proposed the strategic thinking of ‘Large group to lead, Major projects to promote, Clustering driven, Park the bearing’ and map out the top ten industrial clusters within the equipment manufacturing industry in the province. The ten industrial clusters will have a positive effect to create the industry’s ‘gold chain’, and will also enable enterprises to obtain the power to develop rapidly.

2) Xi’an high-tech industries. A number of high-tech enterprises with independent intellectual property rights and strong core competitiveness grew rapidly. Formed a phalanx of industry with backbone enterprises as leaders, technology-based SMEs as supporters.

3) Modern service industry. Modern service industry is the basic industry of the modern economic develop-

ment. Shaanxi modern service industry is still in the developmental stage, but the strong momentum of cluster development is obvious, and has initially formed a trade and logistics industry clusters, the MICE industry cluster and the financial services industry cluster.

4) The tourism industry. Shaanxi is one of the cradles of human civilization and the Chinese nation, Xi’an is a world-famous historical and cultural city and international tourist destination city. With continuous improvement of the Shaanxi tourism infrastructure and the increasing of tourism industry support from the provincial and municipal government, the tourism industry has shown good momentum of development, and advantages of cluster development have become increasingly prominent.

5) Cultural industries. Shaanxi has formed a film and television entertainment media industry cluster, publication printing industry clusters and the cultural and creative industries cluster. Qujiang Cultural Industry Park becomes a national cultural industry base named by the State Council. Tang Paradise, North Square of Big Wild Goose Pagoda, Qujiang Sea World project and other projects under construction have formed the Culture and Tourism Group.

6) Small and medium enterprises. Fruit industry clusters in Liquan; Pepper industry clusters in Hancheng; Dairy cattle industry clusters in Lintong, the Lintong Liuzhai sewing machine parts, Lintong travel souvenir industry; Carton industry clusters in Huxian; Fireworks industry clusters in Pucheng; Energy and heavy chemical industry clusters in northern Shaanxi and so on.

3 Grey Relation Analysis

Grey relational theory was first proposed by Professor Deng Julong^[5] in 1982, afterwards the theory is ap-

plied successfully in many aspects. Gray relation theory is that, in the system development process, if two factors' change trends are consistent, which means high degree of synchronous changes, then the correlation degree is high; otherwise low. The gray relation analysis modeling steps are as follows:

1) The establishment of the original series of the dependent variables and independent variables.

Dependent variables are called the mother sequence, write as $x_0^{(k)}$

$$x_0^{(k)} = \{ x_0^{(1)} \ x_0^{(2)} \ x_0^{(3)} \ \dots \ x_0^{(k)} \}$$

independent variables are called the child sequence, write as $x_i^{(k)}$

$$x_i^{(k)} = \{ x_i^{(1)} \ x_i^{(2)} \ x_i^{(3)} \ \dots \ x_i^{(k)} \} \ (i = 1 \ 2 \ 3 \ \dots \ n)$$

2) Initialization of the original series

$$x_i^{(k')} = x_i^{(k)} \div x_0^{(1)}$$

3) Calculating the absolute value of the difference between mother sequence and child sequence at each time point, taking the maximum difference and the minimum difference.

Absolute value of difference

$$\Delta_i(k) = \left| x_0^{(k')} - x_i^{(k')} \right| \ (i = 1 \ 2 \ 3 \ \dots \ n)$$

Sequence of the difference

$$\Delta_i = (\Delta_i(1) \ \Delta_i(2) \ \Delta_i(3) \ \dots \ \Delta_i(k))$$

Maximum difference

$$\Delta_{\max} = \max_i \max_i \left| x_0^{(k')} - x_i^{(k')} \right|$$

Minimum difference

$$\Delta_{\min} = \min_i \min_i \left| x_0^{(k')} - x_i^{(k')} \right|$$

4) Calculating the grey relation

$$L_{0i}^{(k)} = \frac{\Delta_{\min} + \lambda \Delta_{\max}}{\Delta_i + \lambda \Delta_{\max}}$$

Where $L_{0i}^{(k)}$ is the relative difference of child factor and mother factor at point K . The greater absolute difference Δ , the smaller $L_{0i}^{(k)}$, vice versa. Therefore, the value of $L_{0i}^{(k)}$ describes the influence of x_i to x_0 . λ

is the resolution ratio, between 0 and 1, usually select the value of $\lambda = 0.5$.

