ELECTRONIC SELF-CHECKOUT SYSTEM VS CASHIER OPERATED SYSTEM: A PERFORMANCE BASED COMPARATIVE ANALYSIS

by

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Abstract

Customers want fast checkout systems. Retailers are always searching for ways to improve store checkout systems. This study compared the cashier checkout and the electronic self-check out systems. Data for this study were collected by observations of checkout processes at Wal-Mart Super Centers in the Jackson, Mississippi, area. Formulated research questions were statistically tested employing the independent samples t-tests and the chi square test for independence. Results of these analyses showed that consumers preferred the cashier checkout system to the electronic self-checkout system, although shoppers also want to learn how to use the new self-checkout technology. Further studies were suggested on methods of introducing new Point of Sale technology to consumers, and ways to help managers compare costs of checkout systems.

Dedication

This dissertation is dedicated in memory of my late parents Chief Phillip Opara-Nadi and Chief/Mrs. Helen A. Opara-Nadi.

Acknowledgments

As this journey comes to an end; it would be great if I acknowledge everyone who helped make this journey a success. I know that I cannot recognize everyone of these individuals here. However, I am sincerely grateful to all these wonderful people.

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CHAPTER I: INTRODUCTION

Background of the Problem

The consumer-buying pattern is influenced by several factors including the length of time the consumer spends waiting in line at the checkout counter. Retailers and businesses that use checkout systems in their businesses spend considerable resources searching for ways to improve their methods of customer checkout. Nevertheless, there is an overwhelming need for businesses to value customers' time and install more efficient checkout systems to improve the efficiency of queues and waiting lines. A 1990 survey by the Food Marketing Institute (Alcott, 1991) reported that 89% of shoppers interviewed indicated that a fast checkout process is one of the top priorities in their choice of a store that meets their expectations.

The issue of improving customers' checkout process is not a new phenomenon. Managers in the retail industry have been tackling the problem of improving customers' checkout systems. This concern contributed to one of the earliest inventions for keeping track of commercial transactions and checking out customers on a timely manner. The abacus helped early merchants make arithmetic calculation and checkout customers in the process. A variety of abacus designs followed and led to the present checkout machines used in the retail stores today. The other dimension in the history of the checkout process involved how managers decide on what system to implement to reduce the length of lines and time customers spend in checkout lanes. Early research in this area concerned identifying theoretical models to explain how consumers perceive longer than expected waits in checkout lines. Lewin's (1943) early field theory suggested that when perceived waiting

time is longer, the effect on customers' responses is more negative, when the wait occurs further from the goal state of the service encounter or subsequent to goal achievement than when close to the goal state. Cohoon and Edmonds (1980) investigated customers' anticipatory model. Hui, Thakor and Gill (1998) studied how delays affect customers at different stages of the waiting period. Becker (1965); Osuna (1985); Katz, Larson and Larson (1991); Tom and Lucey (1995), and Zhou and Soman (2003) studied affective reactions and the psychological effects of waiting lines. These studies concluded that when a customer spends more than the expected waiting time in a checkout line, a psychological effect builds and this effect creates a negative reaction towards the store. The researchers further concluded that time spent in a waiting line is an important component of the customer's reaction towards the store.

Weisselburg and Coweley (1969); Foote (1976), Crahill, Gross and Magazine (1977) Jones, O'Berski and Gail (1980) produced studies concerned with how to minimize the time customers spend waiting in checkout lines. The research gap in the previous studies is the limited amount of research in the ways of selecting checkout systems that could help managers in their choice of selecting adequate checkout system for their stores.

Retailers, especially in grocery stores, have experienced decades of changes and innovations toward the improvement of checkout systems. Today, grocery retailers are leaders in the pursuit of efficient checkout methods in the retail industry. There are currently curious minds in organizations in the retail industry that search for an answer to the question: Which checkout system is better or best? Most of these organizations are currently using the store cashier checkout system while looking for methods to improve their system of grocery

and merchandise checkout. Some retail store managers are combating this problem by installing the electronic self checkout system. Others are exploring different queuing theories and waiting line techniques. Labor is a key driver behind the increasing demand for self-checkout in retail stores. Market research studies quote figures in the order of 80%-90% of customers who would change to another retailer for shorter checkout queues (Romsey, 1992). Typically, retailers are saving between 120 hours to 180 hours a week in front-end labor. These numbers are dependent on how efficient the retailer was in the first place, but retailers will also see a decrease in training and employee turnover due to the decrease in necessary manpower. With low unemployment and wages on the rise, the costs of selecting and retaining employees are higher than ever. The complexity of scheduling, unpredictable attendance, and the inability for retailers to "schedule customers" in terms of traffic volume, compound the problem. Self-checkout is a solution that directly alleviates the labor shortage issue in the retail industry (Roussel-Dupre, 2002).

According to Gross and Harris (1998), research indicates that there is more demand for service than there is facility for service available. Retail store managers are constantly making efforts to improve store checkout systems and to decrease the length of time customers spend in checkout lines. The attempts towards improving these situations include such techniques as choosing the best queuing models for the store checkout process and updating the store's technology to meet current checkout standards. Managers in retail firms are frequently looking at measures to improve on the traditional cashier operated checkout system and converting to self service machines that could add to meeting customer's demand for speedier front end service. According to the Knight Ridder/Tribune Business News

(2003), self-service machines are multiplying in grocery and discount stores at a blistering speed.

Self-service is fast becoming a viable alternative to conducting transactions, from ATM machines to gas pumps to self-checkout at retail stores. Customers are demanding better and faster service, and the scarcity and cost of labor are leading to more and more businesses exploring this alternative. The problem confronting managers is the limited source of available information to help them in their efforts to choose among check-out systems. Managerial decision making processes are more complex because front end service requirements vary among stores. So, grocery store managers are constantly exploring different queuing techniques and evaluating current technology to help them make better strategic decisions in their choices of POS (point of sales) check-out terminals.

Research shows that studies have been done in the area of how customers' time spent in waiting lines affects customers' behavior and there are limited studies on how managers choose appropriate checkout systems for their businesses. Hkust and Hkust (2002), in their study expressed that limited research has been conducted to determine how service waits can be controlled. They suggested that, to control the time customers' wait in line, researchers must determine the factors that cause more than expected wait time in checkout lines. Some researchers argue that service waits can be controlled by two techniques: operations management or perception management (Katz, Larson, & Larson, 1991). By conducting this research, "A Comparative Study of the Electronic Self-Checkout System and the Cashier Operated checkout System" managers will have available some added information to help them in their decisions between choosing among checkout systems.

Statement of the Problem

Many previous studies have been conducted to investigate how waiting in checkout lines affects customers. Some of these studies looked at how consumers perceived different wait times in checkout lines and how the consumer perception of the time spent in lines influenced their behavior towards the store they shop in. The studies by Weisselburg (1969), Crahill et al (1977), Foote (1976), Jones et al (1980) explored how to minimize the time customers spend waiting in lines. Their research further supported that time is an important factor to consumers. The focus of their study was on how to minimize the time that customers spend waiting in a queue.

Despite the overwhelming research on factors that cause longer than expected customers' wait in checkout lines, managers are still searching for information that can help them when making decisions that involve their stores' front end services. Managers want to know which checkout system is better or best for their store and their customers. Extensive literature review by the researcher did not reveal any known study that compared the electronic self-checkout system and the cashier operated checkout system. Many stores in the Jackson, Mississippi, area are beginning to install or are contemplating the installation of an electronic self-checkout system. Managers in the area stores are currently evaluating important factors such as cost, customers' preference, how to reduce the time customers spend waiting in line and how to choose a better checkout system. Understanding and controlling these factors could help managers make better decisions when choosing checkout systems. Nevertheless, retail store managers in the area can enhance their decision-making

process if there is available information on which checkout system will most benefit their stores and customers.

