Supply Chain Alliance Factors Evaluation by the Delphi-AHP Method

YI-FEI CHUANG[1], SHUI-HUI CHIA[2, 3], JEHN-YIH WONG[4]
[1, 4] Department of Business Administration,
Ming Chuan University,
250 Zhong Shan N. Rd., Sec. 5, Taipei 11103,
TAIWAN
[1] yfchung@mail.mcu.edu.tw; [4] jywong@mail.mcu.edu.tw
[2] Department of Business Administration,
Ming Chuan University,
250 Zhong Shan N. Rd., Sec. 5, Taipei 11103,
TAIWAN
[3] Department of Marketing and Distribution Management,
Hsing Wu University,
101, Sec.1, Fenliao Rd., LinKou District, New Taipei City 24452,
TAIWAN
[2, 3] 083003@mail.hwu.edu.tw

Abstract: - Taiwanese firms are mainly small and medium-sized, and using alliances to restructure logistical activities, combined with external resources, are excellent methods for gaining competitive advantage. Deciding on the location of a distribution center for alliance is therefore a critical issue. We use the Delphi and the Analytic Hierarchy Process (AHP) to develop a decision hierarchy, and analyze factor and criteria priorities. The Delphi-AHP method provides a good connection between qualitative and quantitative elements that influence multiple criteria decision-making. The analytical results indicate that to improve operation performance, managers should integrate their firms' specializations with those of their partners. Therefore, an alliance strategy that relies on the distribution center location should emphasize industrial clusters. Other factors influencing the decision-making of distribution center location include costs, demand, and logistical support.

Keywords: - Supply chain management, Distribution center, Alliance, Delphi, Analytic hierarchy process (AHP)

1 Introduction

Taiwan currently faces fierce competition in all business sectors, making decision-making in logistics and supply chain crucial. To remain competitive, managers must shift to supply chain management, focusing on organizational boundary elimination among partners rather than addressing internal functional integration only. Managers, while working closely with suppliers, manufacturers, distributors, and various intermediaries, must protect their core strengths, coordinate business with other firms, reduce channel intermediaries and management costs, control inventory, and expand market coverage [1, 2].

Distribution centers execute traditional firm functions such as procurement, storage, cross-docking, sorting, accumulation, assembly, and allocation. Because certain functions overlap with those of supply chain partners, distribution centers can help restructure logistical activities and efficiently fulfill customer requests. Such arrangements boost the productivity of individual firms, as well as of supply chain members [3, 4].

Most studies consider the location decision of the distribution center according to intra-functional coordination, and fail to consider the alliance implications among supply chain partners [4-10]. We focus on the alliance concept to illustrate decision-making for the distribution center location.

Composing distribution center functions into a supply chain alliance strategy is a complex multiple criteria decision-making problem. Managers must take qualitative and quantitative factors and deconstruct this complex multi-factor problem into a hierarchy, in which each level comprises specific elements. We use the Delphi and the analytic hierarchy process (AHP) to construct a decision-making method and prioritize the main factors and criteria for supply chain managers.

Following a review of related literatures, Section 3 explores data collection and decision structure expansion based on the Delphi-AHP method. Section 4 is an analysis of the data and Section 5 presents the research results. Finally, we present an overall discussion of the findings in the conclusion.

2 Literature Review

Supply chain cooperation is a complex process that integrates internal production with external distribution services to end customers. Managers should use partner alliances to increase the efficiency of supply chain management [11, 12].

The objectives of an alliance are to increase market coverage, share financial risk, transfer technology, and increase production efficiency [13]. Because customer service is crucial to each firm, meeting customer requirements and achieving mutual benefits are also key alliance goals [3].

Because alliances enable partners to share both profits and risks, supply chain managers should have sufficient domain knowledge of cooperation logistics before outsourcing or delivering services to their customers [13, 14]. When considering an alliance to design a supply chain network, managers should align core business processes and strategy objectives and simultaneously consider the specializations of supply chain partners and issues related to outsourcing. This changes operational processes from the cross-functional to the cross-organizational level [6, 7, 15, 16].

