

Model of service-oriented catering supply chain performance evaluation

Juanqiong Gou, Guguan Shen, Rui Chai

School of Economics and Management, Beijing Jiaotong University (China)

jqgou@bjtu.edu.cn, 11125185@bjtu.edu.cn, 11125172@bjtu.edu.cn

Received: October 2012

Accepted: March 2013

Abstract:

Purpose: The aim of this paper is constructing a performance evaluation model for service-oriented catering supply chain.

Design/methodology/approach: With the research on the current situation of catering industry, this paper summarized the characters of the catering supply chain, and then presents the service-oriented catering supply chain model based on the platform of logistics and information. At last, the fuzzy AHP method is used to evaluate the performance of service-oriented catering supply chain.

Findings: With the analysis of the characteristics of catering supply chain, we construct the performance evaluation model in order to guarantee the food safety, logistics efficiency, price stability and so on.

Practical implications: In order to evolve an efficient and effective service supply chain, it can not only used to own enterprise improvement, but also can be used for selecting different customers, to choose a different model of development.

Originality/value: This paper has a new definition of service-oriented catering supply chain. And it offers a model to evaluate the performance of this catering supply chain.

Keywords: catering industry, service-oriented supply chain, performance evaluation model

1. Introduction

Since 1991, China's catering industry, always keep the double-digit growth (Date from Ministry of Commerce of the People's Republic of China). As the income level of urban and rural resident's unceasing enhancement and people's life rhythm becomes faster, dining out or calling take-away food has become a way of life, so Chinese food industry's retail sales are still increasing. The catering industry keeps growing, but China's catering market competition is still fierce, especially the competition in the supply chain. For the catering enterprises, it is like a sail against the current catering market, fall behind.

Now the supply chain is not only the supply chain of product, it includes products, information, logistics service, etc. The product is only a part of the service, so in order to have a comprehensive evaluation of the supply chain, the service should be oriented. it means we should not only put focus on the products, but also the food safety, food quality, enterprises' responsibility. It is an integrated supply chain based on service. Absolutely, the service-oriented catering supply chain is the key to increase the competitiveness of the catering enterprises. The enterprises in the service-oriented catering supply chain need to build a stable partnership, and the enterprises should do benefit sharing, information sharing and so on, at last all the enterprises in the supply chain will create a win-win situation. In order to integrate and optimize supply chain, supply chain performance evaluation model is needed to be constructed.

Researchers	The dimensions of construction
Lummus, Vokurka & Alber (1998)	Supply chain, process management, delivery transport, and demand management
Beamon (1999)	Resources, production and flexible
Ma and Ling (2005)	Customer service, production and quality, asset management, cost
Association of Supply Chain (2002)	Reliability, response ability, flexibility, cost and assets
Ma (2005)	The product quality ,service level, commitment level, product prices
Chen (2003)	Logistics coordination, information coordination, cash flow coordination and work coordination
Ma & Chen (2007)	The customer, supply chain internal process, the future development, financial value

Table 1. The dimensions of construction

The main contents of the performance research are including index system construction, the choice of methods and empirical analysis. Ding and Wang (2010) constructed a evaluation system based on research on characteristics of core enterprises in the supply chain. You (2010) constructed an evaluation index system of supply chain performance in agriculture product processing field. Different industries have different indexes to evaluate the performance of supply

chain. This paper summarized the current domestic and foreign research about the dimensions of supply chain performance evaluation indexes.

And about the supply chain performance evaluation method, scholars also did the related research. It includes Benchmarking method, Expert evaluation method, Mathematical statistics, Balanced score method, analytic hierarchy process (AHP), the fuzzy AHP method, Grey correlation method and data envelopment analysis. Qian and Zhu (2002) had research on Supply Chain Benchmarking. Huang and Hua (2007) use expert method to establish the evaluation index on green supply chain. Liang (2011) combined AHP and DEA method to evaluate Supply Chain Performance. Chen and Yan (2011) construct an alternative network DEA model that embodies the internal structure for supply chain performance evaluation. It takes the perspective of organization mechanism to deal with the complex interactions in supply chain. Dong, Young, Sung et al. (2012) developed a framework of service supply chain performance measurement to apply into the hotel supply chain.

