Service Quality in a Reduced payroll Environment: Applying Queuing Analysis to Customer Perception Case Study

Robert Yearout[1], Jack Ballard[1], Jimin Lee[2], Claudel McKenzie[1], and Donna Parsons[1]

[1]Department of Management and Accountancy

[2]Department of Mathematics

The University of North Carolina at Asheville
One University Heights
Asheville, North Carolina 28804 USA

Corresponding author's Email: Robert Yearout: yearout@unca.edu

Abstract: This study was conducted in a national retail pharmacy company's stores in Western North Carolina to examine the impact of the reduction of store staffing, primarily pharmacists and service staff, on customers' satisfaction with service time. Customer arrival rates and service times for each queue were conducted to determine optimal staffing. A random customer survey in multiple store locations provided customers' perceptions of service quality. Analysis determined that over 30% of the customers surveyed were dissatisfied with service time. A regression analysis demonstrated a significant linear relationship ($\sigma = 0.05$) between total service time and customer satisfaction. Study results indicate that cutting staff could result in an unacceptable loss of a competitive advantage. Payroll cost savings of less than $70,000 per year could result in lost revenue dollars in excess of $1,700,000 per year. Thus reducing staff hours (decreasing payroll) in the short term may negatively impact long-term effectiveness and productivity.

Key Words: Customer Perceptions, Queuing Analysis, Service Quality, and Retail Pharmacy

1. Introduction

Today's American business environment has been shaken by what many economists refer to as the Great Recession. The Great Recession, which started in late 2007, has become the longest period of economic downturn in our country's history since the Great Depression of the 1930s (Hughes and Seneca, 2010). Instead of meeting this challenge with innovative ways to increase efficiency, many businesses have relied on further downsizing, a thirty-year business trend that most research has shown to have negative long term implications (Budros, 1999). While businesses may use the current economic conditions to argue that downsizing is necessary to maintain profitability, the question must be asked: is there a point when downsizing undercuts a business' competitive advantage in the marketplace?

Budros (1999) focuses on downsizing's impact on a business' efficiency and effectiveness, where effectiveness refers to "an organization's ability to create socially acceptable outcomes and actions." In the retail sector, these "socially acceptable outcomes" become imperative in the form of customer satisfaction. The drive to reduce payroll costs through downsizing often removes employees that are actively engaged in direct customer service. This push to downsize has created a potential dilemma for retail business organizations: how to achieve a balance between increasing efficiency and maintaining customer service. While businesses may focus primarily on the short term *efficiency* gained through fewer sales staff, they may be overlooking the long term damage to their *effectiveness* through a correlating reduction of customer service.

Results of extensive customer service exploratory research published in the book Delivering Quality Service by Zeithaml, Parasuraman, & Berry (1990) demonstrate that service organizations fail to satisfy the needs of their customers when they do not fully understand their customers' perceptions and expectations of service quality. In their research, Zeithaml, Parasuraman, & Berry (1990) identified the service dimension of responsiveness and promptness, which in retail organizations translates to service time, as being perceived by customers as crucial to customer satisfaction with service quality (Zeithaml, Parasuraman, & Berry, 1990). Current research (i.e., Munichor & Rafaeli, 2007) clearly suggests the negative relationship between customer perception of waiting time and satisfaction. Sridhar (2001) concluded that the relationship between dissatisfaction and satisfaction in the time spent waiting to be served is much more closely related to the customer's expectation of the time that they would spend waiting for service than the actual time in queue. The reality that

many retail organizations now have fewer employees to serve their customers is likely to negatively impact their service times and their customers' perceptions of service quality. This directly impacts a business' long term competitive advantage.

This study examined the impact of the reduction of payroll hours and store staffing in the retail service environment. In particular this study was conducted in a retail pharmacy company's stores in Western North Carolina. The study was completed in two phases beginning in June 2010 with its primary focus being on the service quality dimension of service time. In the first phase of the study data was collected in one store to calculate the store's current rates of service for each waiting line or checkout (queue). This information was then used to perform a queuing analysis to determine the optimal staffing for each queue. In the second phase of the research study a face-to-face random survey of customers was expanded to three store locations within the community. These surveys were analyzed to determine the general trend of customers' perceptions and expectations of service time.