Distribution centers are the convergence point for all production and marketing systems in a supply chain. Thus, decision-making on distribution center locations typically entails a long-term commitment to perform key logistical activities and achieve long-lasting effects on various operating performances [17]. However, because of unforeseen changes in both external and internal business situations, firms may face decisions regarding the relocation of pre-existing distribution centers. Such changes involve designing distribution networks and corporate re-engineering operations among alliance partners. Early scholars of location strategy focused on quantitative analysis of location decision models with various criteria. Most of these investigations assumed costs and profits as the main considerations in optimizing a location model [18-20]. Such quantitative models were developed with clear objectives and were good in practice, however, overall strategic plans consider few intangible factors. Therefore, recent scholars have emphasized the Delphi-AHP method in decision-making [4, 8, 10, 21-25]. We also apply the Delphi-AHP method to examine the distribution-center location issue for forming a supply-chain alliance strategy.

3 Research Method

The Delphi method, developed in the 1950s [26], is a systematic and interactive method that relies on a panel of independent experts. Using a collection of expert opinions on anonymous communication with feedback, it is a flexible tool to reach a consensus, in which judgments are summarized and sent back to the group for further analysis for refining a problem in a wide range of fields. The Delphi methodology process can be time consuming. Scholars have recommended combining the Delphi method with the AHP method to more effectively guide and supplement a multi-criteria problem [22, 27].

The AHP method is a decision-making tool that can help describe a general decision problem by decomposing a complex problem into a multi-level hierarchical structure of objectives, criteria, sub-criteria, and alternatives. The decisions these criteria describe do not fit into a linear framework, but contain both physical and psychological elements. Therefore, this multi-criteria method has become popular among decision science [22]. Although numerous discrete multi-criteria methods exist for supporting the decision-making problem, the AHP method is better in the structuring decision problem, by weighing criteria and alternatives and analyzing judgment consistency [28, 29]. Using the Delphi-AHP method, we determine the elements of questionnaire, establish a decision hierarchical structure, and measure the complexity preference of elements.

3.1 Decision hierarchy formulation

The initial elements of this study extend the survey results by Chen, Lai, and Wang (1998) [30], which identify location choice influences according to the opinions of 14 logistics specialists and 9 scholars, covering six broad factors and 21 detailed criteria. However, stressing supply chain alliance issues, we modify the element definitions by Chen et al. (1998) [30] to match our research purpose based on previous studies [3, 8-10, 23, 31, 32] and the opinions of experts.

The experts include 22 members of the Taiwan

Association of Logistics Management who research significant factors and develop a hierarchical framework for distribution center location decision-making. The 22 experts were mid-to-upper level managers with at least 12 years of relevant experience and domain knowledge, and who had decision-making authority within their respective firms. The 22 firms represented four enterprise types: manufacturing, sales, storage, and transportation. Each firm has different characteristics and content, thus alliance purposes and decision-making factors differ. The manufacturers were concerned with producing quality merchandise and fulfilling orders. Firms involved in sales were middlemen establishing deals between suppliers and customers. Firms involved in storage and transportation were in the warehousing and transportation service industries. Both warehousing and transportation service industries may or may not have merchandise ownership, but contribute to physical distribution and marketing promotion. Table 1 lists the enterprises, main alliance objectives, alliance parties, and alliance contents for the research sample of the distribution center location.

Table 1. Alliance dimensions and profiles related to distribution center location decision-making

Enterprise	**Main alliance targets**	**Alliance partner**	**Alliance content**	**No.**
Manufacturing	Specialization Lowering costs Acquiring technology Energy obtainment Resource obtainment Improving production efficiency	Technology providers Resources suppliers Logistical service providers Middlemen	Forecasting Purchasing Stock control Production control Channel management.	6
Sales	Rapid turnover rates Increasing market coverage Enhancing marketing efficiency Lowering financial risk	Product suppliers Marketing service providers Distribution services providers Middlemen	Forecasting Purchasing Stock control Customer management Shipping and delivery Channel management Post-sales services	6
Storage	Quick customer response Short lead time Rapid order processing Enhancing marketing efficiency Lowering carrying costs	Technology providers Stock suppliers Logistical service providers Middlemen Carriers	Stock accumulation Stock sorting Stock allocation Stock control Packaging Labeling Inventory management Shipping	5
Transportation	Quick customer response Short lead time Raising distribution efficiency Lowering transportation costs	Consigners Shippers Consolidators	Consolidation Dispatch and shipping Recycling	5
Total Firms				22

Repeated anonymity communications with the experts eventually developed the decision-making elements and hierarchy, shown in Figure 1. The first level is the objective level, and the ultimate optimal goal is a strategic alliance to pursue strong customer service and use distribution centers in the supply chain network. The second level comprises the objective level, including seven factors. The third level is the attribute level, which includes 24 evaluation criteria. The definition of each element is as follows.