Purpose of the Study

The purpose of this comparative study is to investigate whether the electronic self-checkout system is better than the cashier operated checkout system for a store and its customers under a certain market condition. The current competitive market and the development of a dizzying array of electronic payment technologies in recent years, however, has dramatically raised the profile of point of sales systems as key competitive weapons within the retail industry. Managers are frequently confronted with the problem of deciding whether to increase the number of cashier checkout counters or replace them with the new electronic checkout machines. This study addresses some of the host of factors that can help managers decide which customer checkout system is better or best for their store and the customers. The study will investigate such factors as the number of items checked out by customers in each system within a specified time period and the average time it takes to check out each customer within each system. The research will also investigate factors dealing with error rates, managers' and customers' affective reactions and confidence. Furthermore, the study will assess and compare acquisition, implementation and operation costs for each system within a specified period of time. The answer to these questions will complement the information managers require when making strategic decisions on their choices of checkout system.

The rationale behind the investigation of the factors includes the average time it takes to checkout each customer that enters the queue, the number of items checked out by each

customer, the error rate calculated for each system, the operational cost associated with each system, and the level of affective reactions and confidence of customers and managers selected for this research. These factors are crucial to managerial decisions.

Research Question

The following research questions will be investigated: Is there a significant difference between the electronic self-checkout system and the cashier operated checkout system? This leads to the following research sub questions: (1) Is there a significant difference in the number of items checked out by customers in the two systems over a stipulated time frame? (2) Is there a significant difference in the times that it takes to check out a customer between the two systems over the specified time period? (3) Is there a significant difference in the error rates between the two systems over a stipulated time frame? (4) Is there a significant difference in the amount of operating cost between the two systems within the stipulated period of time? (5) Is there a difference in the level of customers' affective reactions and confidence between the two systems? (6) Is there a difference in managers' affective reactions and confidence between the two systems?

The following research hypothesis and 6 sub research hypotheses were formulated from the above stated research questions. The following hypotheses are stated in the forms of null and alternate hypotheses:

Research Hypothesis

Ho1 (null hypothesis): There is no significant difference between the electronic self checkout system and the cashier operated checkout system. Ha1 (Alternate hypothesis):

There is a significant difference between the electronic self-checkout system and the cashier operated checkout system.

Sub Research Hypotheses

(1) Ho1 (null hypothesis): There is no significant difference in the average number of items checked out by the two systems over a stipulated time frame. Ha1 (alternate hypothesis): There is a significant difference in the average number of items checked out by the two systems over a stipulated time frame. (2) Ho2 (null hypothesis): There is no significant difference in the average time that it takes to checkout a customer between the two systems over a specified time period. Ha2 (alternate hypothesis): There is a significant difference in the average time that it takes it takes to checkout a customer between the systems over a specified time period. (3) Ho3 (null hypothesis): There is no significant difference in the error rates between the two systems over a stipulated time frame. Ha3 (alternate Hypothesis) There is a significant difference in the error rates between the two systems over a stipulated time frame.

(4) Ho4 (null hypothesis): There is no significant difference in the amount of operating cost between the two systems within the stipulated time period. Ha4 (alternate hypothesis): There is a significant difference in the amount of operating cost between the two systems within a stipulated time period. (5) Ha5 (null hypothesis): There is no difference in the level of customers' affective reactions and confidence between the two systems. Ha5 (alternate hypothesis): There is a difference in the level of customers' affective reactions and confidence between the two systems. (6) Ho6 (null hypothesis): There is no difference between managers' affective reactions and confidence between the two systems. Ha6

(alternate hypothesis) There is a difference between managers' affective reactions and confidence between the two systems.

Significance of the Study

The retail business has experienced a steady increase in the level of competitiveness within the industry. Managers of retail businesses are always confronted with the problem of improving customer checkout systems, thereby increasing their customers' satisfaction, maintaining a good customer base, and increasing company profits. It is becoming a widespread belief among retailers that there is a positive correlation between profit and good customer service. Also, research has shown that consumer-buying patterns are highly influenced by how long they think they have to wait in line to be checked out, or to receive services in a business.

The following issues make this study significant: (1) Businesses are very concerned about how efficiently their checkout systems work and are always in search of ways to improve them. (2) Consumers want fast checkout lanes: consequently the length of time a customer waits in line to be checked out may influence the choice of a store in which he or she shops.

(3) Influences from current advances and changes in retail and supermarket checkout technology have increased managerial problems in choosing among alternative methods of checkout.

(4) Managers of retail businesses are seeking information that can help them in their decision-making process when choosing appropriate checkout systems. (5) There is a paucity of academic research studies comparing differences in checkout systems. (6)

Findings from this study will add to the limited body of literature that could help managers make better strategic decisions in their choices for selection of the better checkout system.

Finally and most importantly, there are very few retail businesses in Jackson, Mississippi that have the electronic self checkout machines. Most of these stores are just starting to install, or are contemplating replacing some of their traditional cashier operated checkout terminals with the electronic self checkout machines. This research will add to the level of needed information store managers require to make better decisions among their choices of checkout systems.

Definition of terms

The following terms are defined for the purpose of this study:

A BETTER OR BEST CHECKOUT SYSTEM is defined in the context of this research as a faster, efficient, convenient, and user friendly system for customers and store management.

AFFECTIVE REACTION is defined as behavior or action of the customer that is caused by or influenced by his or her encountered experience and or pain or misery resulting from more than the expected wait in the store checkout line.

CASHIER is a representative of a retail business who has the responsibility to checkout items purchased by customers, collect and keep records of customer's payment.

CHECKOUT is the process of verifying and paying for items selected for purchase.

CHECKOUT LINE is the location or queue customers go through to verify and pay for items selected for purchase in a retail store.

CHECKOUT SYSTEM is a method designed to checkout customers merchandise in a store.

CONSUMER is a person who buys goods or services in a retail store for personal use or for resale.

CUSTOMER is a person who shops or buys from or patronizes a retail store or a business regularly.

GROCERY is food or supplies sold by a grocer (retail store).

POINT OF SALES is a location or process relating to a place in a business or a retail store where sales are made and purchases checkout.

POS TERMINAL is a counter or a checkout point where sales and purchase transactions are completed.

RETAILER is a person who owns or manages a retail store that sells directly to the consumer.

SELF-CHECKOUT is a process or method in which a customer is solely responsible for checking out his or her merchandize(s).

SELF-SERVICE is a situation or a process that does not require the services of a store attendant to assist customers and complete checkout.

SHOPPER is a person who buys or is browsing or making selections of merchandise to be purchased in a retail store.

SERVER is a person who serves or attends to customers in a retail store

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Assumptions and Limitations

This comparative study is intended to provide some additional information that managers can use when deciding on which checkout system is appropriate for their store. The research makes the assumption that findings of this study can be structured to fit different store situations that managers have and assist in their decision-making process. The study also assumes that factors found in previous research studies that are attributed to the causes for lengthy customers' wait in line are universal.

The major limitation to this study is that there are few retail businesses in the Jackson, Mississippi, area that currently have the electronic checkout systems. This situation can lead to extensive sampling process to help in gathering the appropriate sample size adequate for the population under study.

