TEST Engineering & Management

May – June 2020
ISSN: 0193-4120 Page No. 1770 - 1777

An Application of Waiting Line Model in Organized Retail Stores

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Article Info
Volume 83
Page Number: 1770 – 1777
Publication Issue:
May - June 2020

Article History
Article Received*: 11August 2019*
Revised*: 18November 2019*
Accepted*: 23January 2020*
Publication*: 10 May2020*

Abstract:

The present scenario of the retail competition among corporate players within the nation and between the nations has put forth the importance of quality and timely services. This paper investigates the impact of retail checkouts and delivery system preferred by customer of organized retail shops. About 100 respondents' of four organized retail stores were randomly selected for survey. Waiting line model had been chosen for this study to analyze the customer arrival, waiting time and service rate. The time between two successive arrivals is 5.45 minutes. The average time that one should spend in waiting line is 27.27 minutes. This is due to slow service rate, error in billing and problem with scanner etc.

Keywords: *consumer preferences, waiting line, check out, delivery system, service rate.*

INTRODUCTION

In the world retail destination India has risen as the pioneer as far as retail openings and expected to develop $ 635 billion by 2015. The Indian retail industry is going through a retail blast with the changing front, for example, expanding accessibility of universal brands, and expanding number of shopping centers and hypermarkets and simple accessibility of retail space (Kearney, 2009).

The retail unrest getting clearing as well as gets positive changes the personal satisfaction in the metros and greater towns, furthermore changes in way of life in the littler towns of India. Increment in proficiency, introduction to media, more prominent accessibility and entrance of an assortment of buyer products into the insides of the nation, have all brought about narrowing down the spending contrasts between the purchasers of bigger metros and those of littler towns. Furthermore customers who had been obtaining nourishment and basic food item from conventional sources, for example, road sellers, little retail shops close to the house and so on are moving towards composed current retail outlets (Ramakrishna, 2010).

Most retail firms are organizations from different ventures that are currently entering the retail segment by virtue of its astonishing potential. Because of the passage of numerous retailers in brief timeframe there has been savage challenge among the retailers to serve the shoppers in a superior manner so as to catch piece of the overall industry and to expand client unwaveringness and the retailers endeavoring hard to give great quality support of the buyer.

Fast service creation in the retail domain requires similarly fast adaption of business rules, which increase the competitiveness among existing and new retailers. It is necessary to provide better service to retain customers. One such service through which every retailer can satisfy their

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customer is point of sale service i.e. billing solutions (Berman, 2004).

Billing solutions incorporate all purposes of sale (POS) in hardware and software. POS hardware incorporates electronic sales register, PC, printers, barcode scanners, pole display, and weighing scale; cash counting machine, POS keyboard, cash drawer etc., the billing market is driven by the retail business. The interest for charging ever on the expansion on the grounds that refined modernized bills have supplanted the manual written by hand charges. Organized retail is moving to mechanization and it is important to execute an easy to understand framework for effectiveness, profitability, and forecasting.

All this provides a great shopping pleasure to customers. Some of the critical retail business areas that billing solutions address are demand management, merchandising and assortment planning, space and category management, store operations, price and promotion management, replenishment and allocation of stocks, etc., Appropriate billing solutions help in reducing business complexities. Development of a good billing solution simplifies the regular retail processes like managing and controlling the store keeping units (SKUs), merchandising, selling the products, and the products, and the company's or the store 's accounting system (Davis and Heineke, 2007).

In addition the waiting line of the consumer at check out point could be managed by some extent with providing consumer expected services to utilize their waiting time in effective way (Ravichandran and Rao, 2005). Many organized retail stores are having the waiting line management to reduce the wait time and contending the perceptions of the customers' experience (Davis and Heineke, 2007). Explicitly music likeability of a consumer influenced both wait- length evaluation and mood in the retail store (Baker and Cameron, 2001).

NOTE: This paper has been presented in 14th International conference of Prestige Institute of Management & Research, Indore.

LITERATURE REVIEW

Literature available on waiting line management indicates that waiting in line or queue causes inconvenience to customers and economic costs to individuals and organizations. Hospitals, airline companies, banks, manufacturing firms etc., try to minimize the cost involved in waiting, and the cost of providing service to their customers.