5) Calculating the grey relational degree

This article adopts the method of arithmetic average

$$R_{0i} = \frac{1}{n} \sum_{k=1}^n L_{0i}^{(k)}$$

6) Estimating of the grey relational degree

The grey relational degree usually fluctuates between 0 and 1, the more close to 1, the more degree of relevance. As a matter of experience, we consider the relevance as significant correlation as the factor is greater than 0.6 when $\lambda = 0.5$.

Modeling in this paper is mainly based on cooperation research between regional logistics and industrial clusters, so we selected indicators are representative of the regional logistics characteristics. From the view of logistics services, China's logistics is still in the primary stage, the major logistics businesses are transportation and storage. We select the freight volume and tonnage mileage as two indicators to represent the level of development of the regional logistics. These two indicators are selected as a representative not only with objective reality, and can be approximated to act as a regional logistics indicators. Added-value of manufacturing is selected as representative indicators of the manufacturing industry cluster.

To analysis of the supporting role of Shaanxi Province's regional logistics to its manufacturing industry clusters, we selected five key factors that affect the regional logistics freight volume and tonnage mileage: GDP, total retail sales of social consumer goods (TRSSCG), per capita disposable income of urban residents (PCDIUR), the output value of tertiary industry (OVTI), and manufacturing value added (MVA), to analyze the relevance with regional logistics. Specific indicators data are shown in the following table.

Table 1 Numerical table of Shaanxi's freight volume , tonnage mileage and influencing factors

Year	Freight volume (ten thousands tons)	Tonnage mileage (million tons /Km)	GDP (hundred million yuan)	TRSSCG (hundred million yuan)	PCDIUR (yuan)	OVTI (hundred million yuan)	MVA (hundred million yuan)
2007	45 724	111 531	3 933. 72	1 331. 35	8 272	1 546. 59	1 321. 67
2008	48 826	117 901	4 743. 61	1 542. 37	9 268	1 806. 36	1 830. 99
2009	56 862	136 740	5 757. 29	1 837. 25	10 763	2 178. 20	2 382. 97
2010	77 699	214 073	7 314. 58	2 317. 11	12 858	2 699. 74	2 962. 91
2011	86 147	234 783	8 169. 80	2 699. 67	14 129	3 143. 74	3 147. 58

1) Freight volume and its influencing factors

Table 2 Initial value of Shaanxi's freight volume and its influencing factors

Year	Freight volume (ten thousands tons)	GDP (hundred million yuan)	TRSSCG (hundred million yuan)	PCDIUR (yuan)	OVTI (hundred million yuan)	MVA (hundred million yuan)
2007	1. 000 000 000	1. 000 000 000	1. 000 000 000	1. 000 000 000	1. 000 000 000	1. 000 000 000
2008	1. 067 841 834	1. 205 883 998	1. 158 500 770	1. 120 406 190	1. 167 963 067	1. 385 360 945
2009	1. 243 591 987	1. 463 573 920	1. 379 990 235	1. 301 136 364	1. 408 388 778	1. 802 999 236
2010	1. 699 304 523	1. 859 456 189	1. 740 421 377	1. 554 400 387	1. 745 608 080	2. 241 792 581
2011	1. 884 065 261	2. 076 863 630	2. 027 768 806	1. 708 051 257	2. 032 691 276	2. 381 517 323

Maximum difference: $\Delta_{\max} = 0.798\ 270\ 513$; Minimum difference: $\Delta_{\min} = 0$; Take $\lambda = 0.5$, get the table of correlation coefficient:

Table 3 Correlation Coefficient of Shaanxi's freight volume and its influencing factors