Nature and Conceptual Framework of the Study

The finding of this study is based on the analysis of data gathered from sampling and surveying retail shoppers in the Jackson, Mississippi, area. The conceptual framework for this study is based on Hui and Tse's (1996) behavioral mechanisms study which explains the positive and negative impact of waiting duration and information on consumer service evaluation. The study is also based on Smith's (1999) study that suggests that store managers can make better decisions on implementation of checkout systems if they have clearer understanding of operation research dealing with queuing methods in the waiting line. Finally, the study is also based on Dupre's (2002) study on factors that prompt retailers to provide more self-service checkout options in their stores. My research study draws from the

effect of waiting duration and information on customers' service evaluation, which managers must consider when making decision on which checkout system to use in their store.

This study is presented in five chapters. Chapter 1 introduces the background of the study. The chapter also presents the statement of the problem, the purpose of the study, the rationale, research questions, significance, and definition of terms, assumptions, limitations and nature of the study. Chapter 2 reviews related literature. Chapter 3 discusses the methodology; this section describes the population under study, the research design, the research hypothesis, data analysis, and the survey instrument. Chapter 4 covers data collection and analysis, presents research findings and the interpretation of findings. Chapter 5 covers the summary, conclusion and recommendations. Finally, the study presents relevant references, appendices, and bibliography.

CHAPTER II: REVIEW OF LITERATURE

The review of related literature in this research is grouped into four main sections. Section 1 reviews literature that discusses the factors that influence the length of time customers spend in checkout lines and how these factors affect customers' shopping preferences. Section 2 reviews literature on how "queuing theory" and "waiting line techniques" help store managers minimize the amount of time customers spend in checkout lines. Section 3 reviews the literature on the factors that influence the decision-making processes of managers in their effort to choose between increasing the number of cashier checkout stations or replacing them with electronic self checkout systems. Finally, Section 4 summarizes the major factors that contribute to longer than expected waits in checkout lines and methods of queuing/waiting techniques that help managers in their decision-making processes.

Factors that Influence the Length of Time Customers Spend Waiting in Line

The researcher defines total checkout service time as the time from when a customer is ready for services and enters or joins the queue until when the customer receives service and obtains the receipt for payment of goods purchased. A wait for service is defined as the time that a customer is ready to receive service until the time the service commences (Taylor 1994). The length of time this service takes varies from situation to situation and from store to store. Studies indicate that the causes and effects of these situations are numerous and are analyzed based on their varied circumstances.

A shopper feels that he or she is in charge when shopping or making selections of items to be purchased. The shopper starts to feel the loss of control of his time at the point of joining the queue to pay for purchases. Consumers expect store management to have in place an adequate checkout system to expedite checkout processes. Customers who cannot immediately

access a server experience a costly wait if they choose to stay or not to stay in line (Kocas, 2000). The traditional approach, especially in the operations research literature, has been to treat this wait time to be of economic nature. Baker (1986) equates the value of time to its opportunity cost. A typical assessment of opportunity cost is the wage rate, which suggests a linear economic cost to waiting time.

Normally, consumers naturally tend to react with psychological feelings when confronted with situations beyond their control. When consumers wait in line in grocery stores, they experience unpleasant feelings due to the fact that they, psychologically, feel restricted and do not have much control over the time they have to wait to be checked out.

Time Wasted (Idle Time) In Grocery Store Lines

Osuna (1985) contends that besides economic costs, there are psychological costs to waiting in queues. Many researchers in the field share this opinion. Osuma defines the psychological cost of waiting as the psychological stress accumulated during the waiting period. He proposes that as individuals wait in idleness, they accumulate stress, where the rate of accumulation at a particular moment is represented by the intensity of stress felt by the individual at the moment. The intensity of stress that an individual experiences after having waited a certain amount of time is due both to the time already wasted while waiting in idleness to receive service as well as the uncertainty concerning the duration of the remaining wait. He shows that this stress intensity increases during the waiting process and the total stress accumulated during the waiting process is a marginal increasing function of time.

The Queuing Experience

Bennett (1998) discussed the possibility that waiting in grocery lines could be associated with positive sensations, analogous perhaps with the feelings of warmth and sociability

experienced at a jam-packed party, or the excitement felt at being a member of a crowd at a big football match. Kostecki (1996) noted how the need to improve queue time could even be regarded as an indicator of a store's attractiveness. The individual may assume that because a store is extremely busy, it must be a good store to shop in; otherwise large numbers of people would not have been drawn into it. Arguably, the bottlenecks created by retail store checkouts have the effect of generating a "crown atmosphere" which actually encourages customer purchases but could also generate delay at the checkout lines.

The sight of long checkout queues, Kostecki suggested, provides the prospective customer with information about the caliber of an outlet. This information is easy to obtain, costless, and possibly considered more reliable than advertisements, window displays, etc. Also, the time spent in a queue could be interpreted as a (not unwelcome) break between the end of one activity (shopping), and other activities requiring quite different mental orientations. Hence the psychological rest experienced while waiting-in-line might result in the individual being better prepared for forthcoming exertions.

Previous research on waiting also explored psychological reactions to waiting. Katz, Larson and Larson (1991) stated that as the length of wait in line increases, perceptions of waiting time increase and customer satisfaction at the end of the wait tends to decrease. They also suggested that increased distractions make the waiting experience more receptive and therefore tend to increase customer satisfaction. Hui, Thakor and Gill, (1998) examine the interaction effect of service stages, conceptualized as the distance to the goal, and delay type such as procedural, correctional and unknown, on consumer's reactions to waiting. They find that the service stage at which a delay occurs can influence affective response to the wait without affecting perceived waiting time.

Customers' Perception on Filled and Empty Time

Customer perception of time may differ from the objective measured time (Hornik, 1984; Barnett and Saponaro, 1985). Intuitively, we have experienced the situation where the wait seemed to be much longer or shorter than it actually is. For example, customers may perceive objective-waiting time as longer when it is unfilled or empty than when it is filled (Larson, 1987; Maister, 1985).

Customers want to have a clear idea of how long they have to wait in a line. When the wait is shorter or longer than expected, consumers try to determine the reasons. Thus, a consumer may conclude that an especially long wait is caused by an exceptionally slow customer, a very inefficient and slow checker or the time of the day when the store is usually very busy and crowded. In similar fashion, when the wait is shorter than expected, consumers may determine that the cause for the short wait is a fast, efficient checker or the availability of multiple service lines to serve customers.

Hornik (1984) stated that customers have a tendency to overestimate passive duration and underestimate active duration of time spent in checkout lines. He researched the effect of different temporal and nontemporal cues on individuals' time perception, and observed using data on actual and perceived time in retail checkout lines. He concludes that it is important to consider time perception approaches when evaluating consumers' behaviors.

Haynes (1990) states that actual time is a finite quantity; perceived time can be either stretched or compressed. This research reveals that time is a critical component of the consumer decision-making process. The experience of waiting for service at the point of sale can significantly affect customers' perceptions of the quality of service being provided. Furthermore, waiting expectations are influenced by how customer's value time spent in waiting

in comparison with the reason for the wait. Two factors dominate the waiting experience. First, the value of time spent in waiting is influenced by a customer's time/money trade-off. A second factor is customers' perceptions of their control over and amount of choice in the wait. In conclusion, the study reveals that the final service encounter has the potential to influence not only the customer's satisfaction with that purchase experience but also the customer's total impression of the business. If the customer has not reached total satisfaction with the service encounter and the length of the wait for service, the business operation may suffer in the competitive market.

Bernakiva and Lerman (1995) argued that time spent in queues is resented because it represents "empty time", i.e. blank space between desired activities and events; intervals perceived as "stolen" from a person's life and which, therefore, the individual wishes to keep as short as possible. Evidence of the desire to minimize empty time was derived from studies which have suggested that the "cost" of a minute of delay involved in waiting for a bus is regarded by passengers as two or three times that of minutes actually spent traveling on it. In addition, people who lose parts of their lunch breaks due to having to queue feel greater levels of frustration than do other persons (Larson, 1987).