Therefore, speed of service is very important and increasingly becoming a competitive parameter (Katz et al., 1991). Many studies have shown the negative effect of queues on consumers (Katz et al., 1991; Taylor, 1994; Hui and Tse, 1996). It is very common for customers to overestimate the time which they spend for waiting (Hornik, 1984; Katz et al., 1991). As the perceived time of waiting increases, customers get dissatisfaction (Katz et al., 1991). First, in today's fast moving life time has become more precious and valuable commodity especially in developed countries where the standards of living are very high. So as a result people are less willing to wait for services. Second, this is a growing realization by organizations to make their customer satisfied and also to retain them to get business in today's competitive environment. Finally, advances in technology such as computers, internet etc., (Qureshi et al., 1981) have provided firms with the ability to provide faster services. Addressing the problems of queuing involves a trade-off between the costs of customers waiting time and the cost of providing faster service. Katz et al. (1991) argued that we can control service waits by two techniques: the first one is operations management and second one is perceptions management. The operation management deals with the management of how customers (students), queues and servers can be coordinated and cooperative towards the goal of providing effective service at the least cost. Most

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of the firms have tried the obvious approach to the problem, which is managing the actual wait time for the services through operations management, like, modifying service delivery systems (Shostack, 1985), conducting maintenance work at offices at night, or differential pricing to shift demand, (Maister, 1985; Taylor, 1994, 1995). However, the frequency of queues attests to the limits of operations management.

Davis and Vollman (1990) say that the amount of time customers must spend waiting for services can significantly influence their satisfaction. Furthermore, Taylor, (1994) has demonstrated that customer satisfaction is not only affected by waiting time but also by customer expectations towards services or attribution of the causes for the waiting. As a result, one of the issues in queue management is not only the actual amount of time the customer has to wait for services, but also the perception of the customer's to wait (Davis and Heineke, 1994). There are two ways to increase customers' satisfaction with regard to waiting time: by decreasing actual waiting time, and through enhancing customer's waiting experience.

If the organizations cannot control the actual duration of the waiting, then it might consider how it manipulate the perceived wait time. As Taylor et al. (1994) have observed that the perceived waiting time is usually different from the actual waiting time. It means that understanding the factors that effect the perceptions of waiting, and their subsequent have effect on consumer behavior, provides valuable clues to strategies makers for marketing communications. Apart from operations management, that is making changes to reduce the actual waiting time, studies conducted previously on waiting and its impacts on customer satisfaction have focused on customer perceptions of the waiting and how this will be affected by the factors like, filled wait time which is providing distractions or activities (Taylor, 1994), services provider control that is can the firm be blamed for the delay (Tom and Lucey,1995; Taylor,1994; Baker and Cameron 1996), Queuing theory is basically a mathematical approach which is applied to the analysis of waiting lines within the field of operations management (Nosek and Wilson, 2001).

Any system in which arrivals of customers place demand upon a finite capacity resource may be termed as a queuing system (Singh, 2007). Gorney (1981) and Bunday (1996) argue that queuing theory uses queuing or mathematical models as well as performance measures to assess and expectedly improves the flow of customers through a queuing system .A good flow of customers means that the customers queuing is minimized while a poor customers flow means customers suffer considerable queuing delays (Hall, 2006). Queuing theory can be diversely applied and has been used mainly by the service industries (Nosek and Wilson, 2001). A queuing system or waiting lines consists of six major components: the population, the arrival, queues itself queue discipline, service mechanism and departure or exit.

Against this background, the present study is an attempt to examine the case firm's present check out quality and delivery service with the following objective.

To study the current checkout process and delivery system of organized retail stores.

METHODS

The required data of this study was collected using a well structured questionnaire which was pre-tested before the actual survey. The four organized retail shops in Indore city of Madhya Pradesh were selected based on the customer walk-ins and revenue. From each store 25 respondents were selected randomly. Hence totally 100 respondents' sample data used to produce result of this study.

Queuing theory

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Queuing theory empower organizers to examine service requirements and set up service facilities suitable to express conditions. Queuing theory is expansive enough to cover different delays viz., long waiting time and slow service rate as those experienced by customers in a shopping mall or aircraft in a holding pattern anticipating landing slots (Brown, 1997).

The queuing system consists essentially of three major components:

1. The source population and customer arrival pattern,
2. The service system, and
3. Customer exist pattern from the system.

Customer arrivals and distribution

Arrivals in a service system may be drawn from a finite or an infinite population. This difference is significant in light of the fact that the analyses are depending on various premises and require various conditions for their solution.

Waiting line formulas by and large require an arrival rate or the number of units per period, for example, an average of one every five minutes (Chase and Jacobs, 2007). In observing arrivals at a service system, first, we need to analyze the time between successive arrivals to check if the times follow some statistical distribution. For this situation, when arrivals at a service system occur in a purely random manner, a plot of the inter arrival times yields an exponential distribution.

$$f(t) = \lambda e^{-\lambda t}$$

λ – *Mean number of arrivals per time period*
t – *Time period*

Besides, we can analyze the number of arrivals during certain time frame T. The distribution is obtained by finding the probability of exactly n arrivals during T. If the arrival process is random, the distribution is the Poisson distribution.

