Research of Service Industry's Customer Satisfaction Maximization Problem based on Multi-objective Programming Model

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Abstract

Customer satisfaction is an important factor for service-oriented enterprises to increase their competitive ability. Finding a good method to assign the finite service personnel with different service capabilities to different customers so as to maximize customer satisfaction is crucial for these enterprises. In this paper, we construct a multi-objective programming model with the method of fuzzy analytic hierarchy process and obtain the maximum of customer satisfaction by assigning service personnel according to the requirement of different customers. It is proved that the model is practical and operational by a specific example.

Keywords: Customer satisfaction, Service capability evaluation, Fuzzy analytic hierarchy process, Multi-objective programming model

1. Introduction

Customers are the bread and butter of a service-oriented enterprise. In order to keep customers, enterprises need to take measures to improve their customer loyalty degree [1]. In a service-oriented enterprise, many aspects are considered to select service personnel to provide customers with the most appropriate service. From the perspective of the enterprises: twenty percent of the customers created the eight percent profits [2]. Therefore, enterprises need to classify customers and provide different service quality for different levels of customers. From the perspective of the customers: the customers focus on that whether the service quality provided by enterprises is consistent with their expectations and can satisfy them. From the perspective of the employees: These factors that whether a work is challenging, consistent with their own ability and can bring a sense of achievement for them directly affect the employee satisfaction, subsequently, customer satisfaction(The existing literature have confirmed the positive relationship between employee satisfaction and customer satisfaction [3]). Considering these factors comprehensively, the problem that needs to be solved by a target service-oriented enterprise is how to assign these service personnel in view of different customers so as to maximize customer satisfaction.

According to the RATER index (RATER index is effective to measure the quality of employee service. It is made up of the first letter of five words which represent the reliability, assurance, tangibles, empathy and responsiveness [4]) and related literatures, this paper divides the index of the employees' service capability into 9 first-level indexes and 23 second-level indexes, which are used to establish the evaluation index system. A multi-objective programming model is constructed by combining these factors which

include the importance of customer, the task preferences of employees and the evaluation index system.

2. The Influencing Factors of Customer Satisfaction

Customer satisfaction is a comparison result between customer's expectation about product or service and customer's actual feeling about a product or service [5-6]. We analyze the influencing factors of customer satisfaction based on the service-profit chain mode which constructed by Hesket, Sasser and Schlesinge (see Figure 1). From the model, we know that the internal service quality influences employee satisfaction, employee satisfaction influences employee's productivity and retention, then influences external service quality, and then affects customer satisfaction [7]. That is to say,customer satisfaction is influenced by two factors. The first is the external service quality which is the direct factor. The second is the employee satisfaction which is the indirect factor.
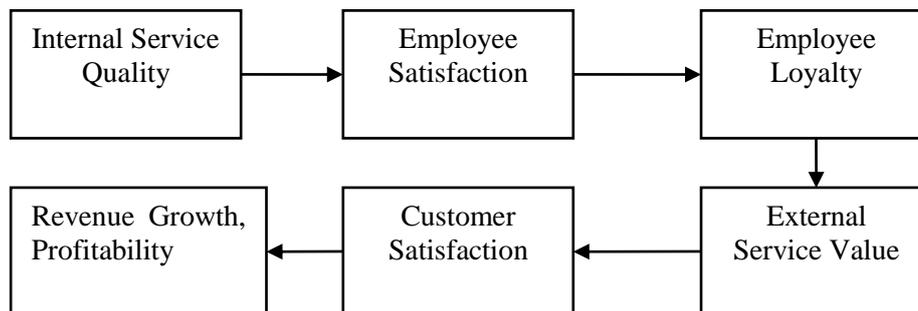

Figure 1. The Service-Profit Chain

We know that the external service quality is reflected in the process of providing service for customers [8]. For service-oriented enterprise, the external service quality depends on the employees' service capability. This paper divides the employees' service capability into nine factors: Business capability, Communication skills, Response ability, Understanding ability, Problem solving ability, Crisis coping ability, Stress ability and Outside image. These factors affect the customer satisfaction in the process of service provided.