Research indicates that the amount of empty queuing time a person finds tolerable depends on a number of variables. The physical environment surrounding the queue creates perceptions, that a queue is being managed in a socially just manner (i.e. following strictly the first-in first-out principle), and the presence of indicators of a delay's likely duration (Hui and Tse, 1996; Larson 1987; Maister, 1985). Uncertainty about how much time will be lost in a queue generates concerns over the possible consequences of being late for subsequent activities. Hence cues regarding expected waiting time reduce stress and uncertainty and, it has been

alleged, cause customers to feel more comfortable and thus to interpret the waiting period as "reasonable" (Hui and Tse, 1996).

Key indicators of likely waiting time are the number of people in a queue and how many goods are in their shopping trolleys, signs of the likelihood of lengthy credit card transactions or form-filling activities, and the observed speed of work of the employee in charge of a checkout. The observed length of an existing queue can be misleading: being 12th in line may raise less concern in a customer than his or her mental calculation that it will take a cashier (say) 15 minutes to process a queue of six customers each carrying a large volume of purchases. The frustration experienced through having to wait for a longer time in the former situation might be far greater than in the latter.

More recently, behavioral researchers in marketing have become interested in understanding the psychological costs that consumers expend while waiting for service (Carmon, Shanthikumar, and Carmon 1995) and in offering prescriptions on how to reduce these costs (Bateson and Hui 1992; Hui and Tse 1996; Katz, Larson, and Larson 1991). In the investigation of psychological perspective on service segmentation models (Carmon, Shanthikumar, and Carmon 1995) stated that people typically do not like to wait, as it causes them to experience a broad range of unpleasant responses such as boredom, irritation, anxiety, tension, helplessness, and sometimes even humiliation. They examined how service should be divided and scheduled when it can be provided in multiple separate segments. Furthermore, their analysis of variants of this problem used a model with a conventional function describing the waiting cost, which is modified to account for some aspects of the psychological cost of waiting in line.

Taylor (1995) stated that customers' overall performance evaluation and performance evaluation of reliability, and responsiveness are highest when perceived service provider is low

and the waiting customer's time is filled. The evaluation is lowest when perceived service time control is high and waiting time is not filled.

Attribution and Affective Reactions

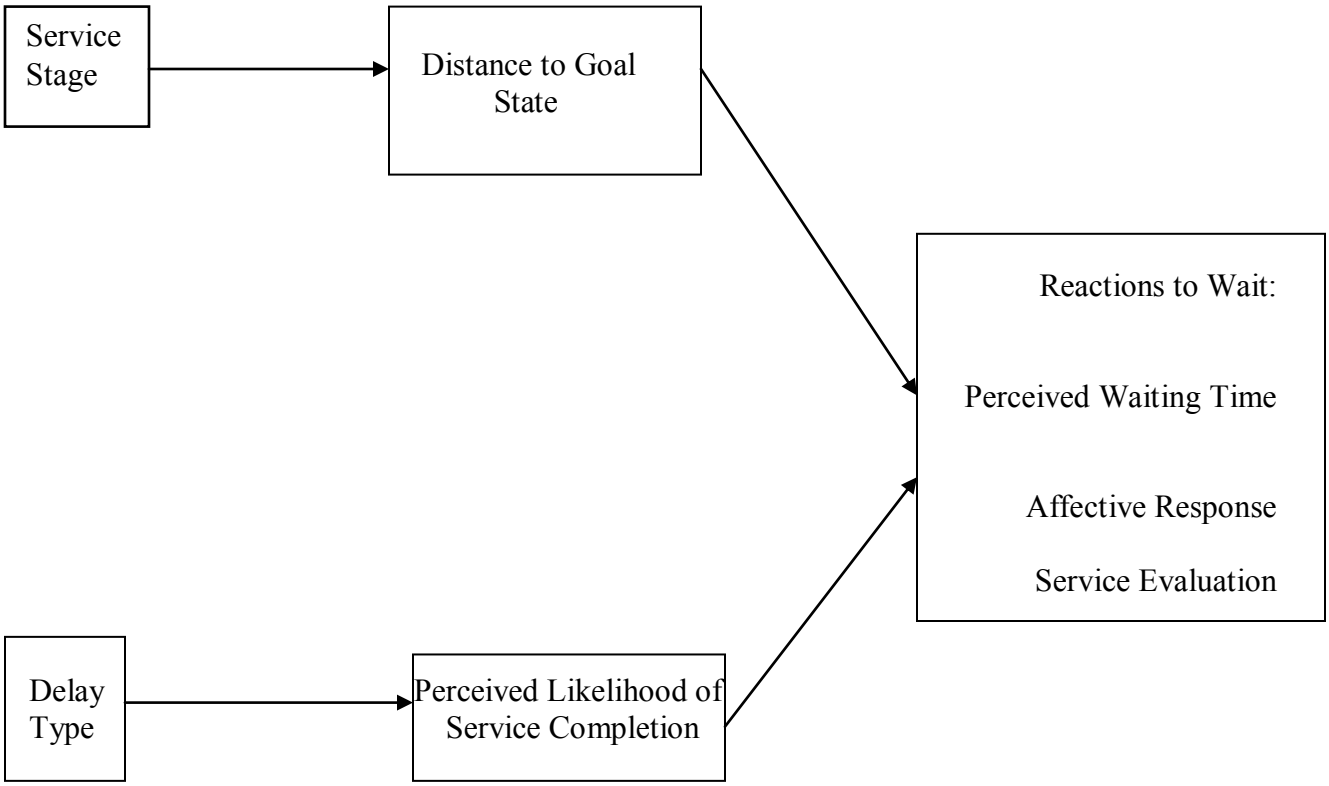
Literature review shows that research assesses a majority of the factors that increase the length of wait in line to be either controllable or uncontrollable store factors. This indicates that store management can strategically plan remedies to minimize the length of time customers spend waiting in checkout lines in grocery stores. Although consumer attributions for the lengths of their waiting time in line may be numerous and varied, they have common underlying dimensions (Weiner, 1985). Causes for the wait can be perceived as being under the store's control or as being due to factors beyond the store's control (Folkes, 1984; Folkes et al., 1987; Taylor, 1994, 1995). For example, when a longer than expected wait is caused by an understaffed store, the length of the wait is store controlled. However, when a slow customer causes a longer than expected wait, the length of the wait is non-store controlled. These causes differ, not only by the degree of control, but also by an orthogonal dimension, the degree of stability (Folkes, 1984; Folkes et al., 1987; Taylor, 1994). These factors or causes can be further classified as either stable or unstable. For example, causes that are relatively permanent are stable; in contrast, causes that are temporary or fluctuating are unstable. For example, customer short waits caused by the store's policy to open a new check stand when there are more than three customers in line are stable (and also store controlled). The reason for a customer's shorter than expected wait in line because he/she is selected to be served immediately by a checker who opens up a new line is unstable (and also under the store's control).

Attribution research would suggest that it may be not just the length of the waiting time that contributes to consumer satisfaction, but the consumers' determination of the reasons for the

wait as well. Consumer satisfaction with waiting time may differ depending on who is blamed/credited with the long/short wait. Bitner's model (1990) proposes that consumer attributions may determine the level of satisfaction associated with the service encounter.

