Analysis of Influencing Factors of Cooperative Innovation Behavior of Cluster Enterprises under Supply Chain Network

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Abstract

With the increasing development of supply chain network, the form of cluster enterprise cooperation is becoming more prominent in kinds of fields. Increasing competition in the logistics industry, a single enterprise difficult to rely on their own resources to quickly respond to changes in the competitive market. Therefore, logistics enterprises need to achieve cluster innovation to meet the fierce market competition trend. In this paper, a representative enterprise rookie station as an example, the design of the relevant questionnaires, from the technical upgrading, partnership, strategic planning, government policy in four aspects of in-depth analysis, and finally concluded: cluster enterprise cooperation and innovation requires technical level, Cooperation, government local policy, enterprise development strategic planning and other factors, and thus widen the supply chain network. It is hoped that the research on this topic will help the innovation and development of the cooperative enterprises in China.

Keywords

Supply chain logistics system, cluster enterprise cooperation, innovation model, test analysis, path innovation.

1. Introduction

One of the goals of China's 13th Five-Year Plan is to maintain medium and high-speed economic growth - to optimize the spatial pattern of development and to step into the ranks of innovative countries. On the one hand, it calls for "deepening the implementation of innovation-driven development strategy - forming several regional innovation centers and innovative cities with strong driving force". On the other hand, it calls for "promoting regional coordinated development - cultivating several growth poles to promote regional common development". Xi'an is one of the twelve international comprehensive transportation hubs of the highest level in China.

The definition of enterprise cluster refers to the collection of institutions and enterprises that are interrelated among enterprises in a specific region and connected in a regional location. With the acceleration of the process of economic globalization, supply chain network formed by enterprise cluster cooperation has been continuously extended and strengthened in many regions of China. For example: Jinjiang City, Fujian Province, China, as a production cluster base of shoemaking industry at home and abroad, has more than 4000 shoemaking enterprises. At present, the development of Jinjiang shoemaking industry has emerged from the manufacturers of standard parts such as soles and heels, to a series of accessories such as shoelaces and rivets, and a number of raw material suppliers have also emerged, cooperating fully with each other to form a clear division of labor and a large-scale supply chain cluster cooperation group. In the supply chain system, the industrial evolution and development of enterprise clusters are diverse and dynamic. In the short run, some enterprises can achieve a certain degree of industrial single production mode; but in the long run, cluster supply chain will inevitably change from simplification to diversification in the process of evolution and upgrading. In the cluster enterprise agglomeration area, these enterprises are interdependent, and affect the development of the whole enterprise supply chain network.

Enterprise clusters can reflect a variety of patterns and forms, but mainly supply chain network enterprise clusters are the most significant. With the rapid development of the Internet, enterprise clusters have become an inevitable trend under the new situation, in which the logistics cluster supply chain network develops most rapidly.

2. Literature Review

Concerning enterprise clusters, relevant definitions have emerged both at home and abroad. Rolf Sternberg (2009), Professor of Economics, Cologne University, Germany, found that there is a strong regional interaction within the cluster area, and the innovation effect of the industry and the performance of the cluster are tighter than that of other links[1]. Min Yu (2012) pointed out in the paper of supply chain technology management how to test the conditions and risk mechanism of enterprise development under the condition of supply chain. At the same time, corresponding measures should be taken to minimize these risks[2]. PhD. Thesis (2016) refers to the measurement of innovation behavior of cluster enterprises in the paper of the manifestation of supply chain network. It can establish the standard by analyzing the influence degree of innovation behavior variables of cluster enterprises[3]. Bilingual He (2016) proposed in the characteristics and development of cluster supply chain that the producer is the core influencing the whole cooperative behavior, and the producer is the most critical subject controlling the development of cluster supply chain. Similarly, the level of development of the whole system is determined by the capability of the producer[4]. Maui (2017) believes that the cooperation mode under the traditional supply chain should be innovated according to the development process of the supply chain. In order to adapt to the continuous evolution of the external overall environment of the supply chain system, enterprises need to make corresponding changes [5]. Zhao Lindu (2007) put forward in the study of supply chain collaborative innovation management mode that enterprises should determine the optimal cooperation path, maximize resource utilization, reduce costs and improve technological strength through enterprise cooperation as far as possible[6]. Zhang Yinghua et al. (2016) constructed the principle and model of the whole supply chain network in the study of supply chain collaborative innovation performance, and validated the conclusion through the analysis of specific companies[7]. Huang Yuping (2016) studies that with the development of network economy, the traditional supply chain has been unable to adapt to the development of the market. Enterprises should adapt to the development of competitive market and change the supply chain to strengthen cooperation and innovation [8].