Employee satisfaction is measured by the difference between employee's perception and expectation at work [6]. To study employee satisfaction, scholars focus on its influence factors which include work content, work reward, work environment, work groups, enterprise background and so on[9]. From the employee's point of view, these factors can be divided into two categories: One is uncontrollable, such as the work reward, the work environment, the work groups, enterprise background and so on; The other is controllable, such as the task itself and job content. For example, the task is optional through communication and coordination with the leader. Therefore, the Enterprise can allow employees to choose task according their ability and preference. This way can improve employee's work enthusiasm and employee satisfaction.

3. Employees' Service Capability and its Evaluation Indexes

3.1. Employees' Service Capability

Employees' service capability refers to the employees' ability that can make the service provided meet the customer's needs. It mainly includes professional knowledge, the concept of service, service skills, service attitude, occupation quality, service level, management of customer life cycle and so on. The employees' service capability directly affects the enterprise's external service quality. Therefore, this paper uses the RATER

index as the theoretical basis of constructing the employee service capacity index system. America Forum Corporation which is the most authoritative customer service organization got the RATER index by making a deep investigation on enterprise service staff in different industries and their customers. The RATER index can effectively measure customer service quality. The RATER index is made up of the first letter of five words which are Reliability, Assurance, Tangibles, Empathy, Responsiveness.

Reliability means that the enterprises honour their commitments to customers.

Assurance means the professional ability, professional skills and occupation accomplishment of service personnel.

Tangibles means the tangible performance which is the company's service facilities, service environment, the external temperament and appearance of service personnel, providing high quality service for customers and so on.

Empathy means that the enterprise service personnel can understand customer's psychology, customer's demand and customer's circumstance.

Responsiveness means that the enterprise service personnel possess stronger response capability and can resolve quickly customer questions.

According to the RATER index and related literature[2, 10-12], this paper divides the employees' service capability into the following aspects:

 (i)Business capability. Business capability refers to the business knowledge and skills possessed by service personnel;

(ii)Communication skills: Communication skills refer to the service personnel's expression ability, communication skills and coordination ability. Meanwhile, the service personnel can give full play to their own knowledge;

(iii)Response ability: Response ability refers to that the service personnel possess an ability which can quickly understand customer's needs and quickly change when dealing with problem.

(iv)Understanding ability: Understanding ability refers to that the service personnel possess an ability which can understand customers' needs, customer psychology and customers' environment when providing services to customers.

(v)Problem solving ability: Problem solving ability refers to an ability that can clearly analyze problems and put forward reasonable measures.

(vi)Crisis coping ability: Crisis coping ability refers to an ability that can make decision and control the crisis situation in a certain range when facing a crisis.

(vii)Stress ability: Stress ability refers to an ability that can efficiently handle transaction and solve problem when pressure exists.

(viii)Reliability: Reliability refers to the staff's honesty and sense of responsibility.

(ix)Outside image: Outside image refers to the external appearance and temperament of the service personnel. At the same time, it includes service personnel's solicitude for customers as well.

3.2. The Evaluation Index System of Employees'Service Capability

According to the classification of employees' service capability in Section 3.1, the evaluation index of employees' service capability (Q) is divided into 9 first-level indexes (B1~B9). Meanwhile, every first-level index includes some second-level indexes (see Table 1):

Table 1. The Evaluation Index System of Employees' Service Capability

Index	First-level index	Second-level index
Employees's ervice capability Q	Business capability B_1	Professional ranks and titles C_1
		Professional knowledge C_2
		Work experience C_3
	Communication skills B_2	Business presentation skills C_4
		Ability to communicate with others C_5
		Organization and coordination ability C_6
	Response ability B_3	Adaptability C_7
		Logical capability C_8
	Understanding ability B_4	Understanding of customer psychology C_9
		Understanding of customer needs C_{10}
		Understanding of customers' circumstance C_{11}
	Problem solving ability B_5	Analysis and judgment ability C_{12}
		Putting forward a reasonable proposal C_{13}
		Dealing with customer complaints C_{14}
	Crisis coping ability B_6	Delicate perception C_{15}
		Decision-making ability C_{16}
		Ability of dominating a situation C_{17}
	Stress ability B_7	Optimism C_{18}
		Ability of active controlling problem C_{19}
	Reliability B_8	Credibility C_{20}
		Responsibility C_{21}
	Outside image B_9	External temperament and appearance C_{22}
		Cheerful and genial personality C_{23}