Hui, Thakor, and Gill (1998) related that Lewin's Field Theory suggests that the further away a delay occurs from the goal state of the service encounter, the more negative its impact will be on the consumers. The anticipatory model, however, suggests that the direction of the impact should be the other way around. Hui, et al, on the basis of their literature review proposed that consumer reactions to a delay are a function of the stage at which the stage at which the delay occurs during the service encounter and can be conceptualized as the distance to the goal state of the encounter. They further stated that the direction of the function is determined by consumers' perceived likelihood of service completion associated with different types of delay (see Figure 1). Results obtained from their experimental study confirm that the nature of the delay, in terms of whether it constitutes a threat to the successful completion of a task or not, moderates the impact of service stage, (i.e., how close to the goal state the delay occurs) on the consumers' reactions to the wait.

Figure 1: THE BASIC THEORETICAL FRAMEWORK (Hui, Thakor, and Gill, 1998)



Perception and Influences on Customers' Preferences

Customer's perception of the waiting time may also be affected by their expectation for the length of the wait. The disconfirmation paradigm (Oliver, 1980; Churchill and Surprenant, 1982; Tse and Wilton, 1988) suggests that consumers compare performance with prior expectations. If performance surpasses or meets expectations, that is, the wait is shorter than, or as long as, expected, positive disconfirmation results and the consumer is satisfied. On the other hand, if the performance is less than had been expected, that is, the wait is longer than expected, negative disconfirmation results and the consumer is dissatisfied.

The research on waiting time indicates that numerous factors affect perceived time and cause consumers to experience it as longer as or shorter than objective time (Davis and Vollman, 1990; Haynes, 1990). Moreover, perceived time, more than objective time seems to form the basis of the reality for consumer and behavior (Barnett and Saponaro, 1985). Thus, although the amount of time customers must spend waiting in checkout lines in stores can significantly influence their satisfaction, it is likely that the customer's perceived time plays a more important role than objective time.

Tom and Lucey (1995) conducted a research study to determine whether customers' perceptions of the causes for longer than expected or shorter than expected waits affect customer satisfaction with the store personnel and the store. The study shows that causes for shorter or longer than expected waits can be classified as being under the store control or caused by factors beyond the store control. The purpose of Tom and Lucey's study was to determine the extent to which customer satisfaction is affected by their perception of the cause and stability of their longer/shorter than expected waits. Results of the study underscored the importance of waiting time to consumer satisfaction. The study revealed that customers were more satisfied with

situations where the wait was shorter than expected than in situations where the wait was longer than expected. More importantly, the results of the study revealed the significance of consumers' attribution. Consumers become dissatisfied or are least satisfied in situations where the wait is longer than expected and when they can lay blame on constantly occurring store-controlled factors. In like manner, when the wait is longer than expected but the causal factors are not within the store's control, consumers' lack of blame on the store does not color their satisfaction with the store or its service. The findings from this study indicate that it is not just the length of the waiting time in line, but the reasons for the wait that determines consumer satisfaction or dissatisfaction.

Taylor (1995) confirms the importance that customer's attribution of delays to their overall evaluation of service as well as to their evaluation of the tangible and reliability aspects of service. The author argues that if you can not control actual wait duration, then control customers' perception of it. To do this effectively, it is important to understand the variables that influence the perception of the wait and the possible impact of the wait on service evaluations. Unfortunately, empirical research in this area is extremely limited (Dube-Rioux, Schmitt, and Leclerc 1989; Katz, Larson, and Larson 1991). As consumers experience a greater squeeze on their time, even short waits seem longer than ever before. If firms can improve customers' perceptions of the time they spend waiting to be served, the customers will experience less frustration and may feel more satisfied with the service encounter (Katz, Larson, and Larson 1991).

Service Relationships and Evaluations

Taylor (1994) explored customer reactions to a service delay by assessing the relationship between delays and evaluations of service empirically and examining some variables that may mediate this relationship. Drawing from prior research in the areas of waiting, service evaluations, mood, and attribution theory, several hypotheses were generated regarding the relationships among a delay, situational variables, affect, and service evaluations. The hypothesized relationships were integrated into a single conceptual model, and were tested empirically in a field setting involving delayed airline passengers. The purpose of her article was to strengthen managerial understanding of the wait experience and its effects. Taylor's research considered such variables as delay, service evaluation, uncertainty, stress and anger.

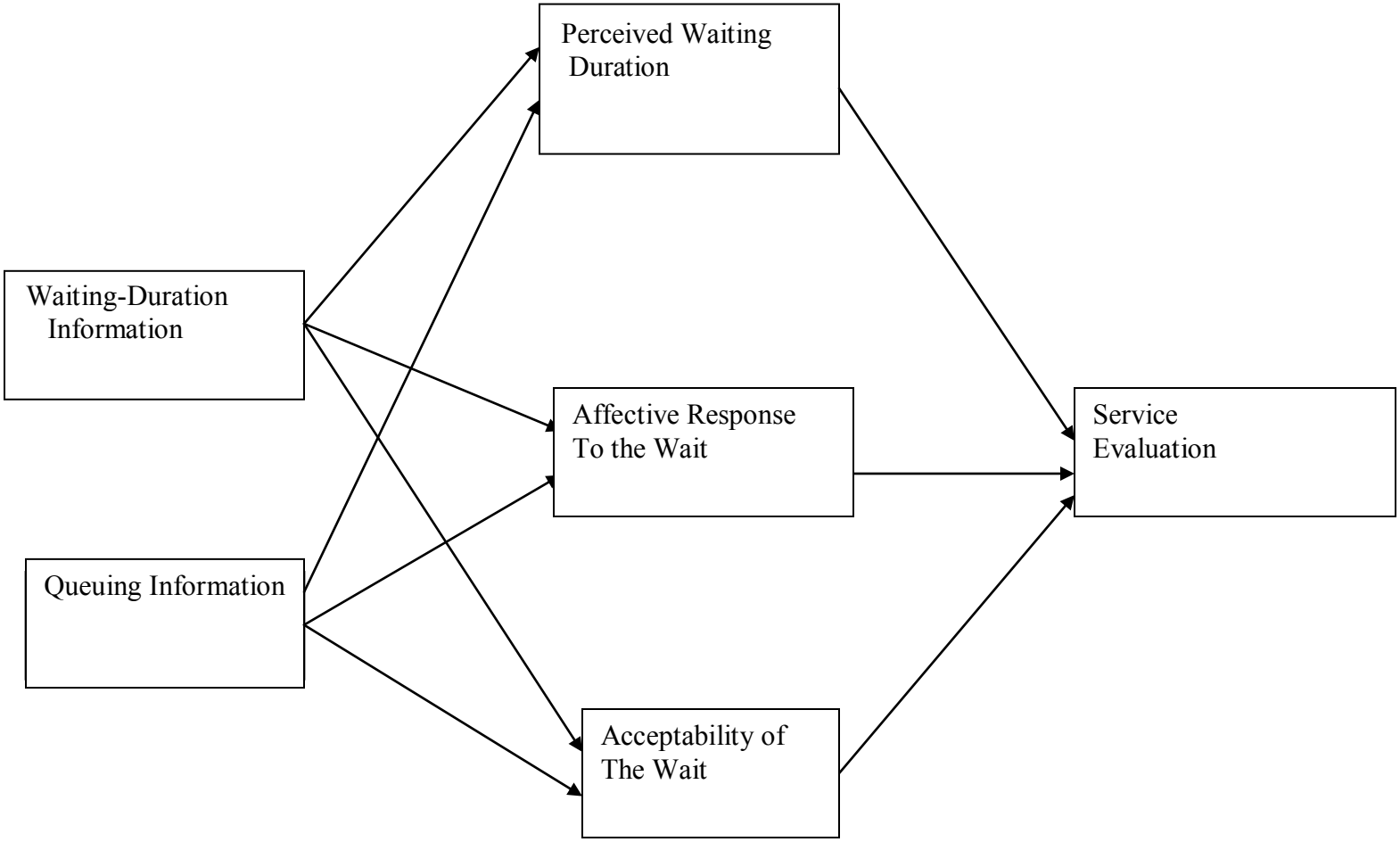
Taylor's study was based on three independent factors: locus of the attribution, stability of the cause-effect linkage, and controllability of the cause and effect. Thus, where the customer places blame for the delay can be expected to influence the affective consequences of uncertainty and anger. Specifically, who or what is blamed and how stability and ability to control the wait occurrence are perceived to be will influence reactions to the wait. Taylor's study also revealed that there are numerous factors that cause the length of time customers spend in checkout lines. These factors range from time to controllable and uncontrollable store factors. Her study represented the first of a series of possible studies investigating customers waiting experiences. Given the theoretical and managerial significance of this research, Taylor stated that it would not be the last. Taylor concluded that variables such as delay, service evaluation, uncertainty, stress, and anger constitute customers reaction to service delay, hence time spent waiting in line.