At present, with the deepening of the competitive market and the deepening of enterprise cluster projects, the development of cluster enterprises under the domestic supply chain network has entered a critical period. However, in the development activities of cluster enterprises under supply chain network, there are still many factors affecting the coordination of various links. How to combine these factors with specific practice will be the focus of this paper.

3. Model Construction

3.1 Theoretical model

Regarding the model of cooperative innovation behavior of cluster enterprises, Liu Yuanhua (2012) analyzed the changes of cooperative innovation emergence in different stages of cluster by constructing the dynamic model of cooperative innovation of cluster enterprises[9]; Wang Fenglian (2016) used AJ model to analyze the variables in four cooperative innovation modes: complete cooperation, semi-cooperation I, semi-cooperation II and non-cooperation. The impact of corporate benefits[10]. By referring to the literature, this paper establishes the relevant model of cooperative innovation behavior of cluster enterprises as follows: Fig. 1:

3.2 Hypothesis Deduction of Influencing Cooperative Innovation Behavior of Newcomer Post

3.2.1. The Impact of Logistics Technology Upgrading on Innovation Behavior

Li Jizi et al. (2011) studied the technological innovation modes and evolution transmission paths of cluster supply chain, and concluded that in order to improve technological innovation capability,

enterprises must master the same direction of evolution path and technological innovation mode[11]. In the interaction of supply chain network, novice post cluster cooperative enterprises emphasize that enterprises can solve problems together by sharing information resources and building trust. Make use of the unique advantages of each cooperative enterprise, improve technology investment, maintain the synchronous development of enterprise carrying capacity and chain upgrading, facilitate and more effective realization of resource sharing within cluster cooperative enterprises, emphasize the timeliness of the latest realization of information, and enhance their own capabilities to a greater extent. Based on the above analysis, this paper proposes hypotheses:

Hypothesis H1: Logistics technology upgrading has a significant positive impact on innovation behavior

