

# Study on Logistics Operation Pattern of Dynamic Alliance-based Industrial Clusters

Zhou Rong<sup>1,2</sup>, Cheng Guoping<sup>1</sup>

1 School of Management, Wuhan University of Technology, Wuhan, P.R.China, 430070

2 Wuhan Polytechnic University, Wuhan, P.R.China, 430070

(E-mail: 93h999@163.com, chengguoping@yahoo.com)

**Abstract:** This article analyzes logistics operation pattern of dynamic alliance-based industrial clusters from four aspects, namely features, operation process, model of cooperative game and operating mechanisms. It summarizes the four defining features of dynamic alliance-based IC logistics operation pattern, namely the dynamic feature, the network feature, the overlapping feature and the game feature, with a further analysis of the logistics operation process itself. It is suggested that with changes in level of interests, alliance will always be in a cycle of "build - evaluate - maintain or collapse". This article also builds a dynamic alliance-based IC logistics operation model of cooperative game. In addition, it is proposed to build some operating mechanisms, namely trust mechanisms, information sharing mechanisms and the mechanisms for the distribution of benefits.

**Key words:** Industrial clusters (IC); Logistics operation; Dynamic alliance; Cooperative game

## 1 Introduction

According to Professor Michael Bolton, Harvard Business School, the person who first proposes this concept, industrial cluster is a geographical concentration of interconnected companies with close supply links, specialist suppliers, service providers, and related industries and institutions<sup>[1]</sup>. Since then, some other scholars from China and abroad, have discussed the functions, characteristics and types of industrial clusters from different perspectives. Williamson put forward the transaction cost theory from the spatial point of view, which explained the competitiveness of IC companies was attributable to the shortened geographical distance and lower logistics costs. Gulyani (2001) analyzed the auto industry in India and found that auto businesses were forced to cluster together to ensure the efficiency of their logistics operation and the reduction of their logistics costs, owing to the conflict between its poor transportation infrastructure and demanding production requirements for modern auto industry. Therefore, they could survive and expand their markets successfully in international markets monopolized by South Korea, Japan and western companies<sup>[2]</sup>. Hai Feng (2006) believed the size of the cluster radiation area was largely determined by logistics<sup>[3]</sup>. Peng Jin (2009) proposed to build three types of integrated logistics management on the basis of five principles to maximize the interests of industrial clusters, while not forgetting the sharing of resources, mutual interests, and the relative risk of interests that serve the development of Dynamic alliance-based IC logistics operation. These three types of managements were the integrated management of dynamic alliance-based logistics, the integrated management of third-party logistics and the integrated logistics management of core business as the leading party. Dynamic alliance-based IC logistics operation pattern is one type of logistics operation, which is meant to share information, integrate resources, and achieve a common goal within the industrial clusters<sup>[4]</sup>. This pattern of logistics operation of industry clusters is mainly applicable to medium and small enterprises in the industrial clusters which is less powerful core businesses, i.e. small enterprise clusters. Without third-party logistics companies to meet their needs in the external environment, small enterprise clusters often tend to choose a dynamic alliance-based IC logistics operation mode. This article focuses on dynamic alliance-based IC logistics operation, studies its operation pattern and builds an operation model of cooperative game.

## 2 Features of Dynamic Alliance-based IC Logistics Operation Pattern

### 2.1 The dynamic feature

Dynamic performance of the model demonstrates itself in the following two aspects. On the one hand, with the presence of logistics tasks at hand, related companies within the industrial cluster will form dynamic alliance; whereas the alliance may automatically collapse at the completion of these tasks. On the other hand, when there are different logistics tasks, corresponding differences can be seen in the number, category and combination pattern of enterprises within the alliance.

### 2.2 The network feature

In industrial clusters, due to geographical proximity and the relevance of enterprises, there are several core businesses in the same part. In the meanwhile there are also core businesses associated with the upstream and downstream of this industry. They are clustered in the same area. These companies (suppliers, manufacturers, retailers, etc.) are loosely linked through informal contracts or closely linked through formal contracts. So a number of parallel supply single-chains emerge[5]. At the same time, different single-chain core businesses compete and cooperate, and there are a large number of medium and small enterprises beyond the single-chain to provide specialized supportive services. As a result, a dynamic network comes up.

### **2.3 The overlapping feature**

A company assumes double or even multiple identities. It can be a member simultaneously of two dynamic alliances or more than two. Multiple dynamic alliances form an overlapping cross-alliance structure.

### **2.4 The game feature**

As the dynamic alliance is not a formal organization, the business cooperation is not everlasting. The formation of dynamic alliance is primarily based on common interests and trust, not the legal system, so the binding force is not strong. There is often a conflict between alliance interests and individual business interests. At this moment, there will be game phenomenon. The positions of various enterprises in an alliance are often similar, so in the absence of a fair chief to preside over the case, ultimately alliance instability follows. So at the beginning of the establishment of an alliance, we should establish and improve the incentives and trust mechanism to maintain long-term cooperation between enterprises.

