

Third Party Logistics Service Provider Selection: Application of the Improved Aggregate Cost Method

Zheng-Zhong Ren

Beijing University of Chemical Technology, School of Economics and Management
renzz2006@163.com

Abstract

During the process of enterprise management, those chemical enterprises usually adopt outsourcing, as they hand over the logistical work to the third party. Here, we call the third part the “logistics service provider”. In this paper, Chemical Enterprise A is set as an example to study the application of the optimizing selection for the third party logistics service provider, as well as its improvement of aggregate cost method. This paper is aimed at theory, practicality and operability, and hoping to choose the provider which can guarantee the cost is smallest by introducing the original provider model. Among all the aspects, this paper is persuasive. Meanwhile, due to the instability of the relevant data which are collected, the factors impacting upon the total cost are uncertain, thus their credibility is affected. Later, according to the actual demand of the logistics service provider as well as the Benefit-Cost Ratio in aggregate cost method, the qualitative method and the quantitative method are combined with each other, and then the cost can be reduced through Analytic Hierarchy Process. Moreover, the factors which are irrelevant to cost selection are reasonably transformed into the cost adjustment proportion, and an improved provider selection model is established. At last, by introducing the specific case of the third party logistics service provider of Chemical Enterprise A, the effectiveness in practical application of improving the provider selection model can be verified.

Keywords: *Chemical Enterprise A; provider; original provider model; improve the provider model; effectiveness*

1. Introduction

With the rapid development of global economy and the emerging logistics industry, enterprise competition becomes more and more intense. In order to guarantee the logistics service provider's own advantages and enhance its competitiveness, the idea to improve the service quality of logistics provider is placed on the agenda [1]. As a new kind of economic source, logistics begins to throw itself in market competition. And the smaller the cost is, the bigger the profit is. Choosing the logistics service provider based on the aggregate cost method meets the requirement of enterprise towards logistics. Among all the factors which have influences on logistics service provider, cost factors are the main factors. So, finding the smallest cost and having advantages over the cost are the key points for the enterprise to win the strongest competitiveness in its industry [2]. Combined with the former studies, including the qualitative method, generalization and analysis, the quantitative analysis is utilized at the same time to study on the third party logistics service provider. By combining the qualitative method with the quantitative method, lay a solid foundation for choosing the most suitable provider [3]. In this paper, how to choose the third party logistics service provider is analyzed and studied according to the specific Enterprise A. And it aimed at selecting the most suitable way for development, besides,

improving the methods further in order to offer a useful way for the selection of logistics provider.

2. Model Establishment

2.1. Original Provider Selection Model

The original model uses aggregate cost method, which is calculating the cost relevant to the purchasing activities [4]. It involves many factors, including the direct cost as well as the indirect cost. Such as ordering price, purchasing management cost, logistics management cost and so on. And the one which has the smallest total cost is chosen as the provider. Among all the things above, the aggregate cost method can be divided into three classes, they are Benefit-Cost Ratio, Activity-Based Costing and Economic Order Quantity [5].

(1) The Benefit-Cost Ratio mentioned above refers to the cost of the product's non-sale price to the total cost ratio;

(2) Activity-Based Costing is to use the form of the model to calculate the purchasing cost. See the following formula:

$$W_i = (Y_i - Y_{\min})xO + \sum A_{jx}B_{ij} \quad (2-1)$$

In the formula: Factor W_i represents the cost value of the No. i provider,

Factor Y_i represents the sale price of the No. i provider,

Factor Y_{\min} represents the minimum value of unit sale price of the provider,

Factor A_j represents the unit cost of the variable cost factor j ,

Factor B_{ij} represents the unit cost of cost factor j caused by the change of provider i .

This model mainly analyzes the relevant producing cost of the enterprise, that is the sum total of direct and indirect cost. The enterprise will choose the provider with the smallest cost according to this model.

(3) According to the Economic Order Quantity, the enterprise has already set the smallest purchasing cost as the target when it can meet the economic batch quantity. Then uses the quantitative analysis to establish the model, and studies out the economic order quantity model on the basis of the cost model.

2.2. Advantages and Disadvantages of the Original Model

(1) Advantages

This model is persuasive, and its results are clearly analyzed. Based on a comprehensive cost analysis, it has logical calculating process and objective facts, so the results are accordingly convinced.

