



Journal of Applied Sciences

ISSN 1812-5654

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Research on Functional Logistics Provider Selection Based on QFD modeling

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Abstract: As for the specialty and importance of choosing suppliers in logistics service supply chain, an advanced QFD model has been constructed with considering various requirements of logistics service integrator, customers and suppliers. This study has smoothly built relationship between indexes of customer needs and evaluation indexes and makes sure weights of every index, with a historical data about logistics service suppliers. After that, this study evaluated all candidates, according to the degree of comprehensive performance about suppliers. Finally, this research validated the efficiency and superiority of the model, with simulating a case to prove it.

Key words: Logistics service supply chain, quality function deployment, functional logistics provider

INTRODUCTION

With the constant development of social distribution, expertise logistics service for product supply chain has been provided by logistics service supply chain. It is one of the important trend about logistics as well. Each of these functions like traditional inventory, transporting, packaging and so on only can offer one-single logistics service function. Each of these can't meet the development of recent product supply chain's logistics requirement. Logistics service supply chain is one of service supply chains that provides specialized, integrated and network logistics service for logistics requirement which depends on advanced information technology to resign logistics service resources and makes integrated logistics service or third party logistics as core enterprise.

RECENT RESEARCH ON CHOICE OF SERVICE PROVIDER

With the beginning of 21 century, the economy was going to service economic period from product economic age. There was an increasingly higher demand for the specialized requirements and strong competence between logistics enterprises. In order to obtain the prize from customers and have a stable development, all of these made the logistics providers decrease the cost of logistics service and improve the ability of logistics service. In this situation, it has come to our vision for the research on logistics service supply chain. The recent study about how to choose a logistics service provider in logistics service supply chain is still on a baby stage no matter in board or out of the board.

At the moment, the choice for logistics service provider mainly focused on two aspects as follows: the choice of evaluation indexes and evaluation methods. The choice indexes of service providers were mainly based on methods of choosing product supply chain providers, with add of indexes about logistics service supply chain. In this case, Weber and Current (1993) applied factor analysis methods to the choice of inventory providers to make a research through questionnaire, as a result that the key points were the performances logistics providers were recognized, the ability, prize, strategy of providers and outside environments. Aissaoui *et al.* (2007) caught up with four elements that obviously influenced the choice for service providers on the basis of previous researches which was ability, cost, quality and reputation of the providers. Yu (2003) systematically analyzed index system of choice for logistics service providers and constructed the choosing model for providers with Analytic Hierarchy Process (AHP). Chu and Lina (2009) put forwarder 5 points that from service range, region advantages, degree of expected cooperation, financial state, management level and operation reliability and so on, with the recent situation of logistics development, according to experiences of choosing the third party logistics (3PLS). Now, there exists an increasing methods to choose logistics service providers, such as Activity Based Costing (ABC), Line Programming (LP), AHP, Fuzzy Comprehensive Evaluation Method, Neutral Network, TOPSIS, Data Envelopment Analysis (DEA), Principal Component Analysis (PCA), Grey Synthetic Evaluation or some integrations and so on (Yonghui, 2010; Saen, 2009; Wang *et al.* 2009; Yunmiao *et al.*, 2009; Shyur, 2006; Huijun and Zhiyou, 2004). All of these

methods have a disadvantage is that they can't combine the customers' requirements in service supply chain effectively.

As a whole, the importance for choosing logistics providers has been recognized by more and more researchers. But as the problem for logistics providers choosing, it always imitates the methods for choosing manufacture providers and fails to consider the characters of integration, network and individual demands of logistics service chain. At the same time, previous researches objects only are logistics service enterprises. They all marginalize quality of service and customers' feeling. Thus, this study puts forward quality room model and conduct advanced quality function deployment model for logistics service provider choosing, with comprehensively considering their demands between branches of logistics service chain enterprises, such as customers, providers and manufactures. It combines service satisfaction degree and cost when choosing logistics service providers. At last, a practical case is proved for constructed model.