Compared with traditional supply chain, service-oriented catering supply chain has characteristics of products diversity, timeliness of product, price stability, the information sharing, the logistics capability, customer satisfaction, food safety and so on. Establish a qualified supply chain can guarantee food fresh, information sharing efficient logistics capability and improve customer satisfaction. Though how to optimize and integrate the supply chain, which part should be first to optimize, how to know whether the supply chain had achieved the demand level. What we have to do is to build a supply chain evaluation system.

2. Model of the service-oriented catering supply chain

2.1. Characteristics of the service-oriented catering supply chain

At present, there are many kinds of definition of supply chain (2008), research on supply chain management of China). Supply chain activities transform natural resources, raw materials and components into a finished product that is delivered to the end customer. With the definition of supply chain given by SCC, this paper gives definition of service-oriented catering supply chain. The service-oriented catering supply chain is network structure, relying on information platform and logistics platform, combining suppliers, logistics processing and distribution center, catering enterprises, customer, and providing the logistics service, information service, product service and customer service.

Compared with the traditional supply chain, the service-oriented catering supply chain has the following features.

Agility: The consumption of products is at a very fast rate; also the kinds of product are variety. The service-oriented catering supply chain should improve the ability in dealing with variable demand and production flexibility.

Logistics capability: Goods, like fresh fruits and vegetables should be transported by the special vehicles, which equipped with cold chain logistics equipment. So the logistics capability of catering industry service supply chain has higher requirements than any other industry.

Customer satisfaction: Consumers today are not only care about the price of food but also the tasty, safety, quality and nutrition of food. Once appear, food security, food service enterprise on supply chain will get the fatal blow.

Stability: The price and the quality of raw materials are fluctuating with unstable factors. While the enterprise clients wish to avoid risks, they hope the price, quality, variety of food has a stable situation.

Information: Improving the Information level, can effectively prevent "the bullwhip effect". Information detection methods can effectively monitor food in transportation in the process of storage quality.

2.2. Construction of the service-oriented catering supply chain model

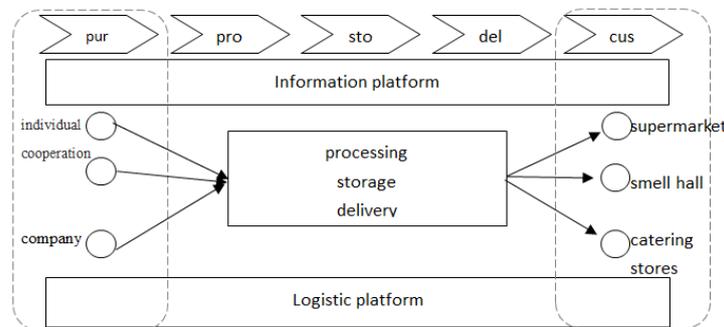


Figure 1. The service-oriented catering supply chain

The catering industry service supply chain is put the raw materials supplier, processing center, logistics center and catering enterprises into the same platform. The production mode on this platform is pull production, pull production system can cope with the rapid changes, and its information platform just like the nerve reflection of people can rapid response the changes in the outside world, so the whole processing and logistics center can keep zero inventory or less inventory, greatly reduce inventory cost, increasing the flow of capital. When logistics and processing center received orders, and create purchase order to the raw materials supplier through information platform, and rapid response ability make raw material be put in place in time to ensure the production plan smoothly, so it can short the customer response time, improve

customer satisfaction. Based on above, catering industry service supply chain model is just as figure 1 shows.