(2) Disadvantages

(1) Due to the demand of credibility, a mass of scientific data become the priority among priorities.

(2) There are assumptions in the establishment of original model, and the ratios of their influencing factors are not same. So, false results are existing.

2.3. Improve the Selection Model of Provider

On the basis of the Benefit-Cost Ratio of the original model, the improved selection model of provider is put forward from the enterprise's actual situation. And the concrete calculating steps are as follows ^[6]:

①: According to the quoted price of the logistics service provider, the direct cost of the purchasing service is gotten;

- ②: Evaluate every alternative provider according to the selection evaluation indicator;
- ③ : Analyze the ratio of each evaluation indicator according to the Analytic Hierarchy Process;
- ④ : Calculating the final evaluation value of each alternative supplier according to the results of the②and③;
- ⑤ : Analyze and compare the assessed valuation of each alternative provider as well as the difference between the providers with the lowest score. See the Table 1.

Table 1. The Value of Provider’s Assessment Difference

Alternative Provider	1	2	3	4	5
Final Assessed Value	4.1	4.8	4.4	4.6	4.5
Value of Assessment Difference	0.0	0.7	0.3	0.5	0.2

⑥ : Members in purchasing project group discuss the percentages of the comprehensive evaluation of price factor and the non-price factor of the final purchasing decision. And during the process, a certain logistics service purchasing is set as the target. After the discussion, people all think that among the factors finally we paid attention, the price factor accounts for 78%, while others account for 22%;

⑦: Multiply the non-price factors by the evaluation difference, and we can get the final adjustment proportion of the cost. See the following Table 2:

Table 2. Adjustable Ratio of the Cost

Alternative Provider	1	2	3	4	5
Final Assessed Value	4.3	4.6	4.4	4.7	4.2
Assessment Difference Value	0.0	0.5	0.3	0.5	0.2
Adjustable Proportion	0.0	0.15	0.07	0.08	0.02

Adjustable Ratio of the Cost means that compare the alternative provider with the one needs smallest cost, and the price of the alternative one is lower than the adjustable ratio, then it can be chosen;

⑧ : Multiply the direct cost by the adjustable ratio, and we can get the final selection cost of each alternative provider. And the provider should be chosen on the purpose of the smallest cost.

2.4 Advantages of the New Model

(1) As for the improved model of provider, we only need to finish the evaluation of the evaluation indexes. And there needn't be a mass of cost information. All of these reduce the complicity of the calculating process, enhance the working efficiency and increase the practical value.

(2) High credibility and clear results.

(3) Due to the comprehensive consideration of every aspects, as well as the combination of quantitative and qualitative methods, the results are more credible and comprehensive.

3. The Application of the Model

3.1. The Introduction of the Third Party Logistics Service Provider of Chemical Enterprise A

Chemical Enterprise A is a branch of a large state-owned enterprise, engaged in phosphate fertilizer production. By upgrading and remolding the products, the scale of production as well as the technical equipment is going up to a new level. And the enterprise gradually becomes a manufacturing enterprise, which has the biggest producing scale, fine technical equipment, complete production equipment as well as full scale production of phosphate fertilizer. Nowadays, the practical capacity of Chemical Enterprise A has already reached a high point that it can produce phosphoric acid 450 thousand ton, sulfuric acid 130 thousand ton, synthetic ammonia 95 thousand ton and diammonium phosphate 85 thousand ton. Moreover, it produces a series of fine phosphorous chemical products according to the market demand, such as the water-soluble monoammonium phosphate and so on. And its annual operating income is over 2 billion.

In 2014, Logistics Company C undertook the outsourcing logistics service of Chemical Enterprise A. And this logistics company is a privately owned one, its general headquarter is in Nanjing. It has cooperated with Company A for several years, so every service between them has reached a high degree of trust. However, since 2007 Company C has always complained about the constantly rising price of every commodity and the declined profit margin. They asked A to increase the service charge, since sometimes they even does a losing proposition, otherwise they would not provide relevant service any longer. After many times of negotiation, A made a compromise, accepted the requirements raised by C, and continued to renew their contract. Later, a found that C's competitiveness was gone, and it wanted to change another logistics company, so bidding activities were carried out. But during the bidding process, through the original model of provider selection, a logistics company with lower cost was found, but the logistics department and the senior management didn't think it had objectivity and democracy. And considering the complicity of company's service abroad, the purchasing department and logistics department reached an agreement on keeping the cooperation with Company C. However, Company C took that opportunity to hike the price. And on the condition that A still could afford the cost, it accepted the requirement again, continuing to cooperate with C [7]. In 2009, a new manager of purchasing department took office, and a second bidding activity was carried out. During the process, it was found that it wasn't the logistics company that went wrong, it was the selection model for the selection of logistics service provider went