Bennett (1998) stated that researchers in the field have justified their concentration on these matters on the grounds that customers consistently report great aversion to having to wait

at retail stores (and other) checkouts (see Tom and Lucey 1995). Crucially, it has been claimed (e.g. Katz et al., 1991; Taylor, 1994) that long waits impact negatively on customer evaluations of an outlet's quality because long queues affect the customer's perceptions of the "punctuality" of a service (i.e. how promptly customer requirements are satisfied) and hence his or her ratings of the service provider's overall efficiency and reliability. The level of resources that a store should devote to reducing queue lengths is, however, subject to debate.

It has been argued (see Hui and Tse 1996) that a person's sense of control significantly ameliorates his or her physical and psychological reactions to stressful events because it reaffirms the individual's competence and mastery over the environment. Moreover, the mental distress associated with queuing may be seen by customers as resulting not from their own misdemeanors, but rather the incompetence of those who manage the store. Hui and Tse further suggest that both waiting duration information and queuing information favorably affect customers' evaluation of the service. The issue is. Are the two types of information equally effective in different wait durations? Their study further stated that the situation becomes interesting when the wait is long. As far as the waiting-duration information is long, it is logical to expect that both the distraction effect (perceived waiting duration as the mediator) and the uncertainty-reduction effect (affective response to the wait as the mediator) continue to operate. However, when the customers are informed that the wait is extremely long, the anticipation of substantial time lost may reduce the positive effect of waiting-duration on their reaction to the wait (see figure 2).

Figure 2: An Integrative Model of Waiting Information and Service Evaluation (Hui and Tse 1996)



A number of empirical studies have concluded that a customer's attribution of the cause of a delay significantly affects its emotional consequences (see Taylor, 1994; Tom and Lucey, 1995). According to these investigations, customers are more unsatisfied with longer than expected waits caused by difficulties that the store could have remedied (e.g. inefficient checkout personnel, understaffing, failure to provide express checkouts) than with delays due to external factors such as random variations in store crowding, till breakdowns, the time of day (some periods are inevitably busier than others) or the presence of customers with large amounts of shopping. This was especially true if little effort on the part of the service provider was needed to improve the situation and/or the problem creating the delay was a regular occurrence. It appeared, therefore, that the reasons for a long queue were major determinants of customer satisfaction or dissatisfaction, not just the delay's duration.

The Psychology of Combining Queues

Combining queues have proven not to be a good technique for managing queues in grocery stores and supermarkets. Studies have shown that even though combining queues have been successful in some service organizations, these techniques have proven to have negative results in grocery stores. Among the factors that cause delays of customers who are in line at the checkout counter in grocery stores is management's attempt to combine queues. Contrary to common calculations, there are reasons for believing that combining queues, especially queues of customers in checkout lines in grocery stores, may at times be counterproductive. Rothkopf and Rech (1987) in their seminar had one participant citing the practice of combining separate queues as an obvious example of the benefits that can accrue from the use of operation research technique that has proven to cause delays in lines. He suggested that managers might be

reluctant to combine queues because of concerns about customers' acceptance; the combined queues look longer.

Conclusively at the end of the seminar, Rothkopf & Rech's (1987) summarized that there were significant reasons for believing that combining queues may at time not be a good thing to do. These reasons include customer reaction, elimination of jockeying, increased service times and costs for combined queues, and the absence of published before-and-after studies. Of course, this is not to say that combining queues is always a bad idea.

The authors further contends that even with jockeying that is nondiscriminatory with respect to service time, the average wait in the single queue system will be longer if for any reason combining the queues increases the service times even slightly. There are several possible reasons why such increases might occur. It may take time to get from the central queue to the next available server. It may be that the physical proximity of the customer to his or her ultimate server can allow some overlapping of service such as unloading a shopping cart or getting a form to fill out while the current customer signs one. It may also be that a server is more accountable and feels more responsible for his or her own queue and may therefore be inclined to work faster, especially when the queue is long. With individual queues, customers "belong" to individual servers, and therefore, a server cannot easily rely on other servers to take care of his or her customers. Finally, they stated that it may also be faster because of a subtle degree of specialization. If a customer usually uses the same teller, that teller may become more efficient in dealing with the customer's typical transactions.

Queues, Affective Experience, Satisfaction, and Decisions

Consumers dislike the idea of having to stand in line to check out groceries in stores after they have walked through the aisles selecting their items. Many consumers find this process

uncomfortable and a waste of time especially when they have to wait for more than the expected duration of time. Zhou and Soman (2003) confirmed that queues were ubiquitous consumer experience (Larson (1987); Hocken-hull 2000). Consumers routinely queue up to take a bus to work, to use an ATM, to check into a flight, to send a parcel at the post office, to speak to a ticketing agent or to pay for groceries at a grocery store. At retail or grocery stores, there are queues for consumers to pay for groceries, there are queues for customers to obtain customer services, and there are even special queues for customers to obtain specialized customer services.

In some queuing situations, consumers have little choice but to stay in the queue. For example, those waiting for an operation or drivers waiting to go through a toll booth will presumably continue to wait for these essential services. However, consumers in other settings may have a choice. Should they wait at the post office or arrange for a pickup for an additional charge? Should they wait in the grocery queue or use the self-checkout lane or should they change lane at an additional hassle cost (Levin 2000)? Or, if possible, should they simply leave the queue and return at another time? In this situation, the factors influencing the wait depend on the choice the consumer can make. The study revealed that customers feel dissatisfied, helpless, and stressed when such options are limited.

Hkust and Hkust (2002) conducted a study that involved presentations from three groups of researchers. They stated that everyday, the average individual might have to wait in a queue for various reasons. He or she may or may not have control of the length of wait time. The researchers, on investigating "the Psychology of Queues" questioned, "Why Does the Number of People Behind Matter?" relating that queues at grocery stores were common consumer experiences. The researchers studied consumer experiences in queues and their decisions to leave (renege) or willingness to pay (WTP) to avoid further waiting. A rational evaluation of

these decisions should depend on the time already spent waiting and the expectations of the remaining wait. However, they found that the number of people waiting behind a person also influences the value associated with the queue position, satisfaction, affect and decisions to leave the queue (reneging). Specifically, with more people behind, the mood and satisfaction is better, and likelihood of reneging is lower. In a series of studies, they tested for the robustness of this effect of the number of people behind, and its underlying mechanisms.

Study 1 describes a waiting scenario taking place in the post office. Both numbers of people ahead (5 vs. 10) and behind (0 vs. 5 vs. 10) were manipulated. Not surprisingly, more people ahead led to more negative affect, greater willingness to renege and higher WTP to avoid further waiting. More interestingly, when there were more people behind, subjects reported more positive mood, were less likely to renege, and indicated lower WTP. Similarly, Study 2 uses a scenario that involves hiring someone to wait in line for you and subsequently paying him for this waiting service. Results show that subjects perceived the service more valuable and were willing to pay much more for it when they found out there were more people behind the positions that were held for them.

