The Improvement of Business Processing Ability of Bank Business Hall by the Queuing Theory

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Abstract. Bank business hall queuing problem is both a common phenomenon and a tricky problem. The key issue in solving the queuing of the banking business hall is how to adjust the relationship between service demand and service supply. This paper introduces the prevalence of queuing problems and the impact of queuing on customers, and then find out the root of the problem, using the relevant knowledge of queuing theory for case analysis. From the adjustment of the supply and demand of services to start by changing the customer's psychological perception to solve the problem of bank queuing, and ultimately improve customer satisfaction. The purpose of this paper is to solve the problem of bank queuing through the adjustment of service supply and demand and the change of customer's psychological perception, and ultimately improving customer satisfaction.

Keywords: Queuing theory · Business processing capacity · Business hall Customer diversion

1 Introduction

In the current fast-paced modern life, banks as the service industry to provide people with convenient and efficient service is the most basic requirements. The contradiction between the expansion of bank customers and the business processing capacity become more and more obvious. Waiting behavior has a strong impact on the customer experience. Waiting for service is an important factor in the perception of customer service quality. In general, the longer the waiting time, the lower the customer's evaluation of the quality of service. So shortening the queuing time is an urgent problem needed to be solved for the bank.

2 Queuing Management Theory

The idea of solving customer queuing is usually to increase the number of service facilities, but the greater the number of increases, the greater the human and material resources, and even the waste. If the service facilities are too few, the customer will wait a long time. In fact, the banks should not only guarantee a certain quality of

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service indicators, but also make the cost of service facilities economically reasonable. How to properly solve the contradiction between customer queuing time and the cost of service facilities is the problem solving by queuing theory.

The general queuing system consists of three basic parts. First, the input process means that the customer arrives at the queuing system [1]. Whether the customer is limited or infinite, the time at which the customer arrives in succession is deterministic or random, whether the customer arrives is independent or relevant, the input process may be smooth or not stable. Second, the queuing rules can be divided into: first come first served, after the first service, random service and priority service. Third, the service organization [2]. It includes the time probability distribution required for each customer service, the number of service stations, and the arrangement of the service desk (series, parallel, etc.). The queuing system is shown as follow:

The queuing theory has several performance indicators: the average queue length in the system L_q, the average waiting time of the customer in the system W_q, the average waiting time of the customer in the system W_s, the average number of customers in the system L_s. The average number of commonly used indicators: average arrival rate λ, average service rate μ, the number of parallel service stations in the system S, service desk strength, that is, the average service time ρ per unit time interval. Steady-state probability P_0 and busy probability of the system P.

3 The Application of Queuing Theory in Banks

In general, the level of bank service will reduce the customer's waiting costs, but it will increase the cost of the bank. Our goal is to minimize the sum of the costs of the two, so as to achieve the optimal level of service [3]. In general, the cost of banking services can be calculated or estimated. The waiting cost of customers can also be calculated. For example, three types of service systems can help us to Fig. 1 out and solve the problem. The level of service is generally expressed by the average service rate. Queuing Theory of Economic Essence: service cost is equal to the cost of waiting, that is, the minimum total cost of services, as shown in Fig. 2.

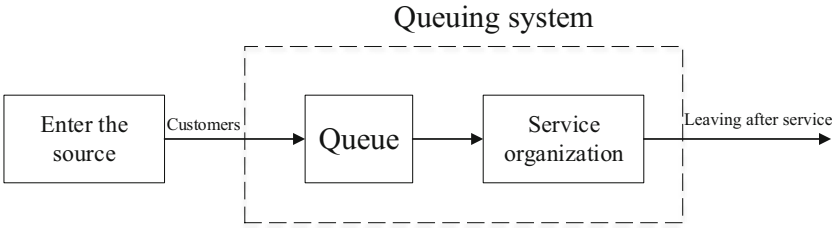

Fig. 1. Queuing system.