Year	GDP (hundred million yuan)	TRSSCG (hundred million yuan)	PCDIUR (yuan)	OVTI (hundred million yuan)	MVA (hundred million yuan)
2007	1.000 000 000	1.000 000 000	1.000 000 000	1.000 000 000	1.000 000 000
2008	0.669 554 624	0.755 215 711	0.841 801 320	0.736 401 577	0.468 340 550
2009	0.559 759 273	0.672 199 869	0.829 370 740	0.629 253 910	0.333 333 333
2010	0.635 899 193	0.871 838 437	0.658 734 132	0.857 967 678	0.340 192 720
2011	0.591 962 845	0.660 602 004	0.613 765 207	0.653 010 203	0.359 906 811
Ave	0.691 435 187	0.791 971 204	0.788 734 280	0.775 326 674	0.500 354 683

We can calculate the grey relational degree of freight volume and its influencing factors are:

$$0.854882984 \quad 0.854991145 \quad 0.88760638, \\ 0.835458046 \quad 0.579083136.$$

The grey relational degree of freight volume and GDP, TRSSCG, PCDIUR, and OVTI are greater than 0.8, which is dominant correlation. Among these factors, the maximum relational degree is between the freight volume and per capita disposable income of urban residents which reached 0.88760638. This is related to the living standard of residents in Shaanxi. The abun-

dance of disposable income has stimulated people's consumption demand so as to accelerate the circulation of goods. Among these factors, the minimum relational degree is between the freight volume and manufacturing value added which is only 0.579083136. The results show that with the active upgrade in the regional manufacturing industry in recent years, the development of the regional logistics is still in lag compared to the industrial clusters, meaning that they have low matching degree.

2) Tonnage mileage and its influencing factors

Table 4 Initial value of Shaanxi's Tonnage mileage and its influencing factors

Year	Tonnage mileage (million tons/km)	GDP (hundred million yuan)	TRSSCG (hundred million yuan)	PCDIUR (yuan)	OVTI (hundred million yuan)	MVA (hundred million yuan)
2007	1.000 000 000	1.000 000 000	1.000 000 000	1.000 000 000	1.000 000 000	1.000 000 000
2008	1.057 114 166	1.205 883 998	1.158 500 770	1.120 406 190	1.167 963 067	1.385 360 945
2009	1.226 026 845	1.463 573 920	1.379 990 235	1.301 136 364	1.408 388 778	1.802 999 236
2010	1.919 403 574	1.859 456 189	1.740 421 377	1.554 400 387	1.745 608 080	2.241 792 581
2011	2.105 091 858	2.076 863 630	2.027 768 806	1.708 051 257	2.032 691 276	2.381 517 323

Maximum difference: $\Delta_{\max} = 0.786285944$; Minimum difference: $\Delta_{\min} = 0$; Take $\lambda = 0.5$, get the table of correlation coefficient

Table 5 Correlation Coefficient of Shaanxi's Tonnage mileage and its influencing factors

Year	GDP (hundred million yuan)	TRSSCG (hundred million yuan)	PCDIUR (yuan)	OVTI (hundred million yuan)	MVA (hundred million yuan)
2007	1.000 000 000	1.000 000 000	1.000 000 000	1.000 000 000	1.000 000 000
2008	0.659 764 937	0.739 949 531	0.820 079 754	0.722 416 331	0.467 765 155
2009	0.548 418 154	0.652 020 489	0.793 425 731	0.612 694 790	0.333 333 333
2010	0.827 951 758	0.617 124 495	0.441 455 062	0.624 048 501	0.472 250 624
2011	0.910 871 670	0.788 624 666	0.420 824 098	0.799 381 450	0.510 674 882
Ave	0.789 401 304	0.759 543 836	0.695 156 929	0.751 708 214	0.556 804 799

We can calculate the grey relational degree of tonnage mileage and its influencing factors are:

$$0.781\ 833\ 332\ \rho.784\ 134\ 74\ \rho.841\ 676\ 822\ , \\ 0.768\ 709\ 791\ \rho.642\ 752\ 416$$

The grey relational degree of tonnage mileage and GDP , TRSSCG , PCDIUR , OVTI and MVA are greater than 0.6 , which is dominant correlation. Among these factors , the maximum relational degree is between the tonnage mileage and per capita disposable income of urban residents which reached 0.841 676 822 , and the minimum relational degree is between

the tonnage mileage and manufacturing value added which is only 0.642 752 416. This is similar to the analysis of freight volume.