There exists a universal human tendency to learn about ones self through comparison with others (Gilbert, Price and Allan, 1995). Customers in checkout lines tend to compare their position in line with those of other customers. However, seeing people behind is somewhat a comfort since “there are people worse off than me”, therefore making the experience less painful. The study outlined three sets of factors (queue factors, personal factors, and situational factors) that might shape the extent of social comparisons, each of which is tested.

Hkust and Hkust (2002) expressed that limited research studies have been conducted to determine how service waits can be controlled. To control the time customers’ wait in line,

researchers must determine the factors that cause the more than expected wait time in checkout lines. Some researchers argue that service waits can be controlled by two techniques: operations management or perception management (Katz, Larson, & Larson, 1991).

History of the Queuing Theory and Waiting Line Techniques

The origin of Queuing Theory can be traced back to A. K. Erlang who published his first paper on queuing theory in 1909 (Riva et al, IIC, University of Delhi (2002). Erlang was a Danish Engineer who applied queuing theory extensively to the study of the behavior of the telephone networks and automatic dialing equipment. By studying a village telephone exchange he worked out a formula, now known as Erlang's formula, to calculate the fraction of callers attempting to call someone outside the village that must wait because all of the lines are in use. Erlang spearheaded the development of several queuing performance evaluations that are still in use today. Although Erlang's model is a simple one, the mathematics underlying today's complex telephone networks are still based on his work. Managers today use his work as background in dealing with waiting and queuing problems.

Queuing and Waiting Line Problems

Riva et al (2002) in a study of the history of the Queuing Theory further elaborated that queuing theory deals with problems of waiting. Some typical examples of queuing might be: 1) Banks and grocery stores – waiting for service or waiting in grocery store lines to check out product selection, 2) Computers – waiting for response, 3) Failure situation – waiting for a failure to be corrected (e.g. in a piece of machinery), 4) Public transport system – waiting for a bus or train.

Queuing Theory examines the process of customers who are waiting to receive the service. Managers of service outlets should understand both the theoretical and the practical

aspects of the queuing system. This will enhance better implementation and the quickening of queues and waiting processes in grocery store check out systems. Riva et al (2002) expressed that everyone might be thinking "What do the customers and servers generic terms imply?" They wanted to know how these terms take various forms depending upon the application in which they are used. In the researchers' attempt to further explain the different focus areas in a queue service system, three areas were considered. They stated that the area of the focus considers 1) Arrivals – entries into a productive system. The number of arrivals is significant (limited – few/many or unlimited – possibly infinite). The pattern of arrivals admitted may be of a tight or loose schedule (i.e. arrival rate may be a constant or may vary randomly). The behavior of arrivals may consist of quiet, patient people, stable/unstable objects, querulous children/adults etc., so this area consists of both the nature and the number of objects entering the process. 2) Attention is drawn to the queue/waiting line. Once established, this (queue/waiting line) can have a limited/unlimited number of customers. Of greater importance to the queue is the queue discipline, the manner in which the arrived customers are served. The most common method is FIFO (First In First Out), but there are other methods like LIFO (Last In First Out), pre-emptive, pre-assigned priority. Also some customers may remove themselves from an active waiting line and so be "lost" to the system. This may result because waiting upsets them or they find that the service is out of order (unavailable). 3) Finally, we arrive to the Service facility. Availability – whether the service is free (available) or already in use is of prime concern. Service time is another critical issue that depends on the capacity of the service facility i.e. whether one or more server is available in the system. One or multiple servers may cater to the various needs of the customer depending upon the system under consideration.

Single Server Queue Model

As customers, we generally do not like to wait more than the expected wait time. The managers of the establishments at which we wait also do not like long waiting times, since such waits may adversely affect customers' loyalty, thereby affecting revenues. In analyzing the queuing-server problem Edwards and Chelst (2002) looked at the single-server queuing problem. They related that, in general, a queuing system involves customers who enter the system, perhaps wait in a line (a queue), are served, or leave the system not served. Although many familiar queuing situations involve people as customers and servers, one or both of these entities are inanimate in other applications. For example, an ATM could be the server, or airplanes lined up waiting for takeoff could be the customers. Nevertheless, the terms "customer" and "server" are still commonly used.

Edwards and Chelst (2002) stated that two important issues managers needed to consider when analyzing a single-server queue concerned the timing of arrivals and the rate of service. In the simplest single-server queuing problems, arrivals and service times are assumed to be random. Usually, the timing of arrivals is described by specifying the average number of arrivals per unit of time, λ, or the average interarrival time, $1/\lambda$. For example, if the average rate of arrivals is λ = ten customers per hour, the average interarrival time is $1/\lambda=1/10$ hour, or six minutes.

In a single-server queuing system, one—and only one – server serves each customer. The rate of service, μ, is the average number of customers served per unit of time; and the reciprocal, $1/\mu$, is the average time required to serve one customer. Thus, if a server can serve an

average of μ = fifteen customers per hour, then $1/\mu = 1/15$ hour, or four minutes, is the average service time for one customer.

Queuing Discipline

The queue discipline is the rule or set of rules that specifies which of the waiting customers is next to receive service. The most common rule is first-come, first-served or (FIFO). Other queue disciplines include last-come, first-served or (LIFO); service in random order; and shortest processing time first. Ittig (1994) in his research on how the queuing theory can help managers dealing with shortening the wait time in lines presents a model designed to help determine the number of clerks or servers in a retail queuing situation. The model demonstrates a realistic treatment of the effect of waiting time on customer demand and revenues by treating the average waiting time as a form of price where the demand rate and service level are interrelated. The number of servers is obtained by balancing the cost of additional servers against the revenues and profits arising from greater demand. Ittig's example used data obtained from a retail business to demonstrate the insight gained from applying the model. Some extensions and research possibilities are considered, including a treatment of ancillary activities.

Ittig's study, covering subject areas: Capacity Planning, Queuing Systems, and Service Operations Management, was conducted in service sector organizations, in which a fundamental problem was the selection of the appropriate service capacity to provide in various situation. For example, a retailer must determine the number of checkout clerks to provide in various time periods. His study deals with this problem in a situation where the imposition of long waiting times may cause a reduction in demand. In such situations a waiting time represents a form of price for the service. Customers will acquire some notion of the price demanded by various providers in money and in waiting time, and will act accordingly. The approach taken in Ittig's

paper is to model the sensitivity of demand to changes in the average waiting time. The average waiting time may be obtained from queuing models if demand is known and if capacity is fixed. Projections of the customer response may then be used to obtain optimal service capacity using an iterative procedure. This is a different approach to the capacity planning problem from those commonly in use, and it is an approach that offers some insight and a realistic treatment of the effect of waiting time on demand and profit that helps managers strategically plan their waiting line systems.

Ittig further stated that the model presented in his paper is intended to assist in retail service level decisions by providing a realistic and intuitively appealing way to account for the effect of customer waiting time on demand and profit. There is a tendency for some managers to favor a situation with high utilization rates and low (lean) staffing. The model may help to demonstrate a more realistic perspective.