2. Methodology Phase I: Data Collection

In the first phase of the research, data was collected to determine the service rates (SR) (Normally distributed) and customer arrival rates (AR) (Poisson distributed) in a retail pharmacy store. Microsoft Excel 2007 was used to randomly select 20 thirty-minute time periods per week for data collection. During these periods the data was recorded and analyzed from three separate waiting lines (queues) within the store, those queues being the front store checkout, the pharmacy checkout and the drive through checkout. The data was collected during a four-week period from June 20, 2010 through July 17, 2010 using an empirical approach of direct observation.

During each of the time periods a stop watch was used to measure the amount of time, in seconds, that each customer waited for total service. This data was then used to calculate the average total service time, which is the customer SR for each time period. The SR was measured from the time the customer enters the service line or queue until the customer's transaction is complete. Microsoft Excel 2007 was then used to store and calculate the SR descriptive statistics for each day, week, and the four-week period.

Data was also collected during these same time periods to determine the customer AR. The customer arrival rate was determined by counting the number of customers that arrive at each queue during the specific time period. The AR data was stored and analyzed using Microsoft Excel 2007 to calculate the descriptive statistics for each day, week and the four week period. A correlation analysis was then performed to determine if there was a relationship between the AR of customers and the SR for each queue

2.1. Methodology Phase I: Queuing Analysis

The AR mean average and the SR mean average for the four-week period of each queue was then used to complete a queuing analysis for each queue. Queue analysis was completed based on queue theory and waiting line analysis, which was first developed by A.K. Erlang in 1917 (Gaither, N. and Frazier, G. , 2001). Moore, Lee, and Taylor (1993) state that the basic assumptions for arrival times and service times are Poisson distributed. However, empirical data has shown that SR times are very rarely Poisson distributed and more commonly either normal or negative exponentially distributed (Moore, Lee, and Taylor, 1993). For this study, the analysis was completed using Storm queue analysis software and the queue discipline of first in/first out (Emmons, Flowers, Khot, and Mathur, 2001). which establishes the order that customers are served and impacts the time each person has to wait for service. In the model used by STORM arrivals are entered as a count and not as inter-arrival times. The model then converts to the Poisson distribution. An average of the service times for the same period is entered and converted to a negative exponential (Emmons, Flowers, Khot, and Mathur, 2001). In a first in/first out environment customers move through the queue or waiting line in the order of first into the line, first to be served (Gaither, N. and Frazier, G. , 2001).

2.2. Methodology Phase II: Survey

The second phase of the research was designed to get direct feedback from the customers in the retail pharmacy store setting regarding their satisfaction with the service quality dimension of total service time. To accomplish this task a simple survey was designed with five questions to gather information directly from customers about their actual service experience. The surveys were administered equally in three store locations using a face-to-face survey method during a four-week period of time beginning July 4, 2010 through July 31, 2010. Sixty total surveys were completed per queue for a sum of 180 surveys. The results of each individual survey were then recorded using Microsoft Excel 2007 software for each queue and then analyzed using descriptive statistics and regression analysis. Customer comments on individual surveys of

dissatisfied customers indicated that they would seek another pharmacy bore out Sridhar (2001) findings that perception may be an important factor in customer satisfaction.

3. Results: Service Rate and Arrival Rate

During the first phase of the research, data was collected and analyzed to determine the SR and the AR for each of the retail pharmacy store queues. The empirical mean service times were collected for each time period and the respective arrival count was analyzed. The data was analyzed for normality using the Shapiro-Wilk, Kolmogorov, Cramer-von Mises, and Anderson-Darling Tests. There was insufficient evidence to reject the assumption that arrival and service rates are normally distributed. Thus the conversions by the STORM software were valid. The store's drive through queue was determined to have an average SR of (μ = 173.16, σ = 10.55) in seconds and an average AR of (μ = 10.42, σ = 0.65) customers per hour. The store's front store checkout queue was determined to have an average SR of (μ = 111.03, σ = 19.06) in seconds and an average AR rate of (μ = 31.45, σ = 1.36) customers per hour. The store's pharmacy checkout queue was determined to have an average SR of (μ = 148.39, σ = 17.41) in seconds and an average AR of (μ = 22.04, σ = 2.75) customers per hour.