CONSTRUCTION ANALYSIS OF LOGISTICS SERVICE SUPPLY CHAIN

Logistics service supply chain has provided whole logistics service for logistics requiring enterprise through integrating social logistics resources which is a new kind of supply chain whose core enterprise is integrated logistics service providers. Integrated logistics services providers choose proper functional logistics enterprises to construct logistics service supply chains to meet the logistics requirements through outsourcing. Integrated

components mainly consist as follows: businesses integration, relationships integration, information integration and cooperation systems integration and so on. The detail relationships and contents are as Fig. 1 manifests.

Logistics service supply chain aims at integrating the different functional logistics service enterprises according to purchasing, transportation, inventory, packaging, manufacturing and distribution etc. with modern communicational technology and information technology. It will formulate a totally functional network structure around integrated logistics providers as well as improve the level of logistics service, decrease the whole service cost and pursue stronger competence and more profits according to provide integrated logistics service with individualization.

LOGISTICS SERVICE PROVIDERS CHOOSING MODEL BASED ON QFD

Quality room model configuration: Quality Function Deployment (QFD) is an efficient tool that used to make comprehensive program for project management. It can transfer the requirements of customers to all technological demands of product manufacturing. And quality room is the most important tool on the course of transfer. In order to improve the technological require of quality room, this study makes evaluation index of functional providers to be an alternative. Quality room after configuration is as Fig. 2 illustrated.

Elements in relation matrix represent relationships between customer needs and evaluation indexes. Ten cents scoring is applied to this research

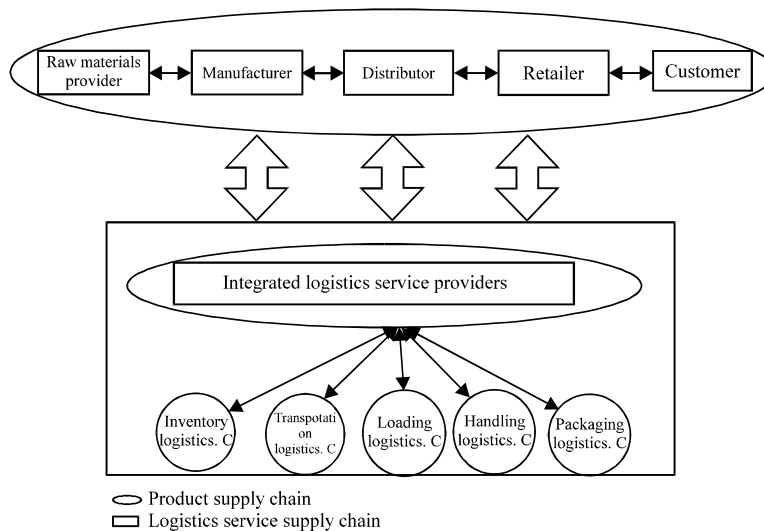


Fig. 1: Construction of logistics service supply chain

and the size of the score manifests related degree of their relationships. This study has converted technological competence module in traditional room to score evaluation module about suppliers, with scoring suppliers according to evaluation index system by special experts. The study has integrated customer needs according to supplier scoring module when evaluates providers, with taking the relationships between customer needs and evaluation index systems of suppliers into consideration.