## **3 Dynamic Alliance-based IC Logistics Operation Process**

In general, one company or some companies in industrial clusters lack of resources or are only good at one aspect of logistics operation, thus there is a demand for logistics. These companies want to carry out logistics tasks jointly, so they become initiators of dynamic alliances. When the initiators get some peer response, an alliance will gradually form. Note that the initiators of dynamic alliance are not necessarily the leaders. On the one hand, some companies, starting as initiators, may be promoted to the position of leaders. As the initiators or leaders, they do not have the absolute exclusive advantages, and they can not lead logistics business. On the other hand, it is certain that there is game phenomenon in dynamic alliance. There is also binding power between companies within the industrial clusters. In accordance with their understanding of the technology, personnel or other resources for professional logistics, companies of the dynamic alliances will distribute tasks professionally and complement each other to their best advantage. With dynamic game progresses, the organization gradually becomes stable. Specifically, the alliance's goal is to maximize the overall interests, and the following factors will affect the alliance as a whole, namely the industry conditions, the general business environment and the lever of cooperation for industrial clusters, collaboration, etc. Therefore, the interest level of the alliance will change constantly so that the alliance will always be in a cycle of "build - evaluate- maintain or collapse". On the one hand, leading companies in the dynamic alliance need to maintain the stability of the existing alliances and ensure the expected benefits; on the other hand, they should pay close attention to the external environment (the general environment, industry environment) and changes in the value of cooperation for enterprises (e.g. node companies and candidate node companies), so that the flexibility of dynamic alliance may be maintained. In this way, the alliance interests may also come to a higher level.

In the early stage of establishment, the benefit of node companies as a whole is A, then the best partners are chosen to create a dynamic alliance so that logistics tasks may be completed jointly. The benefit of node companies as a whole after the establishment becomes B. If  $B < A$ , in other words, the benefit after the establishment is much lower, the alliance will come to an end. Conversely, alliance may be established on the basis of logistics tasks and suppliers. Each node company will make corresponding effort to maintain the alliance.

Subsequently, the alliance will be influenced by various factors. At this point, the alliance faces two decisions. Decision 1 is to try hard to maintain their alliance, whereas decision 2 is to change the original alliance. The precondition is that in the long run, after the collapse of the existing alliance, a more advantageous alliance may be established to achieve a higher level of benefits. The benefits level may rise to C ( $C > B$ ). After that, each node company will accordingly exert efforts to maintain the new alliance. In such a cycle, the allied relationship is constantly in a changing process(see figure 1).

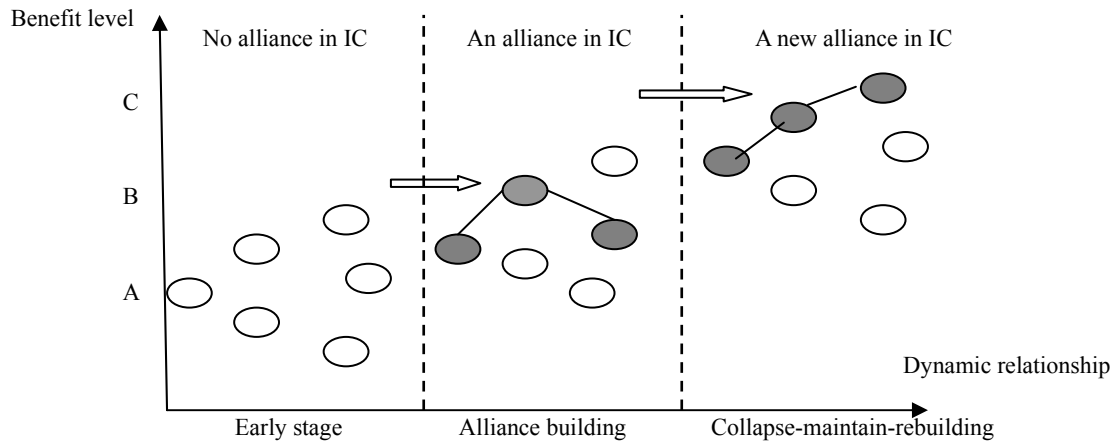


Figure 1 Dynamic Alliance-based IC Logistics Operation Process

### 4 Dynamic Alliance-based IC Logistics Operation Game Model and Mechanism

#### 4.1 Establishing game model

Cooperative game theory is an effective mathematical model method. It can solve the problem which is how to allocate benefit generated by multiple stakeholders coordination actions. When the results are determined by multiple stakeholders behaviors, their coordination actions is cooperation if the actions can bring greater benefits. The basic problem which cooperation game theory studies is how to find an effective benefit distribution method, to strengthen all interests subjects cooperation. Compared with non cooperative game theory, cooperative game theory emphasizes group rationality, efficiency, justice and fairness. It is a "win-win" strategy, often can obtain higher efficiency or effectiveness. In dynamic alliance, the relationship between enterprises is a kind of cooperative relations. If this cooperation will bring to each individual high benefit and efficiency, the alliance is stable.