wrong. Then, the model was changed, and verification was made toward the model by logistics department and purchasing department. And it was verified to be objective, democratic and scientific. Then a third bidding activity was coming. This time an audit team was established, with two persons from purchasing department, two from logistics department, one from sales department and one from producing department. They were asked to check the company's qualification, safety certificate as well as the business license. Then, selected 8 companies those were qualified according to the new model. Service demand, estimation of business volume and other important information were confirmed through the communication between the audit team and each department, meanwhile, the request for proposal of A's logistics service in residence in 2013 was finished. And the whole relevant written statements were accepted by management layer.

3.2. Confirm the Evaluation Index System and the Weight Value

According to the indication of the Logistics Department, those 7 indexes are set as the sub-index to evaluate the logistics. And the evaluation standards are shown in the following Table 3:

Table 3. Evaluation Indexes and Standards

Index	Sub-index	1 score	2 scores	3 scores	4 scores	5 scores
	The average value of <i>KPI</i> in 2014	<= 60%	<= 70%	<= 80%	<= 90%	>90%
Performance of logistics service	Client quantity of the top 500 chemical enterprise	0	1	2	3	≥ 4
	Turnover in 2014	<4.5 million	<9.5 million	<15 million	<35 million	≥35 million
	Experience of logistics service in residence	none	<1.5 years	<3.5 years	<5.5 years	≥5.5 years
Capacity of logistics service	Quantity of own vehicle	≤ 8	≤ 18	≤ 28	≤ 38	> 38
	Quantity of sub-company in mainland	<3	<5	<7	>9	≥ 9

Quality certificate	ISO9000	none	Owned it 1.5 years ago	Owned it 3.5 years ago	Owned it 5.5 years ago	Owned it 7.5 years ago
---------------------	---------	------	------------------------	------------------------	------------------------	------------------------

Confirm the ratio of those 7 indexes according to the Analytic Hierarchy Process, and the specific steps are as follows:

The first step: Build the A_{ij} judgment matrix by using the approach of democratic discussion, and compare the importance of those 7 indexes with each other. And the methods are as follows:

Table 4. Methods Chart

	The average value of <i>KPI</i> in 2014	Client quantity of the top 500 chemical enterprise	Turnover in 2014	Experience of logistics service in residence	Quantity of own vehicle	Quantity of sub-company in mainland	ISO9000
The average value of <i>KPI</i> in 2014	1	2	1/3	1/5	1/4	5	1/3
Client quantity of the top 500 chemical enterprise	1/3	1	1/4	1/7	1/6	3	
Turnover in 2014	3	1	1/4	1/2	7	3	5
Experience of logistics service in residence	5	7	3	1	2	9	3
Quantity of own vehicle	4	6	2	1/2	1	7	2

Quantity of sub-company in mainland	1/5	1/3	1/7	1/9	1/8	1	1/6
ISO9000	2	5	1	1/3	1/2	7	1

The second step: Normalize the matrix by columns, and we can get a new matrix B_{ij} as follows:

$$B_{ij} = \begin{pmatrix} 0.0593771 & 0.0759494 & 0.0788239 & 0.0788239 & 0.055045 & 0.128205 & 0.043297 \\ 0.0214592 & 0.0379476 & 0.0323575 & 0.0533028 & 0.321888 & 0.076923 & 0.131373 \\ 0.1931332 & 0.1294299 & 0.1898734 & 0.1100978 & 0.098535 & 0.179453 & 0.129870 \\ 0.3218884 & 0.3883862 & 0.2654354 & 0.3954324 & 0.446528 & 0.259754 & 0.230765 \\ 0.2278481 & 0.2576865 & 0.2543688 & 0.2086675 & 0.220856 & 0.021764 & 0.179487 \\ 0.0126582 & 0.0128569 & 0.0186439 & 0.0275323 & 0.024633 & 0.012985 & 0.043791 \\ 0.1287554 & 0.1895632 & 0.1313756 & 0.1294687 & 0.129554 & 0.110094 & 0.129874 \end{pmatrix}$$