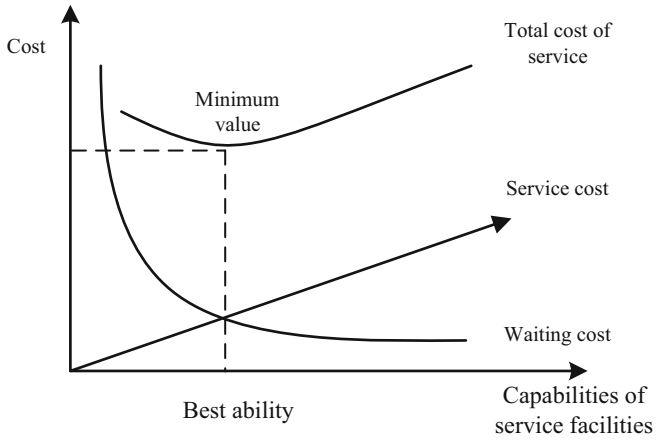

Fig. 2. Cost expenses function curve.

The real meaning of Fig. 2 is that when the cost of service is equal to the cost of waiting, the total cost of the service is minimal, and the best service capability is achieved. According to the queuing theory, for the queuing problem, we have some suggestions for determining the waiting time that the customer can accept and distracting his attention within the waiting time [4]. Promptly informing the customer the real situation. Do not let the customer see the staff rest. The relevant classification of customers. Staff training to deal with queuing phenomenon. Encourage customers to arrive at non-queuing peak, and it can effectively avoid too much waiting time. Develop a feasibility plan to eliminate queuing.

4 M/M/C/∞/∞ Queuing System

First introduce the M/M/C queuing system. The M/M/C queuing system exists in a service: the customer arrives the Poisson distribution with the parameter λ; the customer's service time follows the exponential distribution of the parameter μ; there are C service stations [5]. The customer receives the service in the order of arrival. When the customers arrives, customers will immediately get service if there is a free service station, and the customers will be arranged in a queue waiting for service if all the service stations are busy.

M/M/C/∞/∞ queuing system is the customer source and system capacity are infinite system M/M/C/∞/∞ system, generally referred to as standard M/M/C/∞/∞ systems [6].

5 Analysis of Bank Case

A professional branch of CCB of the existing site can be set up to 6 single temporary counter [7]. The branch can provide up to 6 staff members. The daily expected business volume is 6 million CNY. According to estimates, the amount of work per person per day is 200 million. CCB provides a single deposit and withdrawal business processing time limit of less than 3 min. The customer arrived in the specific selection of the customer to reach a more concentrated representative of the time period for 15 days of survey statistics, the frequency shown in Table 1. Each additional one single temporary cabinet work room will need an additional investment of 100,000 CNY. According to the characteristics of the work of the savings, combined with the customer waiting for service expectations, queuing system indicators of the standard reference value can be the following values (Fig. 3):

$$P_0 = 0.4,\ L_s = 2,\ W_s = 3$$

In general, the customer will form the Poisson flow in the process of arrival, and the negative exponential probability distribution can better describe the probability distribution of service time in the queuing system. CCB's expected daily business volume of 6 million CNY per person per day to complete the workload of 200 million, so the number of service units range [3, 6]. Therefore, the bank's queuing model belongs to the M/M/C/∞/∞ model. Solution: first, to determine the average number of customers arriving per unit time. Second, to determine the average service rate. Third, calculate

Table 1. Customer arrival frequency table.

Number of arrived customers	21	24	33	38	42	45	48	49	52	53	61
Days	1	1	2	1	2	2	1	1	2	1	1

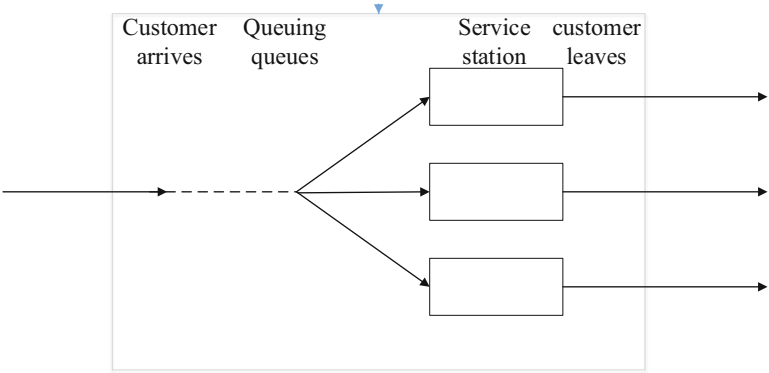

Fig. 3. M/M/C queuing system.

the C points to determine the best number of service units. Fourth, synthesize the amount of investment.