$$P_T(n) = \frac{(\lambda T)^n e^{-\lambda T}}{n!}$$

λ – *Mean arrival rate of units*
T – *Time*
n – *Number of arrivals*

Queuing theory was applied to the attributes of customer arrival. The customer arrival attributes incorporate arrival distribution, arrival pattern, size of arrival and level of patience as shown in Figure.1

Waiting line model

A retailer wants to know how many customers are waiting for a service in queue, how long they have to wait, the utilization of the check-out services, and what the service rate would have to be so that the retailer can provide quality service in terms of speed and customer service and efficient time utilization. There are four waiting line models;

1. Customer in line
2. Equipment selection
3. Determining the number of servers
4. Finite population source

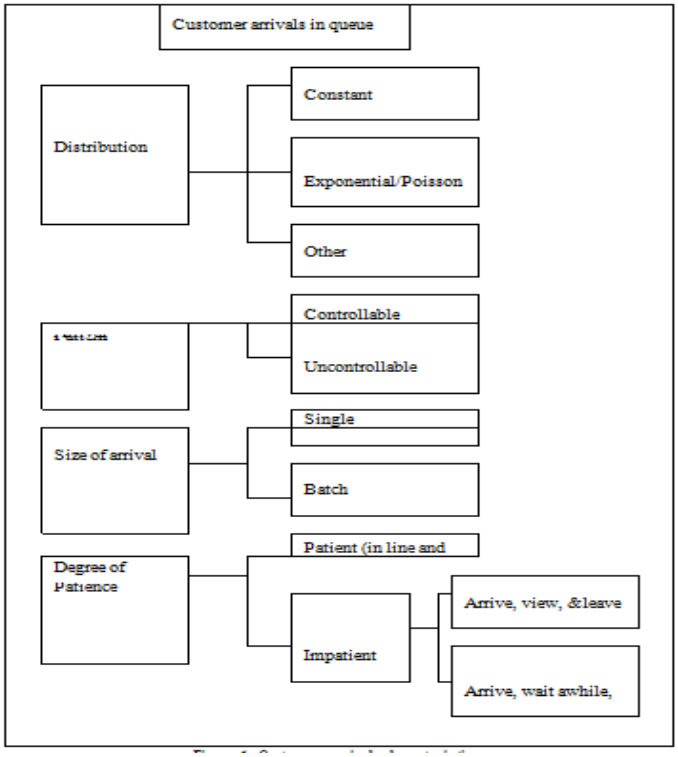

Figure 1. Customer arrival characteristics
(Source: Chase and Jacobs, 2007)

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Average number of customers in line, $L_q = \lambda^2 / \mu\ (\mu - \lambda)$
Average number in system, $L_s = \lambda / (\mu - \lambda)$
Average service time = $1/\mu$
Average time between arrivals= $1/\lambda$
Average time waiting in line, $W_q = L_q / \lambda$
Average total time in system, $W_s = L_s / \lambda$
Probability that an arrival will not have to wait = $1-(\lambda / \mu)$ *where*
λ – Arrival rate μ - Service rate

For this study the above waiting line model has been chosen to analyze the customer arrival, waiting time in system and service rate etc. John McClain of Cornell University developed a computerized queuing model, viz., the excel spreadsheet, Queue Model.xls. This model has been adopted in this study assessing for waiting line/ queue management.

RESULTS AND DISCUSSION

Checkout process

Checkout process helps to study the customer arrival and timing, the waiting line discipline and service rate etc., Respondents were asked to provide information on their arrival time, service rate, waiting line discipline wanted and number of checkout required by them were gathered and furnished.

The customer waiting experience can be reduced by increasing the number of checkouts.

Table 1. Number of checkouts wanted by respondents

S.No	Number of checkouts	No of respondents
1	2	9
2	3	80
3	4	11
Total		**100**

From the Table 1, it is clear that 80 percent of the respondents preferred at least three checkouts in every outlet followed by 11 percent preferred four checkouts. Hence increase the checkouts would be reduces the waiting time of customer as well as increase the service rate.

Result of Waiting Line Model

For using waiting line model the arrival rate and service rate was observed. For the selected stores the arrival rate (λ) was 11 customer/hr. The average customer arrival rate was calculated based on monthly sales data obtained from the store. The service rate (μ) was 5customer/hr.