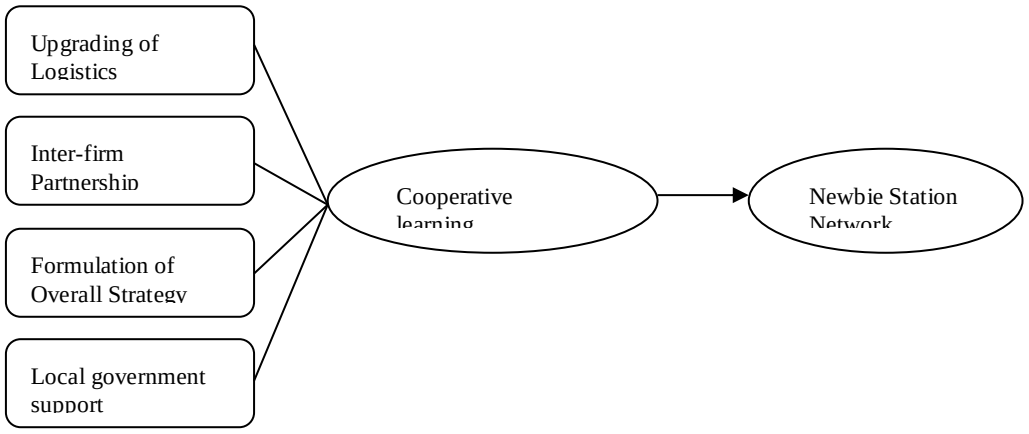

Fig.1 Conceptual model of the study

3.2.2. The Impact of Partnership among Enterprises on Innovation Behavior

In order to make full use of the influence of supply chain, the cooperation between enterprises inside and outside, the balanced distribution of income and the sharing of information and data can be achieved. Sun Wenhong (2013) put forward that the premise of cooperative operation between supply chain node enterprises is to form a good cooperative relationship[12]. The cooperation between novice logistics enterprises can reduce the cost of logistics transportation, share information resources platform, make up for the disadvantage caused by the breakdown of logistics supply chain, and make the collection of post system more convenient. To strengthen the cooperative partnership of newcomer stations can realize service specification and intelligence. In summary, the following hypotheses are proposed:

Hypothesis H2: Partnership among firms has a significant positive impact on innovation behavior

3.2.3 The Impact of Overall Strategic Planning on Innovative Behavior

Cao Lili (2008) pointed out that under the condition of supply chain, facing the development trend of supply chain in the global cluster, we should strengthen the goal planning and specific path analysis of upgrading of cluster enterprises to form a complete development system[13]. As a logistics cluster enterprise, the novice bird post station has strong flexibility and extensibility. The cooperative activities among enterprises should go deep into the relevant overall planning and implementation to maintain the consistency of the development of logistics projects.

Hypothesis H3: The formulation of overall strategic planning has a significant positive impact on innovation behavior.

3.2.4 The Impact of Local Government Support on Innovation Behavior

The various policies issued by the government are the focus of the logistics cluster system, which plays an important role. In the research, Lu Lijun and Zhou Guohong (2009) pointed out that local governments play an important role in promoting SME cluster and network collaborative upgrading,

thereby improving the innovation performance of cluster enterprises[14]. The government actively creates a healthy market environment for enterprises, provides preferential treatment and assistance for innovation within clusters in many aspects, reduces the cost of innovation, ensures that logistics enterprises cooperating with each other are optimistic about innovation expectations, and strengthens the enthusiasm of innovation among cluster enterprises.

Hypothesis H4: Local government support has a significant positive impact on innovation behavior.

In order to verify that the innovation factors of cluster enterprise cooperation in supply chain have an impact on the development of supply chain in any aspect, it is necessary to further study the influencing factors model through questionnaire design and investigation.

4. Empirical analysis and discussion

In view of the influence of the main body of this paper on the innovation behavior of cluster enterprises under supply chain conditions, according to the research model, relevant questionnaires were designed, and the newcomer post of logistics aggregation group in China was selected to conduct a survey. The collected data were analyzed by SPPS Statistics 17.0 software.

4.1 Data Collection and Processing

Questionnaires are distributed on the network platform and filled in manually. Through voluntary return of questionnaires, the deviation caused by unclaimed questionnaires is predicted in the process of data recovery. Through the analysis of the basic variance data, it is found that there is no significant difference between the non-returned questionnaires and the returned questionnaires. Sample enterprises choose the enterprises inside the novice station system. This research will focus on the cooperative behavior inside and outside the rookie logistics system, and select relevant items as the analysis samples. Before the start of the questionnaire, the basic situation of the sample enterprises was counted, and the scale of the related logistics inside the novice post was counted as shown in Table 1.

Table1 Descriptive Statistical Analysis of Samples

Sample enterprise name	Size	Number of valid questionnaires	Percentage
Shun Feng Express	Above 1100	23	16.31%
Yuan Tong Express	500—800	27	19.15%
Zhong Tong Express	200—500	51	36.17%
Shen Tong Express	800—100	30	21.28%
Yun Da Express	500—800	10	7.09%

As can be seen from the table, Zhongtong Express has the largest sample size and the highest proportion, and invests heavily in the development of logistics enterprises. In the five major logistics enterprises, according to the choice of the surveyed personnel, Yunda Express has a low probability proportion between 500 and 800 people and a small proportion within the rookie post.