A correlation analysis of the SR to the AR for each queue over the four-week period demonstrated that the coefficient of determination was **(r^2 = .60 , p < 0.01)** between increases in the arrival rate of customers and increases in the amount of time to service customers or the service rate for each queue. This is significant, because the results show that the AR of customers at each queue has a definite impact on customers' total time of service.

3.1. Results-Phase I: Queuing Analysis

The next step in the first phase of the research was to conduct a queuing analysis of each store queue using the mean SR and the mean AR calculated in step one of the study. Table 1 is a limited summary of the queue simulation analysis results for each queue at the mean point.

Table 1: Summary of Queuing Analysis

Location	Mean Customer Arrival Rate per Hour	Total Time in Queue (1 Server)	Total Time in Queue (2 Servers)
Front Of Store	31	6 Min 29 Sec	3 Min 25 Sec
Pharmacy Checkout	22	3 Min 30 Sec	2 Min 12 Sec
Pharmacy Drive Through	10	7 Min 22 Sec	3 Min 48 Sec

Tables 2 through 4 illustrate the results of the queuing simulation analysis using the arrival data points based on each observed location's mean arrival rate. Mean AR for each location is indicated by an *. Intervals were chosen based upon the standard deviation (σ) for each AR. For AR greater than 3σ above the mean, the results were that the AR exceeded the SR. Thus the queue was infinite.

Table 2: Store Front Analysis

Customer AR	One Server	Time in Queue min (sec)	Two Servers	Time in Queue min (sec)
27	1	3 min (40)	2	2 min (11)
29	1	4 min (47)	2	2 min (35)
30	1	5 min (32)	2	2 min (48)
31*	1	6 min (29)	2	3 min (25)
33	1	9 min (26)	2	3 min (31)
34	1	11 min (53)	2	3 min (47)
36	1	22 min (49)	2	4 min (23)

Table 3: Pharmacy Checkout Analysis

Customer AR	One Server	Time in Queue min (sec)	Two Servers	Time in Queue min (sec)
14	1	1 min (18)	2	0 min (50)
17	1	1 min (52)	2	1 min (36)
19	1	2 min (28)	2	1 min (43)
22*	1	3 min (30)	2	2 min (12)
25	1	5 min (24)	2	2 min (57)
28	1	9 min (27)	2	3 min (51)
30	1	16 min (12)	2	4 min (24)

Table 4: Pharmacy Drive Through Analysis

Customer AR	One Server	Time in Queue (minutes)	Two Servers	Time in Queue (minutes)
7	1	4 min (12)	2	1 min (54)
8	1	5 min (27)	2	2 min (30)
9	1	6 min (25)	2	3 min (10)
10*	1	7 min (22)	2	3 min (48)
11	1	8 min (31)	2	4 min (47)
12	1	9 min (44)	2	5 min (44)
13	1	11 min (40)	2	6 min (45)

The data plotted in tables 2 through 4 showed that there was an exponential increase of time customers spend waiting as the arrivals increase and the number of servers are not increased. In this article Table 3 was chosen for illustrating this point. Including the plots of the other two tables would be redundant; therefore, only one figure was included in this article.