Table 2. Customer in Waitline Model

S.No	Characteristics	Formula	Calculation	Results
1	Average number of customers in line (L_q)	$L_q = \lambda^2 / \mu\ (\mu - \lambda)$	$= 11^2 / 5(5-1)$ = 121 / 20 = 6 customers (negative value is ignored)	6 customers
2	Average number in system (L_s)	$L_s = \lambda / \mu - \lambda$	= 11/ (5-1) = 2.75 customers. (negative value is ignored)	2.75 customers
3	Average service time	$1/\mu$	= (1/5)* 60 = 12 minutes	12 minutes
4	Average time between	$1/\lambda$	= (1/11) * 60	5.45

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	Arrivals		= 5.45 minutes	minutes
5	Average waiting time in line (W_q)	$W_q = L_q / \lambda$	= (5/11) * 60 = 21.82 minutes	27.27 minutes
6	Average total time in system (W_s)	$W_s = L_s / \lambda$	= (2.75/11) * 60 = 15 minutes.	15 minutes
7	Probability that an arrival will not have to wait	$1-(\lambda/\mu)$	= 1 – (11/5) = 1- 2.2 = - 1.2	-1.2

λ - arrival rate μ - service rate

From the Table 2, it is clearly understood that there are 11 customers arrived at one hour and 5 customers get service in one hour. The rest 6 customers were waiting in the line. So the case firm should take action to reduce the number of customers waiting in line. For that the checkout may be increased into 2 or 3 per stores.

The total number in system is approximately 2. The average number in waiting line exceeds the average number in the system. So it is advised that the case firm should take steps to reduce the line length. The service time per customer would take 12 minutes. This will increase the waiting time of other customers. Customers may be patient or impatient. Unless the service time improved the impatient customers may leave the system without purchasing from the store.

The time between two successive arrivals is 5.45 minutes. This will help the case firm to plan about checkout and to make waiting line management decisions. The average time that one should spend in waiting line is 21.82 minutes. This is due to slow service rate, error in billing and problem with scanner etc., Because of the long waiting time many customers felt inconvenient and they might have thought of switch over to another shop. So the case firm should initiate action to reduce the long waiting time by providing training to the employees who are working in the billing section, introduce scanning for all the products, which may reduce the service time and providing assistance for packing at the peak hours.

Waiting line discipline preferred by respondents

Waiting line disciplines a priority rule for determining the order of service to customers in a waiting line. The rule selected can have a dramatic effect on the system's overall performance. The factors affecting the waiting line discipline are the number of customers in line, the average waiting time, the range of variability in waiting time and the efficiency of the service facility.

From the Table 3, it is obvious that 90 percent of the respondents preferred the queue discipline of First Come First Served (FCFS) followed by 5 percent of respondents preferred the discipline of loyalty card holder first and only 3 percent of the respondents preferred largest order first. So the case firm should follow the appropriate waiting line discipline which fulfils the customer expectations.

Table 3. Waiting line discipline preferred by respondents

S.No	Waiting line discipline	No. of respondents
1	FCFS	92
2	Largest order	3

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3	Loyalty card holder	5
	Total	**100**

Consumer preferences towards billing service

From enquiring the customers about billing services whether they need separate billing for low / bulk purchase, cash /credit card purchase and loyalty card holder, the internal attitude of the customers mind about the billing was arrived at. The data was collected and the results were presented in Table 4.

Table 4 Consumer preferences towards billing service

Variables and their Definitions	Number of respondent	Percentage to Total
Need separate billing for low and bulk purchase		
Need	90	90
Not need	10	10
Need separate billing for cash and credit purchase		
Need	11	11
Not need	89	89
Preferential treatment for loyalty card holder		
Prefer	36	36
Not Prefer	64	64

Majority of the respondents (90 per cent) emphasized the need for separate billing for low and bulk purchase (Table 4). So the case firm can explore the scope for providing separate billing for low and bulk purchase which may reduce the waiting time of customers who normally purchase one or two products alone. As well it could be found that majority of the respondents (89 percent) reported that there is no need for separate counters for credit and cash purchase. The main reason attributed by respondents was that the time taken for credit card payment and cash payment was not the factor for waiting. Similarly majority of the respondents (64 per cent) have said they wouldn't like the preferential treatment. 36 per cent of the respondents were need preferential treatment in billing. The reason as told by the respondents for the category 'No' was that majority of them don't have loyalty card. So the case firm can take steps to improve the loyalty card programme through which customer loyalty may be improved.

CONCLUSION

The time between two successive arrivals is 5.45 minutes. The average time that one should spend in waiting line is 27.27 minutes. The average time waiting in the line exceeds the average total time in the system. It is not possible for any organization. So the case firm should take action to reduce the average time waiting in line, which does not exceeds the average total time. The probability of an arrival will not have to wait is negative, which can be taken as zero. So the probability of one will not have to wait is zero. It is advised to the firm to take action to increase the service rate (μ) by which the probability can be changed into positive.

According to waiting line discipline, 92 per cent of the respondents preferred the queue discipline of First Come First Served (FCFS). Though majority of the respondents (90 percent) emphasized the need for separate billing for low and bulk purchase, majority of the respondents (90.83 per cent) reported that there is no need for separate counters for credit and cash purchase and loyalty card purchaser.

Hence the case firms increase the check outs to minimum of three to reduce the customer waiting time in waiting line. Also increase the delivery distance to satisfy the customer at most.

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