- Cost: This factor represents various disbursements for using distribution centers to smooth business operations with parties [8, 23, 31]. *Land*, *construction*, *operation*, and *freight rates* are four criteria considered in the cost factor. The various criteria refer to the total cost of land acquisitions, building funds for a new distribution center, staff salaries, and various costs related to carrier fees.
- Logistical support: This factor infers the importance of locating the distribution center

close to traffic facilities and logistics service providers [8, 31]. *Traffic infrastructure* denotes the construction of the local transportation network; *road quality* represents local street quality in transportation and delivery activities; *traffic congestion* is the degree to which traffic flow causes congestion; and *traffic access* denotes transportation convenience (e.g., the distance from the distribution center to the harbor, airport, railway stations, major highways, and cargo terminals).

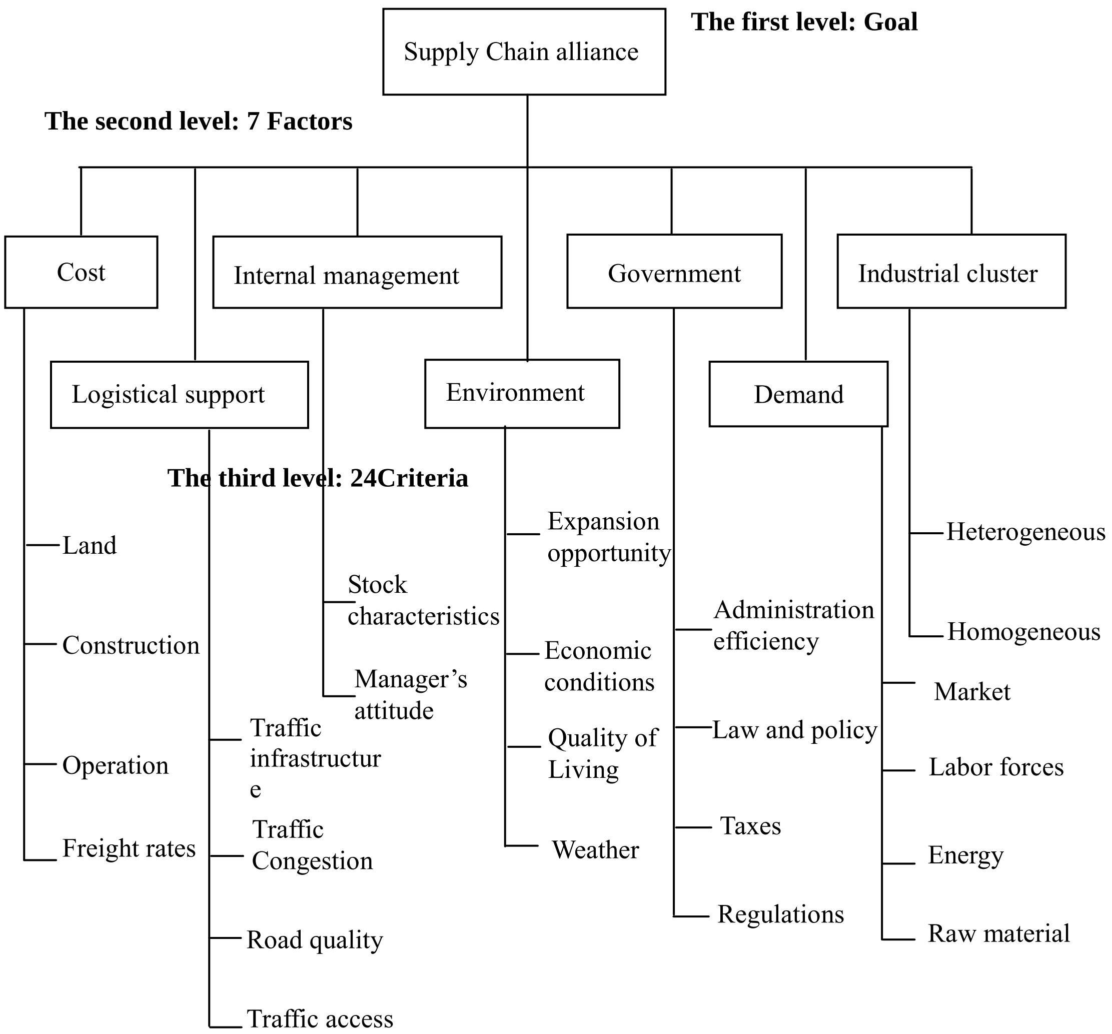

Fig. 1. Decision-making hierarchy for the supply chain alliance

- Internal management**:** Business internal factors, including stock characteristics and manager attitude, influence external logistical operations [3, 9]. Under the internal management factor, *stock characteristics* assess the physical properties of materials or products in the business supply chain. Additionally, *manager attitude* is used to measure the investment and preference tendencies of mid-to-upper level managers and shareholders from four enterprises.
- Environment: Local natural conditions relate to business operations and living quality [31]. The *environment* factor includes four criteria. *Expansion opportunity* is designed to assess the possibility and market potential for future expansion. *Economic* conditions denote the fiscal situation of the local government. Quality of living is the public security and local living conditions. Finally, weather refers to the local *climate* affecting logistic activities, including temperature, humidity, and extreme weather events.
- Government: The impetus of the local government manages the logistics industries in its administrative division [23]. Under the government factor, *administrative efficiency*

represents local government authority to develop and rapidly implement a public logistics plan. *Laws and policies* denote the relevant laws on labor, unions, environmental protection, and urban development. *Taxes* measure the influence of various taxes and duties on the distribution center site selection. *Regulating* responses to government restrictions influences vehicle right-of-way, load regulation, carrying capacity, and business quotas.