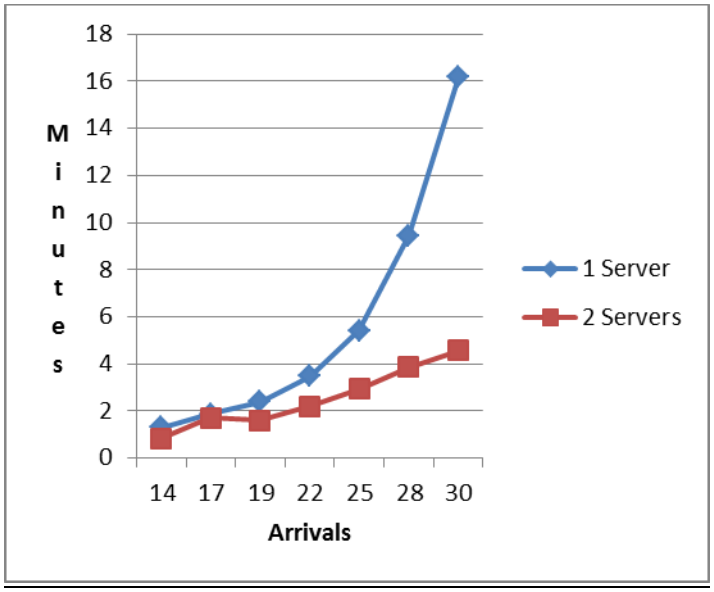

Figure 1: Pharmacy Checkout Waiting Time Results for One and Two Servers

During this phase of the study the queuing analysis was used to determine the statistics of each queue over the range of observed customer ARs for each queue. Other than the summary data shown in tables 1 through 4 and illustrated in figure 1, the statistical results of the queue analysis for the entire range of customer ARs for each retail pharmacy store queue are not given in the results section of this study due to the extreme length of those statistics. Analysis of the data focuses primarily on critical points listed above for the service quality dimension of total service time. The implications of these results are explained in greater detail in the discussion section of the study.

3.2. Results Phase II: Customer Surveys

The second phase of the research study analyzed the data that was collected from the in store surveys of retail pharmacy store customers. The survey findings demonstrated a consistent trend among the stores that were surveyed.

Analysis of the surveyed customers' satisfaction with waiting times determined that 30% of the 180 customers surveyed were not satisfied with their waiting or total service time. Of those dissatisfied customers, approximately 10% offered comments suggesting that the continued unsatisfactory service may result in their search for another pharmacy. The potential loss of customers would negatively affect sales as suggested by van der Wiele, Boselie, and Hesselink's (2002) study which showed a positive relationship between customer satisfaction and company performance. Regression analysis was used to determine if there was a relationship between customer satisfaction and total service time for each queue. The regression analysis of the front store checkout survey data determined that the coefficient of determination was (r^2 = 0.63, p <0.01) between the surveyed customers' satisfaction with service and the total amount of time they had to wait to be checked out. The front store survey analysis also determined that of those surveyed at the front store checkout, total waiting times longer than 3 minutes and 41 seconds were not acceptable.

The analysis of the drive through checkout survey data determined that the coefficient of determination was (r^2 = 0.61, p < 0.01) of the surveyed customer's satisfaction with service and the total amount of time they had to wait to be served. The drive through survey analysis also determined, based on the surveyed customers' total waiting times greater than 5 minutes and 4 seconds were unacceptable. Analysis of the pharmacy checkout customers' surveys determined that the coefficient of determination was (r^2 = 0.68, p < 0.01) of the surveyed customers' satisfaction with service and the total amount of time they had to wait to be checked out. The analysis of the surveys also determined that pharmacy checkout total service times in excess of 4 minutes and 27 seconds were not acceptable.

4. Analysis

The first phase of the research study focused on calculating the descriptive statistics of SR and AR for each checkout (queue) in the retail pharmacy store setting. This statistical information was needed for two reasons, the first of which was to determine if a relationship existed between increases in customer arrival rates and increases in service rates. This relationship of AR to SR is important because it impacts the amount of time a customer has to wait for service. The results of the study showed a strong positive linear relationship between AR and SR. The second reason the statistical information was needed was so that a queuing analysis could be completed for each of the store's three queues: pharmacy checkout, front store checkout and drive through checkout. The queue analysis demonstrated that service rates and total service times increased exponentially as customer arrival rates increase. For example: total wait time at the front store checkout queue is 6 minutes and 29 seconds with one cashier (server) and an arrival rate of 31 customers per hour. When, however, the front store queue customer arrival rate increased to 34 customers per hour with one server projected total wait time climbs to 11 minutes and 53seconds per customer. Obviously no customer wants to wait over 10 minutes in line for service, which means that a second server must be added to the queue to reduce wait time 3 minutes 47 seconds and satisfy the expectations of the customer. This example illustrates why it is so important to calculate the statistics of each queue for the range of customer arrival rates and then use that information as a guide for staffing each queue.