Calculate the average number of customers arriving per unit of time λ:

$$\lambda = \frac{1}{N}\sum nf_n \tag{1}$$

According to the data in Table 1, it can be obtained $\lambda = 0.71$. Calculate the average service rate μ: the maximum time limit for service is 3 min, so it can be assumed that the system processes 0.3 users on average, i.e. the average service rate $\mu = 0.3$. Calculate the values of P_0, L_q, W_q, W_S, L_S when C is 3, 4, 5, 6, and compare with the standard reference:

The calculation of each quantity index is as follows:

$$\mathrm{P}_0 = \frac{1}{\sum_{\mathrm{n}=0}^{\mathrm{s}-1} \frac{(\lambda/\mu)^n}{\mathrm{n}!} + \frac{(\lambda/\mu)^c}{c!}\left(\frac{c\mu}{c\mu-\lambda}\right)} \tag{2}$$

$$L_q = \frac{(\lambda/\mu)^c \lambda\mu}{(c-1)!(c\mu-\lambda)^2} P \tag{3}$$

$$L_s = L_q + \frac{\lambda}{\mu};\ W_q = \frac{L_q}{\lambda};\ W_s = W_q + \frac{1}{\mu} \tag{4}$$

P_0, L_q, W_q, W_S, L_S values shown in Table 2 when C is 3, 4, 5, 6.

Table 2. The value of the number of indicators when the C take different values.

C	P_0	L_q	W_q	W_S	L_S
3	0.056	2.291	3.080	3.226	4.338
4	0.083	0.409	1.001	0.577	1.410
5	0.089	0.100	0.574	0.142	0.808
6	0.090	0.025	0.420	0.036	0.591

Finally, determine the best number of service stations. Compared with the standard reference value $P_0 = 0.4$, $L_S = 2$, $W_S = 3$, it can be found that when $C \geq 4$, the requirements of P_0, L_S and WS are met. From an intuitive point of view, each additional service desk needs to spend more than 100,000 CNY. And the value of the indicators is no significant improvement compared with the C take 4 when C take 5, 6. So the service desk should be set up 4 units.

6 Customer Diversion Strategy

The root cause of the queuing phenomenon is that the service demand does not match the service supply, that is, the service demand is greater than the service supply [8]. So queuing can be done by adjusting service requirements and adjusting service offerings. At the same time, the management of customer queuing because customers do not want to wait, its purpose is to increase customer awareness of the quality of service, thereby enhancing customer satisfaction. And the customer's perception will be different because of the specific circumstances of waiting, so the third way to solve customer queuing problem is to adjust the psychological perception of customer.

6.1 Adjust Service Requirements

Adjust customer demand is through a variety of channels to customers divert to other channels, or encourage customers to do banking business at leisure time, to achieve the purpose of reducing the peak demand for services.

Introducing Customers to Other Business Offices. Drawing an online business hall "electronic map", and the business hall entity queuing called system connection. It can be real-time display of the business outlets of the queuing information. Customers will be able to go through the network to check the business hall of the queue waiting to avoid the flow of people peak. This initiative will effectively achieve the customer's diversion, to avoid too many customers to the same business hall congestion.

Distributing Customers to Other Channels. Try to increase the publicity of electronic channels, guide the customer effectively, including the electronic channel of their own publicity, the use of media and so on. Business hall can also introduce and promote relevant information through the online business hall, SMS business hall, self-service business hall and other channels.

Strengthening Assignments of the Network Lobby Manager for Customer Guide. For larger business outlets, the branch needs to be equipped with a full-time lobby manager. Lobby manager can be the first time to identify customers, and actively take the initiative to do the work area guide work. Knowing the needs of customers in advance and then effectively shunting will help to minimize the waiting time for customers to do business.