- Demand: Demand refers to target customer requirements and daily operation supplementation [3, 9, 23]. The *market* measures the importance of the proximity of distribution center location to customers. *Labor force* reflects the importance of local population density and labor quality, quantity, and educational level. The additional two extended criteria respond to the importance of the sufficiency and convenience in obtaining resources to support production operations. *Energy* denotes electric power and water sufficiency. Finally, *raw materials* represent relevant materials, including goods in process.
- Industrial cluster: Firms cooperate with upstream, downstream, and similar businesses to obtain external resources and technologies and to reduce operating risks [32]. *Heterogeneous* and *homogeneous* are two extended criteria for measuring interviewee options concerning vertical integration and horizontal collaboration in business alliances.

3.2 Pairwise comparisons

After determining the decision-making elements and hierarchy, the expert questionnaire was designed to measure each element level by a 5-point nominal scale and on a 1-9 ratio scale. The expert interviews were conducted alongside the expert questionnaire. The interviewees were the same as the samples in the previous survey. To obtain concealed or distorted group preferences, the relative importance of each element at a particular level was measured by pairwise comparisons and backed up using a consistency test to ensure the expert evaluations were performed properly. The computational procedure is as follows:

Let n denote the number of factors or criteria. The elements of a particular level are compared $(n \times n)$ pairwise to a specific element in the immediate upper level. This means that factors are compared pairwise to the goal. Similarly, criteria are compared pairwise to the factor to which they are linked. Each level of factors and criteria was designed to be measured by a 5-point nominal scale and on a 1-9 ratio scale.

The judgment matrix denoted as A was formed using a pairwise comparison. Let $A_1, A_2, \ldots, A_n$ be the set of stimuli. The quantified judgments on pairs of stimuli A_i, A_j are represented by

$$\mathrm{A} = [\mathrm{a}_{\mathrm{ij}}], \quad i, j = 1, 2, \ldots, n.$$

Each level of factors or criteria was compared to the upper level of the element structure, resulting in the $n(n-1)$ paired comparison matrix. For second level factors, *n* is 7, whereas on the third level, for internal management factors, *n* is 2, and for industrial cluster factors, *n* is 4. The entries a_{ij} are governed by the following rules:

$$a_{ij} > 0, \quad a_{ij} = 1/a_{ij}, \quad a_{ij} = 1 \text{ for all } i.$$

Having recorded the numerical judgments a_{ij} in the Matrix A, the problem is to recover the numerical weights $(W_1, W_2, \ldots, W_n)$, where W is a column vector.

$$\begin{bmatrix} 1 & a_{12} & \cdots & \cdots & a_{1n} \\ a_{21} & 1 & \cdots & \cdots & a_{2n} \\ \cdots & \cdots & 1 & \cdots & \cdots \\ a_{t1} & a_{t2} & \cdots & \cdots & 1 \end{bmatrix} * \begin{bmatrix} W_1 \\ W_2 \\ \cdots \\ Wn \end{bmatrix} = \begin{bmatrix} W_1' \\ W_2' \\ \cdots \\ W_n' \end{bmatrix} \quad (1)$$