The third step: Summate by row, and we can get the matrix V.

$$V = \begin{pmatrix} 0.508835 \\ 0.307689 \\ 1.130415 \\ 2.330867 \\ 1.500689 \\ 0.152624 \\ 0.988881 \end{pmatrix}$$

The fourth step: Normalize the matrix V, and we can get matrix W.

$$W = \begin{pmatrix} 0.068832 \\ 0.040099 \\ 0.147205 \\ 0.357264 \\ 0.218678 \\ 0.022232 \\ 0.140694 \end{pmatrix}$$

The fifth step: Check the conformance, and we can get $A_{max} = 7.1514993$ through the formula. According to Formula 4 we can get $C_i = 0.0252495$, and from Formula 6 we can see $CR = 0.02$, and when $CR < 0.1$, the judgment matrix gets the conformance.

According to the application of Analytic Hierarchy Process, we can get the weight of those 7 evaluation indexes. The details are as follows:

Table 5. The Weight of Evaluation Index

The average value of <i>KPI</i> in 2014	0.068833
Client quantity of the top 500 chemical enterprise	0.040096
Turnover in 2014	0.146203
Experience of logistics service in residence	0.357268
Quantity of own vehicle	0.218693
Quantity of sub-company in mainland	0.022235
<i>ISO9000</i>	0.140694

Through the weight, we can know that the data and results are all on the basis of democracy and objectivity, and the whole process has written statement, which is accepted by all auditors.

3.3. The Application of Improved Model

The manager sends the request for proposal of logistics service to the 8 enterprises taking part in the bidding.

The whole bidding process is divided into two rounds. In the first round, the provider with the biggest price is eliminated by people from purchasing department, according to the set procedure. And there are six companies left. The purchasing department quotes price a second time, and then check the evaluation index and standards. Finally the average mark is given by the audit team. The results are as follows:

Table 6. Results of evaluation

Logistics company	<i>C</i>	<i>S1</i>	<i>S2</i>	<i>S3</i>	<i>S4</i>	<i>S5</i>
The average value of <i>KPI</i> in 2014	10	6	6	6	6	6
Client quantity of the top 500 chemical enterprise	6	10	8	6	6	4

Turnover in 2014	6	10	8	8	4	3
Experience of logistics service in residence	8	6	4	4	4	4
Quantity of own vehicle	2	10	6	0	6	4
Quantity of sub-company in mainland	2	8	6	2	4	4
ISO9000	6	8	6	6	4	8

Remark: C represents the original logistics service provider.

Multiply the final marks of each provider's evaluation index by index weight, and according to the result, the comprehensive evaluation is carried out. See table 2-10:

Table 7. Final Comprehensive Results of Evaluation

Logistics company	C	S1	S2	S3	S4	S5
Comprehensive value	2.98	4.2	2.87	2.06	2.04	2.38

And the difference values of the comprehensive evaluation of all providers are as follows:

Table 8. Final Difference of Assessed Value

Logistics company	C	S1	S2	S3	S4	S5
Difference value	0.86	1.86	0.63	0	0.21	0.37

Through the practical analysis, the comprehensive evaluation of non-price factors account for 25% of the final decision. Thus, we can get the final adjustable ratio of the cost. See the following table:

Table 9. Final Adjustable Ratio of the Cost

Logistics company	C	S1	S2	S3	S4	S5
Adjustable ratio	20.3%	45.5%	15.9%	—	4.1%	8.6%

Multiply the total cost of logistics by the relevant adjustable ratio, and we can get the Final Selection and Comparison of the Cost, see the following chart:

Table 10. Final Selections and Comparison of the Cost

Logistics Company	C	S1	S2	S3	S4	S5
Annual Cost	5001586	3935022	4466495	39884780	4814219	4980645
Cost Comparison	3785688	27522755	3531751	3985132	4571199	4563953

According to the principle that the one which has smallest total cost should be chosen, the original provider C is replaced by a new one S1, as a result of the bidding for logistics in residence in 2014. Although there still exists some unwillingness, the reason that there are operating problems of new provider S1 cannot be put forward. From the standing point of the management layer, they think the whole process is thorough, scientific and democratic, thus the final decision is made on the basis of the cost performance. Through the results, the management layer agrees to change the plan, meanwhile, they asks the relevant departments to cooperate with the handover work between the new and original providers actively. One another thing to note is that the new logistics service provider the company once wanted to choose at the premiere bidding is exactly this new provider S1.