6.2 Adjusting Service Supply

By tapping the potential of the business hall, the rational allocation of resources and improving the efficiency of resource use can increase the service supply of the business hall to meet the service needs. According to the specific circumstances of the business hall, the strategy is as follows:

Dynamic Shift Management. Dynamic scheduling refers to historical data based on business volume. Using the forecast method to calculate the business volume of the next stage business hall. And then according to the changes in traffic, calculate the number of staff required for each period, business hall instructors, the number of staff,

other staff to do business hall shift and desk arrangements, the number of tellers per day and the required number of tellers [9]. Dynamic scheduling is to achieve the business hall business volume, traffic and the number of seats, service personnel and other operational indicators to achieve the best allocation of reasonable conditions.

There are many ways to schedule a job. The commonly used method is to use the collection of historical business acceptance data to calculate. The brief description is as follows:

First, clear the number of business processes for each time period. Second, count the number of each hour of each business for a unit. According to the provisions of each business processing time, calculate the time for each business for all the time required. Use this time divided by 60 min, that is, the number of seats required to be scheduled for this period.

The formula for calculating the number of seats is as follows:

The number of seats to be scheduled for this period = ($\sum$ The transactions in a period of time) $\times$ the length of time required to process the business/60 min.

Implementation of "Flexible Working Hours" and "Flexible Window Measures". For seasonal, phased, regional characteristics, customer queuing problems can be solved through the implementation of "flexible working hours", "flexible window settings" and other measures.

Simplify Business Processes. Now people go to the bank to handle the business tends to be diversified and complicated. And the bank's services can't keep up with the time, so the emergence of the bank long queues phenomenon. To solve the problem of bank queuing is necessary to do customer segmentation. Bank of China has been piloted in Shanghai [10]. The public areas of the bank counters are classified. Paid counters are all used to do the payment business, the other bank agents counter are used for specialized agents business.

Increase Electronic Self-service Equipment and Improve Its Use and Security. The long-term effective way solving the contradiction between the supply and demand of financial services is to replace the manual services by increasing the number of electronic self-service devices (mainly telephone banking, online banking and self-service banks), with lower cost of modern means to solve the problem. Banks not only need to increase the number of electronic self-service equipment, but also to improve the electronic self-service equipment business capacity. The first is to improve the technical content, so that the general counter business can be quickly completed with self-service equipment or online banking. Second, it is necessary to solve the electronic banking security issues, so that customers believe that the bank's electronic products, diverting customers and reducing the pressure on the counter.

Strengthen Staff Training and Improve Business Skills. With the increasingly fierce competition in the industry, new products and new business constantly updated. If the teller business training is not enough, there will be unskilled operator, affecting the business processing speed. Therefore, commercial banks should pay attention to the training of tellers. When the new products and new business launch, the bank should promptly train the staff. Teller skills training should also be strengthened in the regular time for the teller technical level assessment rating. The combination of rating

assessment and assessment will ensure the efficiency of the teller business. Eventually, the customer waiting time is shortened by improving the efficiency of the teller business.

7 Conclusion

Customer evaluation of the service depends on the customer's expectations and service perception, rather than the actual enjoyment of the service. So customers perceive that waiting is usually more important than the actual waiting time. In the case that the customer must wait in line, the waiting time in the customer's sense can be reduced in an appropriate manner so that the customer does not feel that the wait is intolerable and the customer is "willing" and comfortable to wait. We can use a series of means to reduce the customer's waiting time.

Establishing a fair queuing rules. Now a lot of banks will generally give priority to VIP customers to do business, reflecting the high value of the outstanding customer service. But if the customer see the later do their business earlier, the waiting customer will increase anxiety, and even feel anger because of unfair treatment. So bank should try to avoid ordinary customers when the use of the highest priority law on the VIP customer priority service. Fairness also comes from the attitude of the teller. And when the customers feel that the salesperson does not know that they are waiting, or they see the tellers are not at work, they will feel unfairly treated. So the tellers need to strengthen coordination and management that they know customers are waiting.

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