Table 2 Basic Variable Analysis

	Option	Frequency	Percentage	Accumulated percentage
regional distribution	Southeast coast	43	30.50%	30.50%
	North China	40	28.37%	58.87%
	Central region	32	22.70%	81.57%
	Southwest China	16	11.35%	92.91%
	Northwest China	10	7.09%	100%

As shown in Table 2, the distribution of enterprises in the sample of the questionnaire can be found that enterprises are still the main concentration areas in the south-east coast and North China, accounting for 30.50% and 28.37% of the sample survey respectively. The distribution of enterprises in the southwest and northwest regions is relatively small, and the data in the central region is twice as large as that in the southwest region. Relative geographical concentration is also the current trend of cluster enterprise development. Logistics enterprises are centralized and distributed to jointly establish a perfect supply chain network system.

4.2 Reliability and Validity Analysis

4.2.1 Reliability Analysis

The commonly used method for reliability analysis is Cronbach_s alpha coefficient, whose value ranges from 0 to 1. The closer the_value is to 1, the higher the reliability of the scale is, the smaller the error range is, and the better the internal consistency of the data is. It is generally considered that the reliability is not credible in the range of 0.60-0.65; the minimum acceptable reliability in the range of 0.65-0.75; the reliability is quite good in the range of 0.70-0.80; and the reliability is very good in the range of 0.80-1. There are 25 items in this test. After statistical analysis, the scale reliability in this study is shown in Table 3.

Table 3 Reliability statistics

Reliability statistics		
Cronbach´s Alpha	Cronbach_s Alpha Based on Standardization Items	Item number
.900	.877	25

It can be seen from the table that the Cronbach_s_of the sample influencing factors is 0.877, which indicates that the scale in this paper has high reliability and consistency, and the designed questionnaire has high reliability and consistency, which can be used to analyze the cooperative innovation factors within the whole cluster.

4.2.2 Validity Analysis

The cooperative performance of cluster enterprises is analyzed by SPSS. The Bartlett and KMO values in the scale are shown in Table 4. Generally speaking, when KMO value is greater than 0.7 and Bartlett value is less than 0.05, the scale has good validity, and factor analysis can be continued in the next step. Data Table 3 shows that KMO value is 0.871, greater than 0.7, and Bartlett sphericity test value is 0.000 < 0.05. It shows that the validity of the scale is good and it is suitable for factor analysis.

Table 4 KMO and Bartlett test

KMO and Bartlett test	
KMO Sampling Appropriateness Quantity	.871
Bartlett's sphericity test Chi Square Readed Last Time	1180.501
Freedom	160
Saliency	.000

4.3 Relevance Analysis

4.3.1 Pearson parametric correlation analysis

The correlation in the test items is analyzed, and the influence of the technical factors on the overall cooperative innovation behavior is analyzed. The Pearson coefficient is 0.836** and ** P is less than 0.01 between the two test items, which indicates that there is a significant correlation between technological upgrading and innovation of cooperative enterprises in cluster enterprises.

Table 5 Correlation analysis

		Cooperative innovation
Technology upgrading	Pearson correlation	0.836**
	Significance (bilateral)	0.000
	N	141

In the cluster cooperation of supply chain under cluster system, the innovation of cluster cooperation is related to each dimension of technology upgrading. As shown in Table 6, Pearson coefficient of data processing ability among the dimensions of cluster cooperative innovation and technology upgrading is 0.736**, Pearson coefficient of planning technology route within cooperative innovation and technology upgrading is 0.627**, Pearson coefficient of logistics technology improvement within cooperative innovation and technology upgrading is 0.721**, and ** P is less than 0.01; The Pearson correlation coefficient between technological upgrading and cooperative innovation is 0.671** and ** P is less than 0.01, which indicates that there is a significant correlation between the cooperative innovation mode and the internal dimensions of technological upgrading capability in enterprise cluster innovation.