2.3. The function of the service-oriented catering supply chain

The influence and function of Service supply chain on catering enterprises competitiveness mainly reflects in the following aspects:

Supplier integration

From the whole services supply chain, raw material purchasing and the choice of supplier is the first thing throughout the supply chain activities. It is very important. Because the quality of raw material will directly affect the quality of the finished products, thus affecting customer satisfaction; And the price of raw materials is also constitute an important part of the final product price of restaurants, the competition ability of the enterprise will also get an impact. So do raw material purchase and supplier management well is a good beginning for the service-oriented catering supply chain, is also a good way to improve the competitiveness of catering enterprises.

Supply chain resources integration

Service supply chain resources integration of catering enterprises is based on perfect information platform and logistics platform, through integrating resources of service supply chain, can reduce the waste of resources, and reduce unnecessary inventory costs. Measure the level of the whole supply chain is not only seeing the material purchasing supply capacity, but also to see its input-output efficiency and supply chain enterprise on the synergy of benefits. Through the unified purchase, reasonable distribution, take appropriate materials and food in the right time and at the right way to the right place, High efficiency of the supply chain can speed up the transfer of goods, reduce products purchasing and operation distribution costs

Processing and distribution

A perfect service-oriented catering supply chain have professional standardization processing equipment, that ensure the quality of the food during the processing, or a professional outsourcing processing company to complete the processing tasks. Then through professional cold chain distribution, ensure food in low loss of logistics process, and also ensure food fresh and high quality. This is a good way to promote the enterprise competitiveness of catering enterprises.

Customer services

A good service-oriented supply chain can quickly respond to the different needs of customers, in the shortest possible time to provide customer the most satisfactory service, can greatly enhance

the enterprise the competitive ability. At the same time, the good service supply chain can quickly understand customer needs, it is a great help in development of new products, also it is a great help to quickly capture emerging market.

3. Performance evaluation Index of Catering Service Supply Chain

3.1. Index system construction

This paper does a lot of research on supply chain operations reference model (SCOR, 2002) created by the association of supply chain. The model includes plan, learning resources, manufacturing and delivery. It can describe classification and evaluation of a complex management process. SCOR model is divided into reliability, response ability, flexibility, cost, and asset 5 dimensions, according to supply chain operation process. It constructs the supply chain performance evaluation index system. Response ability and flexibility of the catering industry service supply chain largely reflects in the logistics capability and agility. The typical cases talked about the dimension of the customer. For the catering industry, the customer always plays the most important role. So customer satisfaction is an indispensable dimension.

The service-oriented catering supply chain is an inseparable system and the relationship between nodal enterprises of the supply chain is important, directly affects the efficiency of the whole supply chain. So relationships between nodal enterprises can be as a one of the main factors which affect the performance of service supply chain.

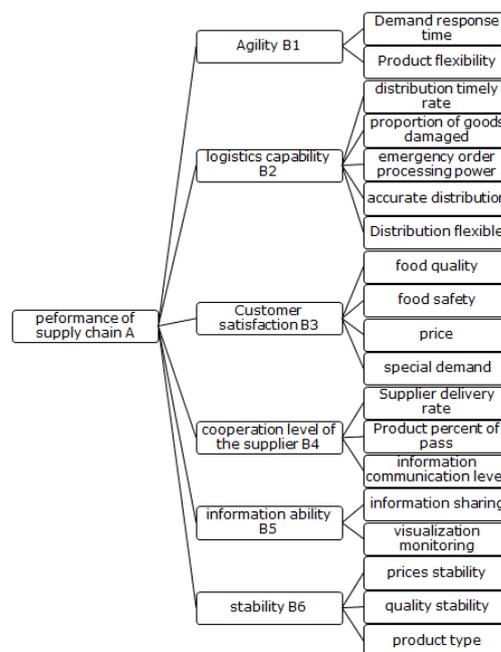


Figure 2. Supply chain performance system

The service-oriented catering supply chain performance evaluation is based on the performance of the whole process evaluation, different from other performance evaluation focuses on a single

enterprise or individual functional department's evaluation. A performance evaluation index system and the management of the supply chain should have the same purpose, reflect the whole situations of supply chain, effectively promote catering service, adapt to the market and the surrounding environment change. Based on the above considerations, combining the catering industry characteristic, this article establishes the service-oriented catering supply chain performance evaluation of level 3 index systems as in figure 2.