W is the principal right eigenvector of the Matrix A, that is,

$$AW = \lambda_{\max} W. \quad (2)$$

Where $\lambda_{\max}$ is the principal eigenvalue of the Matrix A.

$$\lambda_{\max} = \frac{1}{n}\left(W_1'/W_1 + W_2'/W_2 + W_3'/W_3 + \ldots + W_n'/W_n \right) \quad (3)$$

If A is a consistency matrix, eigenvector M can be calculated by

$$A - (\lambda_{\max} I)M = 0. \quad (4)$$

The eigenvector method yields a natural consistency measure, defined by the consistency index $(C.I.)$.

The consistency ratio ($C.R.$) indicates the decision-maker inconsistencies and those resulting from randomly generated preferences. This test was performed to clarify the overall consistency of the comparison matrix (Saaty, 1980) [33].

$$C.I. = \frac{(\lambda_{\max} - n)}{n-1} \quad (5)$$

$$C.R. = \frac{C.I.}{R.I.} \quad (6)$$

Where random index ($R.I.$) represents numerous random entries of reciprocal matrices of the same order as showed in Table 2.

Satty (1980) proposed that when $C.I.$ and $C.R.$ are below 0.1, the matrix passes the consistency test. If the matrix does not pass the consistency test, further expert advice is sought until these two indices decrease below 0.1. Otherwise, the element judgment should be excluded from the hierarchical model.

Table 2. Random Index

n	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
R.I.	0.00	0.00	0.58	0.90	1.12	1.24	1.32	1.41	1.45	1.49	1.51	1.48	1.56	1.57	1.59

3.3 Model aggregation

In this study, because the second level in the hierarchical model holds seven factors, the 42 pairwise comparisons are formed into a $7*7$ judgment matrix. Land, construction, operation, and carrier rates are four criteria under the cost factor in the second level, which are made into 12 pairwise comparisons to form a $4*4$ judgment matrix. The other calculations are performed in the same preceding procedure to demonstrate the options with the 22 practical experts. Table 3 shows that the expert believes internal management is five times that of cost, construction cost is two times that of operation cost, and stock characteristic is three times that of manager attitude for the relative importance measurement when making a decision regarding the distribution center location for alliance strategy. In this study, each expert must respond to eight $n*n$ judgment matrixes, answer 53 pairwise comparison problems, and pass eight consistency test sets. To ensure that all experts achieved sufficient agreement, we used a geometric mean to average expert preferences without obscuring individual opinion differences. Table 4 shows the consistency test results for all experts.

Table 3. Pairwise comparison judgment matrices from an expert

Factors	*C*	*LS*	*IM*	*E*	*G*	*D*	*IC*	**Priority**	**Consistency test**
Cost (*C*)	1	1	1/5	1/5	1/7	1/6	1/8	0.31246	$\lambda_{\max} = 7.3889$
Logistical support (*LS*)	1	1	1.	1/4	1/3	1/5	1/7	0.31517	*C.I.* = 0.0648
Internal management (*IM*)	5	1.	1	1/4	1	1/4	1/4	0.33860	*C.R.* = 0.0491
Environment (*E*)	5	4	4	1	1	1	1	0.39019	
Government (*G*)	7	3	1	1	1	1	1/3	0.40631	
Demand (*D*)	6	5	4	1	1	1	1/2	0.42074	
Industrial cluster (*IC*)	8	7	4	1	3	2	1	0.48920	

Cost	*L*	*CO*	*O*	*F*	Priority	Consistency test
Land (*L*)	1	1/4	1	2	0.19957	$\lambda_{\max} = 4.1880$
Construction (*CO*)	4	1	2	2	0.44829	*C.I.* = 0.0648
Operation (*O*)	1	1/2	1	1	0.18568	*C.R.* = 0.0491
Freight rates (*F*)	1/2	1/2	1	1	0.16645	

Internal management	*SC*	*MA*	Priority	Consistency test
Stock characteristic (*SC*)	1	3	0.75000	$\lambda_{\max} = 2.0000$ *C.I.* = 0.0000
Manager's attitude (*MA*)	1/3	1	0.25000	*C.R.* = 0.0000