3) Comparative analysis between Shaanxi and Shanghai , Jiangsu , Zhejiang

We collected the related data in year 2000 ~ 2006 of three provinces in south China , Shanghai , Jiangsu and Zhejiang^[6]. In this article , we use the data to make comparative analysis between Shaanxi Province and the three provinces to find the gap and make evaluation.

Table 6 Comparison of the grey relational degree of freight volume and its influencing factors

Province/ year	GDP (hundred million yuan)	TRSSCG (hundred million yuan)	PCDIUR (yuan)	OVTI (hundred million yuan)	MVA (hundred million yuan)
Shaanxi 07-11	0.691 435	0.791 971	0.788 734	0.775 327	0.500 355
SJZ 00-06	0.779957	0.828 742	0.887 668	0.767 260	0.648 114

Table 7 Comparison of the grey relational degree of tonnage mileage and its influencing factors

Province/ year	GDP (hundred million yuan)	TRSSCG (hundred million yuan)	PCDIUR (yuan)	OVTI (hundred million yuan)	MVA (hundred million yuan)
Shaanxi 07-11	0.789 401	0.759 544	0.695 157	0.751 708	0.556 805
SJZ 00-06	0.911 371	0.910 786	0.823 856	0.881 134	0.625 213

By comparing , it is not hard to see that the grey relational degrees of tonnage mileage and GDP , TRSSCG is remarkably high in Shanghai , Jiangsu , Zhejiang , which are 0.911 37 and 0.910 786. This is associated with the high level of economic development of the three provinces compared with Shaanxi. According to the ‘Growth Pole’ theory , production factors like manpower , material resources and financial resources will all gather here , forming a ‘Growth Pole’ rapidly. Formation of industrial clusters will promote the development of ‘Growth Pole’ through agglomeration effect , as well as the development of surrounding area through diffusing effect. The circulation of production elements in the process will further promote the demand for regional logistics.

4 Countermeasure Suggestions

1) Strengthen the macro-guidance of government

To promote the formation of a regional industrial cluster , the government should have a logistic system planning in the first place. Increasing logistic facilities investment and strengthening policy support will form a good base for logistic industry , reduce the regional transportation and transaction cost and attracts more manufacturers. Leasers and staff of government at all levels should enhance the study of the theory of modern economics , especially the theory of industrial

cluster and then use them in the macroscopic policy.

2) Construct logistics system to match industrial clusters

In order to guarantee the smooth operation of every industrial cluster , logistics system must be constructed according to the characteristics of the industrial structure. The matching is mainly embodied in three aspects: structure , capacity and content. Shaanxi province should accelerate the construction of five logistics systems and the coordinated development of the four regional logistics to promote the cultivation of large logistics groups.

3) Establish strategic cooperation between industrial clusters and logistics system

To promote the integration of industrial clusters and regional logistics , realize the coordinated development of the two systems and motivate the development of regional economy and logistics , the establishment of strategic cooperation mechanism is an important strategy. According to the economic developing experiment of China’s southeast coastal provinces , leading enterprise and famous brand product has strong radiation effect on the development of local economy. We should correctly guide the leading enterprises with great relevance and strong connections to cultivate a batch of famous brand products and improve self

growing ability. Under the influence of agglomeration effect of the core logistics enterprises , other logistics enterprises will be also promoted. On this basis , an integrated third-party logistics service body is forming independently of the industrial chain and service the industrial chain at the same time.

4) Improve the industrial clusters logistics information system

Logistic system can not run smoothly without fast and accurate information channels. Cluster logistic system connects information of each enterprise and sets up collaboration across the enterprise as a whole industry oriented chain. Within the cluster , vertical associated enterprises , horizontal competing enterprises , supporting agencies and customers are geographically integrated as a would-be social ecological system where members share complementary resources and information. In reality , information interaction between enterprises in the logistic system is more frequent than between traditional enterprises. Parallel information transfer mode considers uncertainty and dynamic factors with higher flexibility and agility.

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Brief Biographies

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