Analysis of customer needs in logistics supply chain:

The key point to construct QFD model is to obtain the requirement of customers. Integrated logistic service as core enterprise in a logistics service supply chain, has integrated proper logistic resources which is correspond with logistics service supply chain, according to logistic demands in product supply chain. This study has generalized a deployed table of commonly logistic

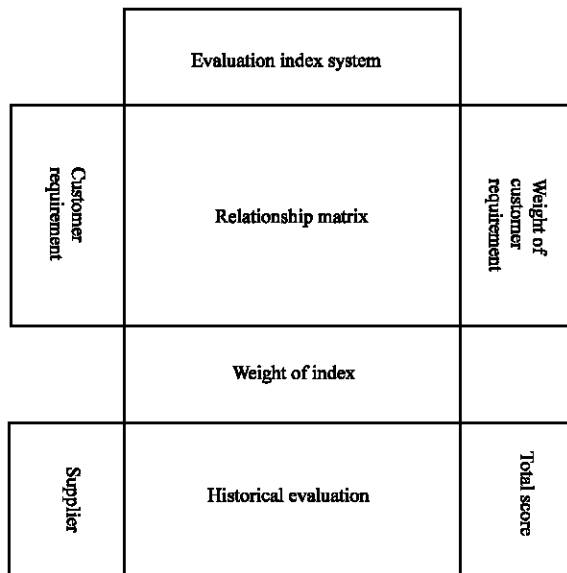


Fig. 2: Advanced QFD model

demands about manufacturers which is on the basis of deep documents analysis and practical investigation. The customer needs are usually as Fig. 3 shows.

As Fig. 3 illustrates, there are various needs from five aspects that most customer always want to get. Reliability is an ability to perform one’s promise reliably and accurately. Responsiveness is about to have a great willing to assist customer with providing instant service as long as they need. Assurance will make customer feel reliable and trusted by our company and its staff. Individual treated character requires that we should show more care on customer and treat them individually. Sensibility advises that all things which is visible should make a good impression on customers.

Construction of evaluation index system for logistics service suppliers:

There exist several of evaluation indexes for logistics service suppliers at the moment, according to documents analysis and questionnaire investigation. This chapter constructed a comprehensive, total, objective, scientifically evaluation index system for logistic providers which was on the basis of previous literatures (Kumara *et al.*, 2004; Gao, 2004), with the quantitative and qualitative principles. The evaluation index system is as Fig. 4 illustrates.

As Fig. 4 shows, there are mainly 6 branches about this index system. Operation ability of functional resources consists of transporting, inventory, distribution, handling and circulation processing abilities. Ability of risk management is related to the capacity of dealing with an emergency and capability of arbitration assurance. Planning ability of basic management is about capabilities on such aspect as market development, management of cost and service and resources integration. Ability of cooperation and integration focused on the capacity of supply chain integration and distribution. Operation ability of the company consists of capabilities of quick responsiveness, innovation and strategic flexibility match. Social effects of the company are about the ability of enterprise culture construction, degree of social reputation and brand building.