4. Construction of Service Industry's Customer Satisfaction Maximization Model

By analysis, we know that the service quality and the employee satisfaction are influential factors of customer satisfaction. They are positively related to customer satisfaction. Therefore, we construct the multi-objective programming model from two aspects of service quality and employee satisfaction.

The specific steps of model construction are as follows:

At first, we assume that the company's service sector has N service personnel $S_i (i = 1, 2, \cdots, n)$ and M customers $P_j (j = 1, 2, \cdots, m)$;

Step1: (Getcustomer importance weight) For an enterprise, the importance of each customer is different. Therefore, we set a weight for each customer. The weight represents the importance of the customer. The process of getting customer importance weight is as follows: Firstly, we construct the customer importance hierarchy model (see Figure 2). Then experts evaluate the importance of each customer in the hierarchy model. Finally, we compute eachcustomer importance weight by using FAHP. Each customer importance weight is represented by $\theta_j (j = 1, 2, \cdots, m), \theta_j > 0$.
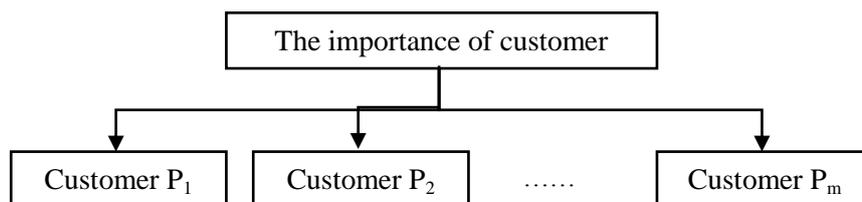

Figure 2. The Customer Importance Hierarchy Model

Step2: (Get each employee's service capability weight to each customer) According to the evaluation index system of employees' service capability, we construct the service capability hierachy model (see Figure 3).
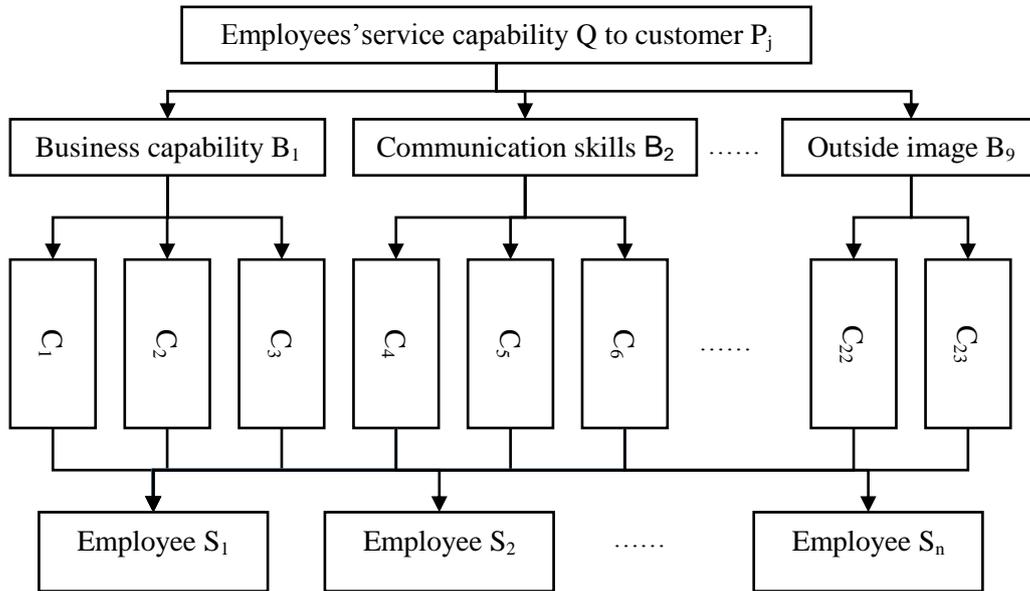