3.2. Selection and application of index system evaluation

From the above we see the evaluation method for the service-oriented catering supply chain evaluation is not much. Not all the evaluation methods are suitable for the service-oriented catering supply chain .after research on these methods; this paper chooses the fuzzy AHP evaluation method to evaluate the catering industry service supply chain performance, according to the characteristics of the catering industry and the constructed indexes.

The construction of the hierarchy indicators

The problem divide into different elements, according to the relationship between factors, subordinate relations and different levels, combined factors together, forming a multi-layer analysis structure model.

The construct judgment matrix

We construct judgment matrix according to the evaluation index level structure mentioned above. Through comparing the weight of each index, we construct judgment matrix. In the AHP method, in order to make the importance of each index to quantitatively shows, we get the judgment matrix scale (1 ~ 9 scale method) see table 2:

Scale	Explain
1	The same important
3	The former is slightly important than the latter
5	The former is obvious important than the latter
7	The former is extremely important than the latter
9	The former is strong important than the latter
2, 4, 6, 8	Importance Between the scale mentioned above
$B_{ji} = 1/B_{ij}$	

Table 2. Judgment matrix scale

Compare the factors, as important as you think is 1:1, then The former is strong important than the latter that is 9:1, Compare two factor, fill the numbers in a judgment matrix (diagonal in judgment matrix is 1).

Calculate the weight of each index

Set maximum characteristic root of judgment matrix A-Bi for λ_{max} , the corresponding eigenvector for W, the W and λ_{max} calculation method is as follows:

- elements Bi in Each line of the judgment matrix multiplies ;
- root product of n ;
- vector normalization ,get the weight vector W

$$\lambda_{max} = \sum_{i=1}^n \frac{(Bi * W) i}{n * Wi} \tag{1}$$

Consistency test

Because of the complexity of the performance evaluation of each index and the fuzziness of the relative important degree among the index, there are certain errors. In order to ensure that error in allowing range, through the consistency test, the judgment matrix is considered effective, or it should be amended.

- Calculate Coincidence index Ci:

$$Ci = \frac{\lambda_{max} - n}{n - 1} \tag{2}$$

- Calculate Consistency ratio CR :

$$C_R = \frac{Ci}{I_R} \tag{3}$$

When $CR < 0.1$, the judgment matrix is considered effective. Coincidence index of judgment matrix numerical value of IR shows as table 3

n	1	2	3	4	5	6	7	8	9
I _R	0	0	0.58	0.9	1.12	1.24	1.32	1.44	1.45

Table 3. Coincidence index of judgment matrix

The fuzzy matrix evaluation

- Establish factors set and evaluation sets

factors sets U is consists of factors which have influence on judge object, $U = \{U1 ,U2 , \dots ,Un \}$

. Evaluation sets V is consists of judgment results, $V = \{V1, V2... Vm\}$.

- Fuzzy evaluation

First evaluation starts from the single factor in set U, make sure the membership degree in each factors. Then get n factor assessment set into a general evaluation matrix, usually show as R

- Establish a weight vector

Various factors important degree is usually not the same, in order to reflect the degree of each factors important , each factors should give the corresponding weight W_j , $W_j = [W_1, W_2... W_n]$ called factor weight vector.

- The fuzzy comprehensive evaluation mathematical model

When W and R is already known, the fuzzy comprehensive evaluation mathematical model:

$$B = W \cdot R \tag{4}$$

The B normalized to 'B,

B' multiplies with fuzzy evaluation vector V, comprehensive evaluation results obtained score for:

$$G = B' \cdot V^T \tag{5}$$

And V is obtained according to the comments of the median level.