The queuing model identifies the point when bottlenecks or extended wait times begin to occur and helps determine the point when more servers are needed to staff the queue. The queuing model accomplishes this task by calculating the service times for each queue based on the customer arrival rate, the service rate and the number of servers for each queue. Once the queue statistics have been calculated the manager or staff scheduler needs to know what his or her customers expect in terms of service time for each queue to establish proper staffing guidelines. As discussed in the introduction of this study, having the correct customer perception and expectation is a necessity for meeting those expectations and delivering quality service (Zeithaml, Parasuraman, & Berry, 1990). This is why it was so important to complete a customer service perception survey during the second phase of the research study. Analysis of the survey results determined that over 30% of the total customers surveyed were dissatisfied with their total service time. This percentage is very concerning when you consider the impact it has on customer perception of quality service. Previous research has shown that responsiveness and promptness, which in retail stores translates to service time, is imperative for meeting customers' expectations for service quality (Zeithaml, Parasuraman, & Berry, 1990).

4.1. Analysis: Lost Revenue

In today's very competitive environment retail service companies must determine the expectations of their customers and strive to meet those expectations for quality service or risk losing a large percentage of their customers to the competition.
The body of research on wait times clearly establishes the negative relationship between perceived wait time and customer satisfaction. Although most extant research assumes a negative link between customer satisfaction and switching behaviors

(i.e., switching to a different service provider), at least one study (Keaveney, 1995) classifies inconvenience to the customer, partially conceptualized as wait times, as an often-reported reason for customer switching behavior.

Results in this research study indicate that this particular retail pharmacy store company could potentially lose between 10% to 30% of its customers to competition because of customer dissatisfaction with service. Ten percent of customers indicated likey switching behaviors due to dissatisfaction with waiting time and 30% indicated dissatisfaction with service time. This dissatisfaction with service is the result of downsizing store staffing to lower payroll costs. To put this into perspective, the average stores in this study currently have an average front store customer count of 2,381 customers per week or 123,812 customer transactions per year. Using this data, it is possible to estimate that losing a maximum of 10-30% of this front of store customer base would mean losing somewhere between 3,714-37,144 customer transactions per year. Since the average front store customer for 2010 spends $13.80 per transaction this loss of customers would amount to lost revenue for the front store amounting to over $500,000. The pharmacy department in these stores has an average weekly customer count of 1414 or 73,528 customer transactions per year. A loss of 10-30% of the pharmacy customers would amount to losing somewhere in the range of 2,205-22,058 customer transactions per year. With the average pharmacy customer spending over $58.00 per transaction in 2010 the potential loss of revenue for the pharmacy department would be in the range of $127,936-1,279,364. Combining the totals for the front store and pharmacy departments shows a potential loss of revenue for a single store to be a staggering $177,936-1,776,364 per year. This potentially substantial loss of revenue is not justified by the cost savings that the store is able to receive by the reduction of store staffing. To be specific the pharmacy department has had a reduction in payroll hours amounting to 45 staff hours a week at a payroll cost savings of $750 for the same period. The front store has had a reduction in payroll hours amounting to 60 staff hours per week, which translates to a payroll cost savings of $540 per week. In total these payroll cuts will potentially save the store $67,080 per year in payroll costs. Savings of $67,080 in yearly payroll costs does not begin to justify the potential high end loss of annual revenue dollars.

5. Discussion

Management should use the results of the customer perception survey to establish guidelines for service time at each queue and then use the queue analysis developed for each queue to set optimal staffing standards for each individual queue. For example, the survey determined that customers at the front store checkout queue become dissatisfied with service when they wait longer than 3 minutes and 40 seconds for wait time for service, this should be the front store queue guideline. Based on this guideline for service time, the front store queue analysis determines that a second server must be added when the customer arrival rate exceeds 27 customers per hour. At 34 customers per hour the queue analysis projects customer wait time to be 11 minutes and 53 seconds. This is not within the customer service guideline. At an AR of 29 customers per hour the total wait time exceeds the guideline at 3 minutes and 40 seconds. Following this same guideline for total wait time a third server would need to be added to the front store queue when the customer AR exceeded 34 customers per hour.