Figure 3. The Service Capability Hierarchy Model

According to the service capability hierachy model, experts evaluate each employee's service capability to each customer P_j ($j = 1, 2, \cdots, m$) (employee is represented by S_i ($i = 1, 2, \cdots, n$)). Then we can get the employees' service capability weight vector $W_j = (w_{1j}, w_{2j}, \ldots w_{ij} \ldots, w_{nj})$ to customer P_j by using FAHP. The weight vector is composed by each employee's service capability weight. Finally, we can get the comprehensive weightvector $A_j = (a_{1j}, a_{2j}, \ldots a_{ij} \ldots, a_{nj})$, where $a_{ij} = w_{ij} \cdot \theta_j$, θ_j is the customer importance weight obtained in Step1. The results are as follows (see Table 2):

Table 2. The Comprehensive Weight

Customer \ Employee	P_1	P_2	P_3	$\ldots$	P_m
S_1	a_{11}	a_{12}	a_{13}	$\ldots$	a_{1m}
S_2	a_{21}	a_{22}	a_{23}	$\ldots$	a_{2m}
S_3	a_{31}	a_{32}	a_{33}	$\ldots$	a_{3m}
$\ldots$	$\ldots$	$\ldots$	$\ldots$	$\ldots$	$\ldots$
S_n	a_{n1}	a_{n2}	a_{n3}	$\ldots$	a_{nm}

Step3: (Get the preference weight of employee about task) Preferences of different employees about the same task are different. So each employee need to set a weight for each task. This weight represents the preference weight of employee about this task. At first, we construct the hierarchical model of preference (see Figure 4). Employees

evaluate every task according to their ability, task competence, challenging of the task and so on. Then we can compute the preference weight of employee $S_i (i = 1, 2, \cdots, n)$ about each task by using FAHP. The weight is $B_i = (b_{i1}, b_{i2}, \ldots b_{ij} \ldots, b_{im})(i = 1, 2, 3, \cdots, n; j = 1, 2, 3, \cdots, m)$. The results are as follows (see Table 3):
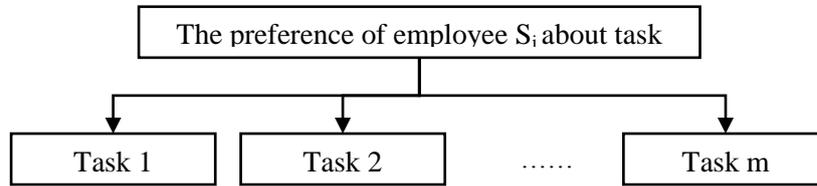

Figure 4. The Hierarchical Model of Preference

Table 3.The Evaluation Results of Employee Preferences

Customer / Employee	P_1	P_2	P_3	…	P_m
S_1	b_{11}	b_{12}	b_{13}	…	b_{1m}
S_2	b_{21}	b_{22}	b_{23}	…	b_{2m}
S_3	b_{31}	b_{32}	b_{33}	…	b_{3m}
…	…	…	…	…	…
S_n	b_{n1}	b_{n2}	b_{n3}	…	b_{nm}

Step4: (Construct Multi-Objective Programming Model) According to Table 2 the comprehensive weight and Table 3 the evaluation results of employee preferences, we can establish a multi-objective programming model which can make customer satisfaction maximize. Set $x_{ij} \in \{0, 1\}$. When employee $S_i (i = 1, 2, \cdots, n)$ provides service for customer $P_j (j = 1, 2, \cdots, m), x_{ij} = 1$. When employee $S_i (i = 1, 2, \cdots, n)$ does not provide service for customer $P_j (j = 1, 2, \cdots, m), x_{ij} = 0$.