Table 6 Relevance Analysis of Dimensions

		Cooperative innovation			Cooperative innovation
		Data Processing Ability	Planning Technical Route	Improving Logistics Technology	
Technology upgrading	Pearson correlation	0.736**	0.627**	0.721**	0.671**
	Significance (bilateral)	0.000	0.000	0.000	0.000
	N	141	141	141	141

4.3.2 Spearman Rank Nonparametric Correlation Analysis

The correlation in the test items is analyzed, and the technological upgrading conditions in the influencing factors are selected for analysis. Data such as table 7 are analyzed. The correlation between the technological upgrading items in the influencing factors in the cooperative innovation of cluster enterprises is tested. The significance of the non-parametric Spearman coefficient is 0.000, which is less than 0.01. It shows that the technological innovation of factors is significant for the cooperative innovation of cluster enterprises. Sex correlation coefficient is 0.765, which plays a vital role in the process of innovation. Suppose H1 is validated preliminarily.

Table 7 Nonparametric correlation analysis

			Technology upgrading	Cooperative innovation
Spearman's Rho	Technology upgrading	correlation coefficient	.831	.765**
		Sig. (unilateral)	.	.000
		N	141	141
	Cooperative innovation	Sig. (unilateral)	.765**	.831
		Sig.（单侧）	.000	.
		N	141	141

The correlation was significant when the confidence (unilateral) was 0.01.

4.4 Regression Analysis

4.4.1 Regression Analysis of Technology, Cooperative Partnership, Policy and Cluster Enterprise Cooperation

Using technology upgrading, cooperative relationship and local policy as independent variables, and cooperative innovation performance as dependent variable, the regression analysis data obtained by SPSS17.0 regression analysis are as shown in table 8.

Table 8 Regression Analysis of Cooperation Effect and Cooperation Factors

independent variable	dependent variable	Non-standardization coefficientβ	Standardization coefficientβ	T value	Sig value

Technology upgrading	Cooperative Innovation Performance	0.258	0.412	5.727	0.000
Partnership		0.454	0.262	6.291	0.000
Local policy		0.284	0.321	4.710	0.000
F value: 167.753		R side: 0.412		After adjustment R side: 0.419	

As shown in the table, the standard coefficients beta between technology upgrading methods and cooperation effects are 0.412, sig = 0.000 is less than 0.005, the standard coefficients beta between enterprise cooperation relations and cooperation effects are 0.262, sig = 0.000 is less than 0.005, the standard coefficients beta between local policy support and cooperation effects are 0.321 and SIG = 0.000 is less than 0.005, which illustrates the three dimensions. The research hypothesis H1, H2 and H4 are established. The upgrading of technology, the strengthening of enterprise cluster relationship and local policy support will have a positive impact on the development of cluster enterprises under the supply chain, and can achieve the goal of promoting innovation and cooperation development of cluster enterprises.

4.4.2 Regression Analysis of Strategic Planning and Cluster Enterprise Cooperation

Strategic planning is set as independent variable and cooperative innovation performance is set as dependent variable. The results are shown in table 9.

Table 9 Regression Analysis of Enterprise Cooperation Performance and Strategic Planning

independent variable	dependent variable	Non-standardization coefficientβ	Standardization coefficientβ	T value	Sig value
strategic planning	Cluster cooperation	0.325	0.161	6.118	0.000
F value：37.430		R side：0.212		After adjustment R side: 0.206	

The data show that the standard coefficient beta between strategic planning and cluster enterprise cooperation is 0.161, sig = 0.000 is less than 0.005, which indicates that the more perfect the strategic planning is, the more closely the cluster enterprise cooperative innovation relationship will be.

5. Conclusion and Policy Suggestion

This paper investigates the existing supply chain development model of the novice bird post by issuing questionnaires, puts forward some factors affecting the cooperative behavior of enterprise clusters, and carries out correlation analysis and regression analysis with SPPS software, and draws the following conclusions:

(1) The cooperative innovation of supply chain cluster enterprises needs the positive influence of technological level, cooperative relationship between enterprises, local government policies, strategic planning of enterprise development and other special factors in order to develop continuously and expand the supply chain network. Cluster enterprises share market risks through cooperation, and constantly derive relevant links to innovate and develop in adapting to competition.

(2) The highly honest and cooperative relationship between enterprises can deal with such problems as cooperative relationship, benefit distribution and resource allocation mechanism, so as to continuously improve the defects of cluster enterprises in the process of cooperative development.