Table 4. Consistency test for all experts

Expert	*C.I.*	*C.R.*	Expert	*C.I.*	*C.R.*
1	0.1476	0.0553	12	0.0567	0.0590
2	0.0251	0.0236	13	0.0521	0.0536
3	0.0499	0.0512	14	0.0465	0.0474
4	0.0398	0.0405	15	0.0549	0.0568
5	0.0508	0.0529	16	0.0488	0.0506
6	0.0518	0.0531	17	0.0532	0.0549
7	0.0358	0.0380	18	0.0854	0.0898
8	0.0517	0.0538	19	0.0475	0.0487
9	0.0542	0.0566	20	0.0591	0.0621
10	0.0576	0.0599	21	0.0482	0.0498
11	0.0511	0.0527	22	0.0324	0.0316

After the consistency test, the importance weighting of each factor and criterion were calculated according to the determined relevance level. The AHP analysis results are shown in Table 5, which lists the top four factors in the second level as industrial cluster, cost, demand, and logistical support. Within the industrial cluster, heterogeneous industries have a greater weighting than homogeneous industries, whereas for cost factor, freight rates and operation costs have the greatest weight. For demand, energy and raw materials are ranked first and second in importance, followed closely by market access, and for logistical support, traffic access has the top weighting.

Table 5. AHP distribution center location criteria and priorities for supply chain alliance

Decision-making factors	Local weights	Criteria	Global weights	Criteria ranking
Cost	0.1921	Land	0.1865	
	(2)	Construction	0.1519	
		Operation	0.2132	2
		Freight rates	0.4489	1
Logistical support	0.1480	Traffic infrastructure	0.2393	
	(4)	Road quality	0.1862	
		Traffic congestion	0.2454	2
		Traffic access	0.3290	1
Internal management	0.1338	Stock characteristics	0.5556	1
		Manager attitudes	0.4444	2
Environment	0.1313	Expansion opportunity	0.2727	1
		Economic condition	0.2308	
		Quality of Living	0.2690	2
		Weather	0.2246	
Government	0.1402	Administration	0.2017	
		Related laws and policies	0.1600	
		Taxes	0.2488	2
		Regulation	0.3895	1
Demand	0.1560	Market	0.2409	
	(3)	Labor force	0.2273	
		Energy	0.2699	1
		Raw materials	0.2519	2
Industrial cluster	0.2100	Heterogeneous	0.5063	1
	(1)	Homogeneous	0.4937	

Note: Those marked within ( ) are second-level decision-making factors ranked in the top four for importance.

4 Discussion of Results

Throughout the evaluation process, we found that **industrial cluster** factors have the highest weighting, meaning that managers should be mainly concerned with coordinating with partners. This conclusion differs from those of previous studies on channel management alliances mainly because of the differences in partnership characteristics, alliance behavior, and decision-making goals [9, 23, 34-36].

Cooperating with different or similar firms reduces operational risks and drives the success of supply chain parties [32, 37, 38]. Industrial clusters thus help alliance firms to reduce lead times, accelerate customer responses, and effectively develop business relationships.

According to the industrial cluster factor, heterogeneous industries are more important than homogeneous industries, showing that Taiwanese firms rely heavily on the power of upstream and downstream companies to conduct their business if they are unfamiliar with the domain field. Despite the effectiveness of horizontal integration in concentrating competitive forces, vertical integration is more suitable for coordinating various business capabilities owing to alliance issues related to technology transfer and regulations. Vertical collaboration enables supply chain partners to integrate their specializations and expand their businesses. This reduces the risks associated with struggling alone and boosts the competitive advantage for all supply chain partners. Thus, when considering applying distribution centers to achieving alliance purposes, managers tend to integrate vertically rather than horizontally.

Cost has been a primary focus in previous studies on distribution center location [4, 9] and lowering costs is a main reason for firms to work within alliances and to re-engineer their processes [39]. We found cost factor weighting to nearly equal that of industrial cluster factors. The analytical results indicate that when conducting cost analysis, managers should first consider transportation and distribution problems before considering operational and salary problems.

Operating and labor costs are internal managerial costs and are therefore much easier to control than external costs. This lowers their degree of importance compared to transport freight rates. However, transportation and delivery costs are closely connected to customer service policies. Because high customer service requirement leads to high transportation and delivery expenses, firms should carefully control relative expenses. However, supply chain members have less individual power to decide shipping fees unless the cargo is large or the distance traveled is long [40, 41]. Only co-planning to solve transportation problems involving joint routes and joint distribution with partners reduces freight rates. Firms should analyze the long-term effect of freight rates on profit growth and increasing market opportunities and participate in planning cargo consolidations and shipments with carriers to reduce freight costs.