The model is as follows:

$$\max Z_1 = \sum_i^n \sum_j^m a_{ij} x_{ij}, \quad a_{ij} \geq 0$$

$$\max Z_2 = \sum_i^n \sum_j^m b_{ij} x_{ij}, \quad b_{ij} \geq 0$$

(2)

$$\begin{cases} \sum_i^n x_{ij} \leq 1, & j = 1, 2, \ldots, m \\ \sum_j^m x_{ij} \leq 1, & i = 1, 2, \ldots, n \\ x_{ij} \in \{0, 1\}, & i = 1, 2, \ldots, n; j = 1, 2, \ldots, m \end{cases}$$

The first objective function in (2) indicates that the employees' service capability is maximized, namely the service quality is maximized. The second objective function in (2) indicates that the preference weight of employee about task is maximized, namely the employee satisfaction reaches maximum under the controllable influence factors of employee satisfaction. The first constraint in (2) represents that one service personnel at

most serves one customer. The second constraint in (2) represents that one customer is served at most by one service personnel.

5. Model Application

This paper takes a software service corporation in Tianjin for example. All the company's customers are departments within a hospital. In a service process, the company chose five employees to provide service for five departments of the hospital. The five employees are Pang Gong, Shi Gong, Zhang Gong 1, Zhang Gong 2 and Li Gong. The five departments of the hospital are Registration fees, Outpatient doctor workstation, Blood bank, Outpatient pharmacy and Outpatient nursing station.

According to the customer importance hierarchy model in Step1 of Section 4, the company'smanagers evaluate the importance of the five departments, and thenwe can compute the importance weight of five departments by using FAHP.The results are as follows (see Table 4):

Table 4.The Importance Weight of Five Departments

Department	Registration fees	Outpatient doctor workstation	Blood bank	Outpatient pharmacy	Outpatient nursing station
θ	θ_1	θ_2	θ_3	θ_4	θ_5
Weight	0.2250	0.2500	0.1500	0.2000	0.1750

According to the service capability hierarchy model in Step2 of Section 4, the company'smanagers evaluateeach employee's service capability to each customer, and then we can get the employees' service capability weight to each customer by using FAHP (see Table 5). we can get the comprehensive weightby combining the importance weights of five departments (see Table 6).

Table 5. The Employees' Service Capability Weight

Department \ Employee	Registration fees	Outpatient pharmacy	Outpatient doctor workstation	Outpatient nursing station	Blood bank
Pang Gong	0.2135	0.2112	0.2128	0.2096	0.2121
Shi Gong	0.2051	0.2065	0.2054	0.2070	0.2048
Zhang Gong 1	0.1981	0.2003	0.1998	0.2008	0.1987
Zhang Gong 2	0.2127	0.2093	0.2102	0.2097	0.2085
Li Gong	0.1709	0.1729	0.1720	0.1725	0.1763

Table 6. The Comprehensive Weight

Department \ Employee	Registration fees $\theta_1=0.2250$	Outpatient pharmacy $\theta_2=0.2000$	Outpatient doctor workstation $\theta_3=0.2500$	Outpatient nursing station $\theta_4=0.1750$	Blood bank $\theta_5=0.1500$
Pang Gong	0.0480	0.0422	0.0532	0.0367	0.0318
Shi Gong	0.0461	0.0413	0.0514	0.0362	0.0307
Zhang Gong 1	0.0446	0.0401	0.0500	0.0351	0.0298
Zhang Gong 2	0.0479	0.0419	0.0526	0.0367	0.0313
Li Gong	0.0385	0.0346	0.0430	0.0302	0.0264

According to the hierarchical model of preference in Step3 of Section 4, employees evaluate every task according to their ability, task competence, challenging of the task and so on, and then we can compute the preference weight of each employee about each task by using FAHP. The results are as follows (see Table 7):