This same type of staffing guideline should be used for the pharmacy in store check-out and the pharmacy drive through check-out queues as well. Based on the survey results, customers at the pharmacy in store check-out queue become dissatisfied with service when they have to wait longer than 4 minutes and 27 seconds for total wait time. Based on the results of the queuing analysis one server could meet the pharmacy check-out wait time guideline up to a customer AR of 22 customers per hour. At 25 customers per hour the wait time of 4 minutes and 27 seconds with one server exceeds the guideline, so a second server would need to be scheduled when the customer AR for the pharmacy check-out queue exceeds 22 customers per hour. Following this same time guideline of 4 minutes and 27 seconds a third server would need to be added to the pharmacy queue when the customer arrival rate exceeded 30 customers per hour. Survey results for customers of the drive through queue determined that customers become dissatisfied with service when time wait exceeds 5 minutes and 4 seconds. In order to meet the drive through guideline for total service time of 5 minutes and 4 seconds a second server would need to be added when the customer AR exceeds 8 customers per hour. It is very important to note that the retail pharmacy store used for SR and AR data collection for this study has a mean customer AR for the drive through queue of 10 customers per hour. Since this particular retail pharmacy store does not have a second drive through window or remote drive through server the store is not capable of meeting the customers' expectation for total service time at the drive through. A second drive through or remote server would need to be added in order to meet the customers expectation for total service time. Dissatisfied customer comments on individual surveys that they may seek another pharmacy bore out Sridhar (2001) findings that perception may indeed trump reality.

6. Conclusion

This research study focused on the impact of reducing staffing or downsizing in retail pharmacy stores within the Western North Carolina community on customer service and maintaining competitive advantage in that market place. The decision to downsize made by the company in this particular study is reflective of the larger trend to use the current economic environment to justify reducing payroll through cutting service staff. However, the strategic value of this decision is highly questionable. Indeed, research by Cappelli (2000) and Hughes, J.W., & Seneca, J.J. (2010) have demonstrated evidence that decisions made by management to downsize are many times more closely related to management practices than to actual economic conditions. For the retail pharmacies examined in the current study, the results quantitatively indicate that the managerial practice of downsizing has passed beyond a balance between efficiency and effectiveness.

This research has shown that downsizing and staffing cuts are having a direct negative impact on the stores' ability to meet the expectations of their customers for service quality. This has direct implications for the company's ability to remain competitive in the marketplace. The queue analysis completed during the first phase of the study demonstrated that the stores are not being staffed at the optimal levels to meet the expectations of the customers for service time. Further analysis during the second phase of the study indicated that over 30% of the total customers surveyed in the community were dissatisfied with their total service time.

As explained in analysis section 4.1 of the study, downsizing and staffing cuts to reduce payroll costs, may result in much larger and more significant lost revenue dollars. Savings of less than $70,000 per year in payroll costs may result in a competitive advantage loss to other area competitors, which could potentially result in estimated lost revenue in the range of $170,000 to $1,700,000 per year, per store. The risk of losing a substantial number of the store's customers and revenue dollars does not justify the dollars saved by downsizing the staff and reducing payroll hours. Middle and upper management should implement a plan to staff their stores to meet the expectations of their customers based on guidelines established from customer feedback and queuing analysis. Staffing and payroll cuts made without real world cost benefit analysis will result in the continual erosion of company revenue and profits in that market. There appears to be a disconnection between managerial practices and real world analysis. For instance, the particular company examined in this study has planned further downsizing of their payroll budgets for 2011 in this market despite strong evidence that this practice has already potentially undermined their competitive advantage in the market.

It is important to note that this study was limited to data collected within a limited number of store locations within a single market. Based on these limitations it is the recommendation of the study that future studies for retail organizations be completed on a broader scale for data collection. This study also recommends that management should then take a scientific approach through real data analysis to discover if their organization is meeting their customers' service expectations. This information would assist in establishing a staffing baseline that would meet customer perceptions and expectations for specific retail and service environments. This would help them achieve a balance between payroll cost controls while maintaining their competitive advantage in the marketplace.

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