4. Practical application

Through research on customers, suppliers and partners in the service supply chain, we get the judgment matrix A - B_i, the following table 4 shows

	B1	B2	B3	B4	B5	B6
B1	1	1/8	1/7	1/3	1/2	1/5
B2	8	1	2	5	6	3
B3	7	1/2	1	3	5	2
B4	3	1/5	1/3	1	1	1/2
B5	2	1/6	1/5	1	1	1/3
B6	5	1/3	1/2	2	3	1

Table 4. B_i judgment matrix

According (1) get $\lambda_{max} = 6.0828$

$WB = [0.034769, 0.402848, 0.260383, 0.081673, 0.063564, 0.156763]$

According (2) get CI = 0.166, from table 4 IR = 1.24

According (3) get CR= 0.013 < 0.1

similarly, we can get Relative weight of vendor evaluation index of C(table 5)

indexes	Weight	Indexes	Weight
Agility	0.037	Demand response time	0.833
		Product flexibility	0.167
Logistics capability	0.402	Distribution timely rate	0.352
		Proportion of goods damaged	0.235
		Emergency order processing power	0.135
		Accurate distribution	0.193
		Distribution flexible	0.083
Customer satisfaction	0.26	Food quality	0.403
		Food safety	0.364
		Price	0.155
		Special demand	0.077
Cooperation level of the supplier	0.081	Supplier delivery rate	0.606
		Percent of pass	0.21
		Information commutation level	0.183
Information ability	0.064	Information sharing	0.75
		Visualization monitoring	0.25
Stability	0.157	Price stability	0.593
		Quality stability	0.249
		Product type	0.157

Table 5. Relative weight of vendor evaluation index

According table 5, we get W

$$W=[0.031,0.006,0.141,0.095,0.054,0.078,0.033,0.105,0.095,0.04,0.02,0.04,0.018,0.015,0.048,0.016,0.093,0.039,0.025]$$

19 factors which have influence on supply chain performance can form $f U$, the factors in set U has 5 kinds of judgment results, excellent, good, medium, general and poor, it made up of the evaluation sets V. According to the judgment of customers, suppliers and partners and industry experts, service supply chain evaluation data get the following evaluation matrix R

$$R= \begin{pmatrix} 0.3 & 0.5 & 0.1 & 0.1 & 0 \\ 0.4 & 0.2 & 0.3 & 0.1 & 0 \\ 0.5 & 0.3 & 0.2 & 0 & 0 \\ 0.4 & 0.4 & 0.1 & 0.1 & 0 \\ 0.3 & 0.4 & 0.2 & 0.1 & 0 \\ 0.3 & 0.5 & 0.1 & 0.1 & 0 \\ 0.4 & 0.3 & 0.2 & 0.1 & 0 \\ 0.6 & 0.2 & 0.1 & 0.1 & 0 \\ 0.6 & 0.3 & 0.1 & 0 & 0.1 \\ 0.3 & 0.3 & 0.3 & 0 & 0.1 \\ 0.2 & 0.3 & 0.3 & 0.1 & 0.1 \\ 0.5 & 0.3 & 0.2 & 0 & 0 \\ 0.7 & 0.2 & 0.1 & 0.1 & 0 \\ 0.2 & 0.3 & 0.2 & 0.2 & 0 \\ 0.2 & 0.3 & 0.2 & 0.2 & 0.1 \\ 0.3 & 0.2 & 0.3 & 0.1 & 0.1 \\ 0.2 & 0.3 & 0.4 & 0.1 & 0 \\ 0.5 & 0.3 & 0.2 & 0 & 0 \\ 0.3 & 0.2 & 0.4 & 0.1 & 0 \end{pmatrix}$$

According (4) get $B=[0.408,0.320,0.190,0.070,0.022]$

Normalized, $B'=[0.405, 0.320, 0.190, 0.070, 0.022]$

According (5) get $G=78.2$, and $V=[95,80,60,40,15]$, it is thus clear that the performance of the service-oriented catering supply chain is good.