Assuming that the number of enterprises in a industry cluster which set up a logistics dynamic alliance is  $n$ , the willingness mix of each enterprise is respectively for  $a_i (i = 1, 2, \dots, n)$ ,  $a_i \in A = \{ \text{alliance, not alliance} \}$ , abbreviated as  $A = \{Y, N\}$ . The expected profit of the enterprise is for  $S_i$ . Dynamic alliance combination is  $(N, N), (N, Y), (Y, Y), (Y, N)$  respectively. When expect profit is payoff, the payoff matrix is obtained.

When the expected profit that the enterprise obtains from the alliance is greater than the cost of establishment and management alliance, a dynamic alliance would be established. Let players set is  $N = \{W_1, W_2, \dots, W_i\}$ . Any element in  $N$  is known as an independent individual,  $N$  is for alliance.  $P(W_i) (i = 1, 2, \dots, n)$  is for individual payoff.  $P(W_1 \cup W_2 \cup \dots \cup W_i)$  is for the payoff that the players in alliance  $N$  obtain through the cooperation. For the particular players in  $W_1, W_2, W_3$ , characteristic function satisfies :

$$P(W_1) + P(W_2) + P(W_3) \leq P(W_1 \cup W_2) \cap P(W_2 \cup W_3) \cap P(W_1 \cup W_3) \leq P(W_1 \cup W_2 \cup W_3) \tag{1}$$

For a particular player in  $W_1, W_2, \dots, W_i$ , characteristic function expands:

$$P(W_1) + P(W_2) + \dots + P(W_i) \leq P(W_1 \cup W_2 \cup \dots \cup W_{i-1}) \cap \dots \leq P(W_1 \cup W_2 \cup \dots \cup W_i) \tag{2}$$

General formula of characteristic function is:

$$\sum P(W_i) \leq P(\sum W_i) \quad i=1,2,3,\dots,n \tag{3}$$

#### 4.2 Operation mechanism

Operation mechanisms in a dynamic alliance mainly include the trust mechanism, information sharing mechanism and benefit allocating mechanism (see Table 1).

**Table 1 Dynamic Alliance Operation Mechanism**

	<b>name of mechanism</b>	<b>explain of mechanism</b>
1	trust mechanism	1) To establish the corresponding supervision and punishment mechanism, the purpose is to prevent opportunistic behavior and afterwards. 2) To improve the long-term cooperation prospect, to reduce short-term behavior To construct a convenient information communication channels, so that the information can be timely delivered in alliance.
2	information sharing mechanism	1) To establish the unified service standard of the information system function and structure. 2) To prompt the logistics information to integrate between the enterprises in alliance.
3	benefit allocating mechanism	1) The ultimate goal of benefit allocation mechanism of the alliance is fair allocation. 2) To follow the risk compensation principle and more pay for more work principle.

## 5 Conclusion

The efficiency of logistics services directly affects the level of competitiveness of industrial clusters. The businesses in the small enterprises clusters are mostly medium and small-sized enterprises, which are not strong enough to be the core businesses. If there are not the third-party logistics companies, they tend to choose the dynamic alliance-based logistics operation pattern. This pattern is dynamic, networking, overlapping and has apparent game phenomenon. It can be concluded, through the analysis of the logistics operation process of the dynamic alliance-based industrious clusters and the establishment of the game model, that the relationship between alliance members will be influenced by the various factors caused by different dynamic relations. If the cluster companies obtain more expected benefits from the alliance than the costs of alliance establishment and management, dynamic alliance relationship is solid. Meanwhile the stable operation of the dynamic alliance involves building three related mechanisms: trust mechanisms, information sharing mechanisms and the mechanisms for the allocating of benefits.

## References

- [1] Porter M. E. The Competitive Advantage of Nations[M]. Beijing :Hua Xia Press, 2002
- [2] Gulyani S. Effects of Poor Transportation on Lean Production and Industrial Clustering: Evidence from the IndianAuto Industry[J]. World Development, 2001,29
- [3] Hai Feng. On Regional Logistics: Theory, Empirical Research and Case Study[M]. Beijing: Economics and Management Press, 2006:104-106 (In Chinese)
- [4] Peng Jin. Construction of a Dynamic Alliance of Logistics of Industrial Clusters Based on Integrated Management Model [J]. Science Mosaic,2010 ,(8) (In Chinese)
- [5] Li Jizi, Liu Chunling. Cluster Supply Chain: Coupling Between Industry Cluster and Supply Chain[J]. Modern Economic Research,2006, (5) (In Chinese)