Property costs are extremely high, thus most Taiwanese distribution centers are built on the outskirts of cities where land is relatively cheap. The Taiwanese government has recently relaxed restrictions in this area, significantly reducing land acquisition costs for firms. However, because of construction costs, managers apply existing facilities when planning to move materials and products in a supply chain and tend to believe that building a new distribution center to cooperate with an alliance is not an economical approach.

Customer **demand** influences expected profits, and thus most channel management studies generally support locating distribution centers near the end market to ensure easy implementation of demand-side customer service [14, 42-44]. However, the samples we examined are biased toward upstream firms. Interviews with the experts in this study affirmed that sufficient energy and access to raw materials are more important than market access, differing from previous studies.

Practical experts believe that obtaining sufficient energy and resources, security inventory management, rapid order processing, rapid response to varied demands, efficient delivery of varied services to end customers with shortened lead times, and lower operation costs achieve a good alliance for supply chain parties with distribution center applications.

Alliance cooperation should be focused on resource and operational efficiency to ensure alliance quality [41, 45]. Sufficient electricity and water to support basic operations are necessary to ensure smooth execution of internal and external operations. Energy and raw materials are thus more important than market proximity for Taiwanese distribution center locations.

Labor force and the quality of logistical operations are closely related. However, the high population density of Taiwan ensures an adequate, high quality labor force. Thus, when searching for supply chain partners and determining distribution center location, labor costs are not a key consideration.

Supply chain management focuses on time-based competition and the flexibility of a firm's response to customer demand is crucial to competitiveness. Therefore, rapid delivery is a standard indicator of quality customer service [5, 23]. Appropriate distribution center location helps to obtain raw materials and products from suppliers at the right time and at the right cost and allows manufacturers to distribute in a timely and economical manner. However, **logistical support** system performance is constrained by transportation infrastructure and traffic services.

We show that traffic access has an important influence on behavior in co-planning a firm's logistical activities. A distribution center that is located in close proximity to ports, airports, railway stations, major highways, and cargo terminals can rapidly integrate internal production and marketing functions to external organizations [46]. However, to ensure timely delivery, managers should also consider traffic flow and avoid congested areas.

Adequate traffic infrastructure implies that local transportation networks are well constructed and convenient, ensuring rapid response in customer delivery. Traffic access and traffic congestion problems are important considerations for managers considering an alliance to develop a logistical network through an appropriate distribution center location. These considerations enhance or restrict the logistical process and therefore require careful consideration.

5 Conclusion

Stronger and more sophisticated customer demand, intensifying competitive pressures, and a continuously evolving market environment are forcing firms to reconsider their operating strategies through supply chain alliance. An individual firm making policies cannot improve the quality of its supply chain management, whereas the distribution center application helps to restructure logistic activities and efficiently fulfill customer requests. This arrangement boosts the productivity of individual firms and all supply chain members [3, 4]. To fulfill the alliance objective and contribute to the competitiveness of both individual firms and entire chains, managers seek the optimum blend of numerous party operations by carefully designing a supply chain distribution center network [47].

We explored several elements of distribution center location related to alliance issues. We found that whereas managers are concerned with coordinating supply chain processes to obtain external resources, technologies, and reduce operating risks, they favor vertical integration over horizontal integration. When working on cost control, the first priority should be transportation costs, followed by internal operational expenditure. From the demand perspective, we suggest locating distribution centers near energy and raw material supplies, whereas the analysis of logistical support factors indicates that firms should be close to their logistical service providers and concerned with the quality of traffic infrastructure for delivery to customers within promised times.

Future research on distribution center location regarding alliances can take four directions. First, because we adopt various industrial viewpoints, future studies could simply focus on manufacturing, sales, storage, or transportation for a detailed understanding of the individual differences in making distribution center location decisions among these four enterprise types. Second, supply chain partners can cooperate through vertical or horizontal integration. Therefore, conflict inevitably occurs regarding the objectives of strategic alliances and these strategic objective conflicts can be the subject of future studies. Third, sharing information with upstream, downstream, or other partners is related to physical distribution flows and market demand responses. Therefore, information sharing would be a valuable issue for future study. Fourth, we only used Taiwanese experts as research subjects. Therefore, the findings cannot be generalized to non-Taiwanese firms and future studies could be extended outside Taiwan.

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