(3) In the way of improving technological upgrading, improving data processing ability, planning effective technological route and improving logistics technology all have an effective impact on Enterprise Cooperative behavior.

Therefore, under the condition of market competition environment, it is an inevitable choice for the development of market economy for enterprises to cooperate and integrate resources to cope with the fierce market competition. Establishing professional system consistency and sharing market resources, industry information and development technology openly will improve the soft power of enterprises and win more opportunities for them under the trend of cluster cooperation and innovation.

References

[1] Rolf Sternberg. The relation mechanism of technology innovation and firm structure[J]. Economic Studies, 2009, 34(6):213-228.

[2] Min Yu. Supply chain Network Operations Management of a Blood Banking System with Cost and Risk Minimization[J]. Computational Management Science, 2012, 9(2): 205-231.

[3] Ph.D.Thesis. Measuring performance in supply chain networks[J]. Andreas Seiler, 2016, 60(2): 167-189.

[4] Binghua He. The Features and Evolution of Cluster Supply Chain Network[J]. Open Journal of Business and Management, 2016, (4): 751-762.

[5] Maui.HI. Academic Entitlement In Nontraditional Undergraduates[J]. LACB.ICE&ISEC Proceedings, 2017, (1): 1-5.

[6] Zhao Lindu. Research on Supply Chain Collaborative Innovation Management Model [J]. Management Science, 2007, (5): 9-13.

[7] Zhang Yinghua, Peng Jianqiang. Establishment of performance evaluation index system of enterprise collaborative innovation under supply chain[J]. Social scientist, 2016 (10): 71-75.

[8] Huang Yuping. Research on Enterprise Supply Chain Management and Its Development Behavior in Network Economy[J]. China Collective Economy, 2016 (13): 42-43.

[9] Liu Yuanhua. Dynamics Model of Cooperative Innovation Emergence in Enterprise Clusters [J]. Scientific Research, 2012, 30 (9): 1416-1420.

[10] Wang Fenglian. Benefit Analysis of Collaborative Innovation of Cluster Enterprises Based on AJ Model [J]. Systems Science and Mathematics, 2016, 36 (10): 1688-1696.

[11] Liu Chunling, Guo Jun, Li Jizi, etc. Research on technological innovation mode and evolution transmission path of cluster supply chain [J]. Research and development management. 2011, 23 (05): 56-65.

[12] Sun Wenhong. An Empirical Study on the Impact of Supply Chain Cooperation on Supply Chain Synergy and Performance [J]. Journal of Yanshan University (Philosophy and Social Sciences Edition), 2013, 14 (1): 100-105.

[13] Cao Lili. Supply Chain Innovation in Industrial Cluster [J]. Economic and Management Research, 2008 (10): 48-53.

[14] Zhou Guohong, Army. Local Government Collaboration and Innovation Performance of Cluster Enterprises: Based on the Questionnaire Survey and Analysis of 1184 Cluster Enterprises [J]. Research on Science and Technology Management, 2009 (6): 150-151.

[15] Zhu Lin. Research on the influence of different behaviors of supply chain members on cooperation [J]. Journal of Nanjing University of Technology (Social Science Edition), 2013, 18 (2): 49-54.

[16] Wang Song and Shengya. Research on the Cooperation Degree, Openness and Growth Performance of Cluster Innovation Networks under Uncertain Environment [J]. Scientific Research Management, 2013, 34 (2): 52-60.

[17] Tianwei. Strategies for Cooperative Innovation of Cluster Supply Chain [J]. China Business, 2015, (12): 251-252.

[18] Zhang Yinghua, Peng Jianqiang. Establishment of performance evaluation index system of enterprise collaborative innovation under supply chain [J]. Social scientist, 2016 (10): 71-75.

[19] Zhao Zuoquan, Zhao Lu. Research on the Innovation Strategy of China's "13th Five-Year Plan" Cluster Based on Innovation Ability [J]. Journal of the Chinese Academy of Sciences, 2016 (1): 24-33.