5. Conclusions

With study on the service supply chain and analyses of the present catering situation, this paper presents the service-oriented catering supply chain model based on the logistics and information platform. Also it analyses the difference between the service-oriented catering supply chain and traditional supply chain. And summarized the characteristics of the catering supply chain. Then from aspects of agility, the logistics capability, customer satisfaction, and suppliers, information ability and level of stability to construct the service-oriented catering supply chain model. At the same time, six aspects subdivided into a number of indicators to construct the performance evaluate system. At last, this paper evaluates the service-oriented catering supply chain by the fuzzy hierarchy of comprehensive evaluation method.

The results of evaluation can not only used to own enterprise improvement, but also can be used for selecting different customers, to choose a different model of development. According to different customers, we will have different judgment matrix, and thus get the performance evaluation is not the same. So the customer groups classification based on the performance evaluation is our direction of our works.

References

- Association of Supply Chain (2002). Operations Reference-model-Version 5.0. <http://www.supply-chain.org>
- Beamon, B.M. (1999). Measuring supply chain performance. *International Journal of Operation & Production Management*, 19(3/4), 275-292. <http://dx.doi.org/10.1108/01443579910249714>
- Chen, C., & Yan, H. (2011). Network DEA model for supply chain performance evaluation. *European Journal of Operational Research*, 213(1), 147-155. <http://dx.doi.org/10.1016/j.ejor.2011.03.010>
- Chen, Z. (2003). Application of AHP Method in Agile Supply Chain Coordination Performance Measurement Decision Support System. *Computer engineering and applications*, 39(33), 33-41.
- Ding, Q., Wang, X. (2010). Study on the Evaluation Index System of Core Enterprises of Supply Chains. *Logistics technology*, 29(7), 137-139.
- Dong, W.C., Young, H.L., Sung, H.A. et al. (2012). A framework for measuring the performance of service supply chain management. *Computers & Industrial Engineering*, 62(3), 801-818. <http://dx.doi.org/10.1016/j.cie.2011.11.014>
- Huang, G., & Hua, F. (2007). Research Model of Performance Evaluation of Green Supply Chain. *Industrial Engineering Journal*, 10(1), 116-121,129.

- Liang, W. (2011). Application of AHP/DEA Model in Supply Chain Performance Evaluation. *Logistics Technology*, 30(9), 128-130.
- Lummus, R.R., Vokurka, R.J., & Alber, K.L. (1998). Strategic supply chain planning. *Production and Inventory Management Journal*, 39(3), 49-58.
- Ma, L. (2005). Research on supply chain performance evaluation. *Modern Management Science*, 10, 94-95.
- Ma, S., & Chen, T. (2007). Elements & evaluation method of supply-chain-based logistics service capability. *Computer Integrated Manufacturing Systems*, 13(4), 744-750.
- Ma, S., & Ling, Y. (2005). *Supply Chain Management*. China machine press.
- Qian, L., Zhu, D. (2002). Research & Discussion Research on Supply Chain Benchmarking. *Logistics Technology*, 4, 29-33.
- You, Y. (2010). Evaluation Index System of Coordinated Performance of Supply Chain System of Agriculture Product Processing Enterprise. *Science & technology progress and policy*, 27(17), 139-143.

Journal of Industrial Engineering and Management, 2013 (www.jiem.org)



El artículo está con Reconocimiento-NoComercial 3.0 de Creative Commons. Puede copiarlo, distribuirlo y comunicarlo públicamente siempre que cite a su autor y a Intangible Capital. No lo utilice para fines comerciales. La licencia completa se puede consultar en <http://creativecommons.org/licenses/by-nc/3.0/es/>