Table 7. The Evaluation Results of Employee Preferences

Department / Employee	Registration fees	Outpatient pharmacy	Outpatient doctor workstation	Outpatient nursing station	Blood bank
Pang Gong	0.2050	0.1800	0.2700	0.1900	0.1550
Shi Gong	0.1500	0.2000	0.2500	0.2250	0.1750
Zhang Gong 1	0.1600	0.2100	0.2100	0.2100	0.2100
Zhang Gong 2	0.2800	0.1800	0.1800	0.1800	0.1800
Li Gong	0.1650	0.1650	0.2150	0.1900	0.2650

According to Table 6 and Table 7, we obtain the comprehensive weight matrix A and the weight matrix B of the employees' preference weight about task:

$$A = \begin{bmatrix} 0.0480 & 0.0422 & 0.0532 & 0.0367 & 0.0318 \\ 0.0461 & 0.0413 & 0.0514 & 0.0362 & 0.0307 \\ 0.0446 & 0.0401 & 0.0500 & 0.0351 & 0.0298 \\ 0.0479 & 0.0419 & 0.0526 & 0.0367 & 0.0313 \\ 0.0385 & 0.0346 & 0.0430 & 0.0302 & 0.0264 \end{bmatrix} \quad B = \begin{bmatrix} 0.2050 & 0.1800 & 0.2700 & 0.1900 & 0.1550 \\ 0.1500 & 0.2000 & 0.2500 & 0.2250 & 0.1750 \\ 0.1600 & 0.2100 & 0.2100 & 0.2100 & 0.2100 \\ 0.2800 & 0.1800 & 0.1800 & 0.1800 & 0.1800 \\ 0.1650 & 0.1650 & 0.2150 & 0.1900 & 0.2650 \end{bmatrix}$$

Set $x_{ij} = \{0,1\}$, a_{ij} is the element of matrix A and b_{ij} is the element of matrix B. We obtain the multi-objective programming model:

$$\max Z_1 = \sum_{i}^{5} \sum_{j}^{5} a_{ij} x_{ij}, \quad a_{ij} \geq 0$$

$$\max Z_2 = \sum_{i}^{5} \sum_{j}^{5} b_{ij} x_{ij}, \quad b_{ij} \geq 0 \tag{3}$$

$$\begin{cases} \sum_{i}^{5} x_{ij} \leq 1, & j = 1,2,3,4,5 \\ \sum_{j}^{5} x_{ij} \leq 1, & i = 1,2,3,4,5 \\ x_{ij} \in \{0,1\}, & i = 1,2,3,4,5; j = 1,2,3,4,5 \end{cases}$$

We solve the model by using the linear weighted method. Firstly, Introducing two variables w_1 and w_2. Experts set $w_1 = 0.6$ and $w_2 = 0.4$ by evaluation. Then solve the model and the results are as follows:

$x_{11} = 0, x_{12} = 0, x_{13} = 1, x_{14} = 0, x_{15} = 0, x_{21} = 0, x_{22} = 0, x_{23} = 0, x_{24} = 1,$

$x_{25} = 0, x_{31} = 0, x_{32} = 1, x_{33} = 0, x_{34} = 0, x_{35} = 0, x_{41} = 1, x_{42} = 0, x_{43} = 0,$

$x_{44} = 0, x_{45} = 0, x_{51} = 0, x_{52} = 0, x_{53} = 0, x_{54} = 0, x_{55} = 1$.

From the results we can see: Pang Gong is assigned to the Outpatient doctor workstation. Shi Gong is assigned to the Outpatient nursing station. Zhang Gong 1 is assigned to Outpatient pharmacy. Zhang Gong 2 is assigned to Registration fees. Li Gong is assigned to Blood bank.

6. Conclusions

This paper constructs a multi-objective programming model. This model integrates three factors considered by managers. These factors include the importance of customer, the service quality of enterprise and the preference of service personnel about task. The service quality is a direct factor affecting customer satisfaction. The preference of service personnel about task is an indirect factor affecting customer satisfaction. The results of the model can maximize the customer satisfaction of enterprise. The actual example proves that the model is practical and operational.

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