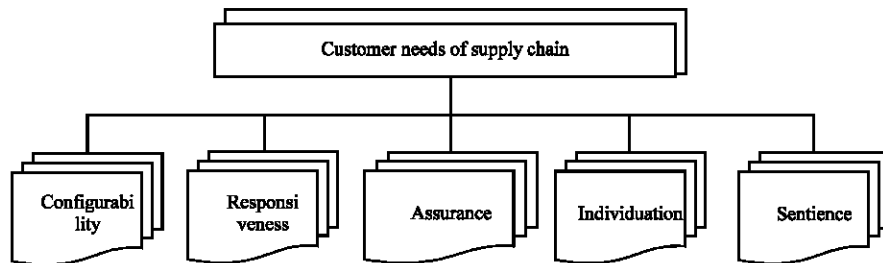


Fig. 3: Deployed table of customer logistic demand

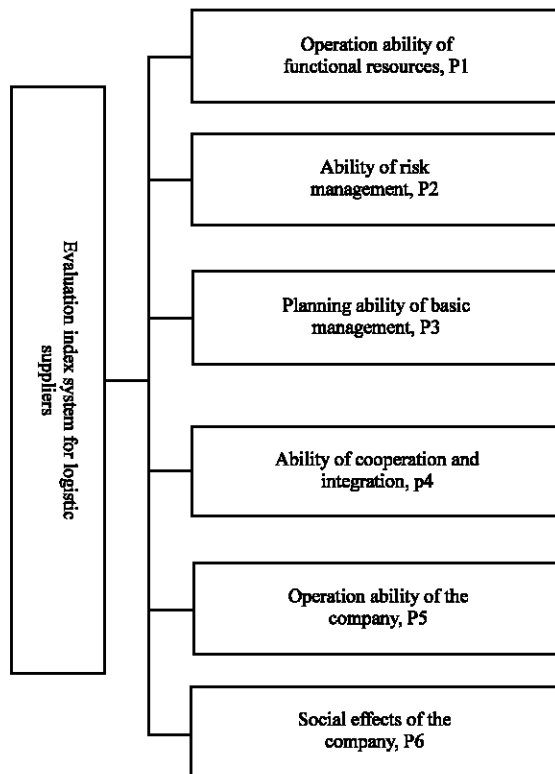


Fig. 4: Evaluation index systems for logistic suppliers

Construction of advanced QFD model for logistics service suppliers:

- **Construction of relationship matrix:** A two-dimensional table about relationship matrix is constructed according to the demand of customers selected and logistics supplier evaluation index. Then the relationship is scored from 1-10 between evaluation index and customer demand. And a relationship matrix is constructed by the quality house processed. The relationship matrix shows that there is some relationship between supplier evaluation index and customer demand
- **Weights calculation of customer demands:** Every index of customer demand is scored through the questionnaire survey and expert score. The scores indicate customers' importance degree on demand. Then the importance degree of customer demand is quantified using AHP method and then the absolute importance of every customer demand is determined. At last, it is normalized and θ is used to represent it
- **Weights calculation of service supplier evaluation index:** Combining the relationship matrix based on advanced QFD model, we multiply the weights of

customer demands by figures in relationship matrix directly and then calculate the weights of every index. At last, it is normalized and p is used to represent it

- **Standardization of logistics service supplier evaluation index:** Count each logistics service supplier's history data with each evaluation index, β is used to represent it. Because the utility values of different indexes are various, we need to standardize these statistics. Evaluation index constructed in this study is the main benefit index and cost index, designed standardization formula for the two indexes as following:

Beneficial indexes:

$$\beta'_{ij} = \frac{\beta_{ij} - \min(\beta_{ij})}{\max(\beta_{ij}) - \min(\beta_{ij})} \tag{1}$$

Cost indexes:

$$\beta'_{ij} = \frac{\max(\beta_{ij}) - \beta_{ij}}{\max(\beta_{ij}) - \min(\beta_{ij})} \tag{2}$$

- **Calculation of comprehensive performance degree of logistics service suppliers:** Combining the evaluation index weight and standard statistical data, we can calculate the comprehensive performance degree of every logistics service supplier, the formula as following:

$$R_i = \sum_j p_i \beta'_{ij} \tag{3}$$

THE EXPERIMENTAL SIMULATION

This study studies a third party logistics enterprise which services an automobile factory. The enterprise helps the factory transport the finished cars and required parts. The sales volume of automobiles shows a blowout phenomenon so that the logistics enterprises can't meet the demands with present resources. But they don't want to buy so much logistics equipments because it will be set aside in future, so these enterprises start to integrate the logistics resources in society and build a flexible and efficient logistics service supply chain to enhance the competitiveness of enterprises. Next this study will evaluate the six selected transportation suppliers:

- Step 1:** Experts grade the indexes of customer requirement and construct the evaluation matrix, marked as:

$$P = \begin{pmatrix} 1 & 1/3 & 1 & 2 & 1/2 \\ 3 & 1 & 3 & 3 & 2 \\ 1 & 1/3 & 1 & 2 & 3 \\ 1/2 & 1/3 & 1/2 & 1 & 1/3 \\ 2 & 1/2 & 1/3 & 3 & 1 \end{pmatrix}$$