4. Conclusion

The new selection method for provider solves the selection problem of Chemical Enterprise A's logistics service effectively. On the basis of the principle that the logistics service provider with the smallest total cost should be chosen, Analytic Hierarchy Process is used to decide the selection of the evaluation indicator ratio and establish the improved model of provider selection, so that the logistics service provider with the smallest cost can be selected. And this new model is not only scientific and objective, but also it can be carried out easily. Moreover, it doesn't need multiple data statistics.

Through the case analysis mentioned above, we can realize that as for the same logistics service provider, different results can be gotten when different purchasing methods are adopted. Because price, service quality and safety factors are connected and restricted with each other, conflict of profit exists among different department. Without a good method, we are afraid to use any provider, even if it is the best one. But in this case, a new method is used to select the provider by the new manager of logistics purchasing. The investigation is thorough, objective and clear, and it wins the support affirmation from the leaders of relevant department. Meanwhile, the changing plan is also goes smoothly. Not only the new provider's ability and quality are accepted by logistics department, but also it reduces the outlay of the company's logistics. With no doubt, the company will enhance the service quality, decrease the operating cost and improve the market competitiveness after cooperating with the new logistics service provider.

Acknowledgments

Foundation project: the national natural science foundation (71171011,71072157), in the new century excellent talents to support plan (NCET-12-0756), the central college basic scientific research business expenses project (ZZ1317).

References

- [1] A-Bdier, S. Hghuoiv and C. dfhjo, "A Weighted Max-Min Model for Fmul Selected in a Supply China", International of Production Economic, vol. 131, no. 1, (2008), pp. 125-165.
- [2] S. Talluri and R. Narasimhan, "Vendor evaluation with performance variability: A max-min approach", European journal of operational research, vol. 146, no. 3, (2003), pp. 543-552.
- [3] C. Weber Selection and S.G. Deshmukh, "A multi-Criteria Group", The Journal of Supply China Risk and Vendor Selection Problem: Simulation Analysis, Systems with Applications, vol. 37, no. 12, (2010), pp. 3376-3401.
- [4] D. Manda and S.G. Deshmulh, "Vendor Selection Using Interpretive Structural Modeling", International Journal of Operation & Production Management, vol. 14, no. 3, (1994), pp. 45-54.
- [5] F. Emre Boran, S. Genc, M. Kurt and D. Akay, "A Multi-Criteria Intuitionistic Fuzzy Group Decision Making", vol. 34, no. 3, (2009), pp. 9032-9034.
- [6] S. Talluri and R. Narasimhan, "Vendor evaluation with performance variability : A max-min approach", European journal of operational research, vol. 14, no. 3, (2003), pp. 543-552.
- [7] J. Verville and A. Halington, "A six-stage model of the buying process for ERP software", Industrial Marketing Management, no. 32, (2003), pp. 585-594.
- [8] K. Szczepaniak, P. Listos and W. Lopuszynski, "Granulomatous Peritonitis in a European Brown Bear Caused by Baylisascaris transfuga", Journal of Wildlife Diseases, vol. 48, no. 2, (2012).
- [9] F. Lei, Y. Shen-jun and L. Ting, "A Cloud Computing Application in Land Resources Information Management", : IEEE, (2010), pp. 388-393.
- [10] W. Liu, "Research on cloud computing security problem and strategy", In 2012 2nd International Conference on Consumer Electronics, Communications and Networks (CEC Net) t, (2012), pp: 1216-1219.
- [11] K.-K. Hong and Y.-G. Kim, "The critical success factors for ERP implementation: an organizational fit perspective. Information Management", no. 40, (2002), pp. 25-40.

Author



Zheng-Zhong Ren, he is a student of the School of Economics and Management in Beijing University of Chemical Technology. He had achieved his Bachelor Degree and now is studying for his Master Degree. The address of the University is 15 BeiSanhuan East Road, ChaoYang District, Beijing.