Then this study calculates the weight of the indexes of customer requirement using the eigenvalue method and the largest eigenvalue of matrix P is $\lambda_{max} = 5.39$ and then calculate its consistency ratio C.R. = C.I./R.I.:

$$C.R. = (\lambda_{max} - n)/(n - 1)/R.I. = 0.089 < 0.1 \tag{4}$$

As a result, we can get the weights of the indexes of customer requirement is $\theta = (0.14, 0.38, 0.22, 0.08, 0.18)$

Step 2: Build the relationship matrix of customer requirement and evaluating indicator using QFD model, as Table 1 shows below:

This study calculates the weight of the indexes of logistics service providers based on the weight indexes of customers' demands and relationship matrix:

$$p_i = \sum_j \theta_j W_{ij}$$

W is the relational matrix and the result is $p = (0.20, 0.14, 0.18, 0.15, 0.16, 0.17)$

Step 3: This study standardizes the historical statistical data of every supplier using standard formulate. The standardized result is:

$$\beta' = \begin{pmatrix} 0.18 & 1 & 0.52 & 1 & 0 & 0.22 \\ 0.82 & 0.47 & 0 & 0.33 & 0.78 & 0.43 \\ 1 & 1 & 0.14 & 0.33 & 1 & 1 \\ 0 & 0.82 & 0.72 & 0.17 & 0.56 & 0.57 \\ 0.36 & 0.35 & 1 & 0 & 0.22 & 0.43 \\ 0.64 & 0 & 0.38 & 0.67 & 0.33 & 0 \end{pmatrix}$$

Step 4: Calculate the comprehensive evaluation value of functional logistics suppliers:

$$R = \sum_j p_j \beta'_j = 0.16, 0.17, 0.19, 0.16, 0.13, 0.19$$

This study sorts out the logistics service providers based on the comprehensive value and customers could choose suppliers according to this ranking. Blow is some

Table 1: Relationship matrix

Relationship matrix	P1	P2	P3	P4	P5	P6
Configurability	9.5	7.0	7.5	7.0	5.5	9.0
Responsiveness	8.0	4.5	9.5	7.0	9.5	8.0
Assurance	9.5	9.5	8.5	8.0	3.5	2.5
Individuation	6.5	5.0	1.0	1.5	5.0	7.0
Sentience	5.0	3.5	4.0	4.0	5.0	7.5

Table 2: Statistics for ability of logistic suppliers

Suppliers	P1	P2	P3	P4	P5	P6
Supplier 1	72	85	76	80	68	65
Supplier 2	86	76	65	72	82	68
Supplier 3	90	85	68	72	86	76
Supplier 4	68	82	80	70	78	70
Supplier 5	76	74	86	68	72	68
Supplier 6	82	68	73	76	74	62

conclusions that are gained in the experimental simulation. The modified QFD model considers the integrated logistics service provider, the functional suppliers and customers' requirement when choosing suppliers, so it can integrate resources very well and provide flexible and effective logistic services. Company only considers its own interests when choosing suppliers in traditional way and ignores the selected company's interests. But the modified QFD model considers all company's needs and encourages suppliers to supply better services. Then a logistics service supply chain with good cohesion will be generalized as well.

CONCLUSION

- As for the specialty and impotence of choosing suppliers in logistics service supply chain, this study has totally considered various requirements from integrated logistics services providers, customers, suppliers and other aspects, constructed an advanced QFD model for logistics service suppliers. The model fully considered the importance of customer requirement in evaluating process and overcome the defects only considering unilateral interests in traditional evaluating process
- Combining AHP with QFD model, we made a research on the weights calculation of logistics service suppliers and well complement the defects due to lack of quantitative data and casual qualitative evaluation in weights calculating process
- We use the statistics of logistics service supplier's history data to calculate the comprehensive evaluation degree and through the comprehensive evaluation degree we sequence and select logistics service suppliers. This method makes full use of history data and makes the evaluating results more reliable

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