Causes of Waiting in Line

As noted earlier, there is more demand for service than there is facility for service available. According to Gross and Harris (1998), that there might be many reasons for this: there may be a shortage of available servers; it may be infeasible economically, for a business to provide the level of service necessary to prevent waiting; or there may be a limit to the amount of service that can be provided (generally, this limitation can be removed with the expenditure of capital). The researchers further stated that to know how much service should be made available, one would need to know answers to such questions as, “How long will a customer wait?” and “How many people will form in the line?” Queuing theory attempts to answer these questions through detailed mathematical analysis, and in many cases it succeeds. They stated that the word “queue” is in more common usage in Great Britain and other countries than in the

United States, but it is rapidly gaining acceptance in this country. However, it must be admitted that it is just as unpleasant to spend time in a queue as in a waiting line (Gross and Harris 1998).

The mathematics of queuing theory enables a decision-maker to model the behavior of a queuing system. Mathematical equations are used to calculate the time spent waiting and the number of customers waiting. In some situations, if the lines are too long, customers may go elsewhere to be served. In this case the queuing manager is interested in the number of customers lost due to long waits. Generally, if the waiting time seems excessive and customers are dissatisfied, a manager will explore cost-effective strategies for increasing the service capacity by adding more servers or increasing the speed of service Gross and Harris (1998); Smith (1999).

However, raw numbers fail to tell the whole story. The experience of waiting in line is influenced by the waiting area environment and our expectations as to the length of the wait. Imagine having to wait standing up in a dentist's office for twenty minutes, while a patient is screaming in an adjacent examination room. Now imagine an alternative wait in comfortable chairs with access to the "latest" magazines for a variety of customer tastes. For your ten-year old child there is a video game machine, and the area is sound proof.

Gross and Harris (1998) related that managers of many companies are working to become experts in understanding the psychology of waiting. Queuing and waiting line techniques help managers to come up with innovative ways to manage these slow moving or stagnant lines. Waiting in a line that is moving seems less boring than standing still in the same spot.

Methods of Managing Queues

F. R. Jacobs, in an article retrieved on April 24, 2004 from http://www.pom.edu/p304/ch4sppt/sld007.html, suggested that managers not overlook the effects other methods of managing queues that deal with the store environmental queuing problems. Following are some of the innovative methods suggested:

(1) Perceptions management - Consumer concern about waiting is growing. There is no limit to the frustration that waiting can cause. Cities are becoming more crowded, the work-week is expanding, the economy is worsening, and people need more free time to deal with these ever-growing frustrations. Now, more than ever, excellent service is the key to success. Using perception management to improve customers' satisfaction is only a tool, but it's a good tool.

(2) Waiting Time – Determine the acceptable waiting time for your customers. One minute of waiting in a bank will probably go unnoticed, whereas a minute on hold on the telephone can be infuriating. Determining an acceptable waiting period will help managers set operational objectives and, if those are met, will improve customer satisfaction.

(3) Store Distractions – Install distractions that entertain and physically involve the customer. If the content of the distraction is light, fresh, and engaging, customers remain interested and entertained for many visits.

(4) Getting customers out of line. Whenever customers can be served without having to stand in line, both company and customer can benefit. The challenge to increase customer awareness is very important and the use of these tools is highly recommended.

(5) Estimating Customer Waiting Time. Only make people conscious of time if they grossly overestimate waiting times. There is a trade-off between the accuracy of waiting time perceptions and the awareness of time.

(6) Modification of customer's arrival behavior. Customers are often aware of peak times before they arrive at a service location, but they show up then anyway. If some customers could be convinced to arrive at other times, everyone would be better off. To achieve this, signs that list off-peak hours could be posted in stores and banks and incentives could be used to encourage off-peak arrivals.

(7) Keep resources not serving customers out of sight. Customers do not mind waiting so long as the tellers seem to be working as hard as they can. They tend to become annoyed if they see several unencumbered workers present but not serving customers.

(8) Segment customers by personality types. The three types of customers (watchers, impatients, and neutrals) want different types of service. Watchers find the bustle of the environment entertaining and prefer a friendly smile to a shorter line. The impatient group is more apt to emphasize the length of the queue in their definition of overall satisfaction.

(9) Adopt a long-term perspective. Managers must take a long-term approach when attempting to improve perceptions.

(10) Never underestimate the power of a friendly server. Although waiting is an issue worth addressing, managers should not lose perspective. Servers should continually be trained and rewarded for good service, since their efforts can overcome many negative effects of waiting.

Queuing Theory and the Psychological Cost of Waiting

Carmon, Shanthikumar, and Carmon (1995), in their study of queuing and waiting line techniques, examined how service should be divided and scheduled when it can be provided in multiple separate segments. Their analysis in variants of this problem using a model with a conventional function described the waiting cost, which is modified to account for some aspects of the psychological cost of waiting in line.

The researchers stated that management of consumer queuing systems should, therefore, be an extensively researched area. Surprisingly, this statement is true in only a limited sense. Research shows that consideration of the psychological cost can result in prescriptions that are inconsistent with the common wisdom of queuing theorists derived according to the conventional approach (e.g., equal load assignments). More generally, the purpose of their study is to illustrate that aspects of the psychological cost of waiting can be accounted for in the analysis of queuing systems.

Hkust and Hkust (2002) stated that Queuing Theory relates to how, in single-server queue with exponential inter-arrival times and service times (an M/M/1 queue), a customer with full information minimizes expected waiting time by balking immediately or joining the line and staying until served. Reneging is never optimal. However, customers typically do not have full information, and considerations of psychological costs may lead them to different decisions than those prescribed by queuing theory.

This research helps to determine the impact of various types of information on balking and reneging, assesses participant satisfaction with decision-making, establishes the rules that participants used in their decision-making and compares these rules to queuing theory benchmarks, and to provide guidance to managers of service systems.

The study develops a computer simulation of an M/M/1 queue; participants had the option to join or to balk and return "tomorrow". If they joined, they still had the option of reneging and returning tomorrow. Those who balked or reneged faced another queue, the length of which was independent of the one they left. This time they had to wait until served. After two training sessions, each participant encountered ten queuing situations, where the lengths of the queues were randomly varied.

Researchers studied the impact of two informational factors on decision-making. The first factor, called the clock factor, consisted of the presence or absence of data customer normally has namely clock time and its variants, such as elapsed time. Participants would only be able to see and use these data after they joined the queue, but the practice sessions ensure that they know that these data will be available to them should they join the line. The second factor, called the information factor, consisted of the presence or absence of information about the expected time before service, provided before a participant joined the queue. In all conditions customers were asked to estimate their waiting time before receiving service. Those who balked or reneged were also asked to estimate the line length on the following day. Approximately 60% of participants systematically underestimated the expected waiting time for long lines and overestimated it in short lines while 40% did the opposite. The researchers captured this heterogeneity in a parameter β-as β increases, the overestimate of waiting time increases - which was used as a covariant in the analysis of the data from the experiment. This research study formed the basis for several subsequent managerial training sessions on balking and reneging assessment.

Customer Relationship

Jones, O'Berski, and Gail, T (1980) stated that one of the key problems that grocery store managers face each and every day is that of attempting to see that the customers are checked out as quickly as possible once they have completed their shopping. This fact is considered as paramount in sustaining good customer relations. Studies concerned with how to minimize the time spent waiting in lines have been carried out in depth for many years (Crahill, Gross, and Magazine, 1977): (Weisselberg and Coweley 1969). These studies, based on queuing models, have shown that single-service waiting lines are applicable and do in fact reduce the average in-line waiting times in most situations (Foote, 1976).

Why then could it not be utilized in grocery stores?" Jones, O'Berski, and Gail, T (1980) addressed this question. However, the real objective of their study was not whether single-service line systems could be implemented – it is obvious that implementation is possible – but rather would the consumer accept such a checkout system in retail outlets and grocery stores. In this regard, it is important to realize that banks and post offices have, in effect, a captive audience. For example, because it would not be logically feasible for the consumer to continually move from one bank to another to conduct business, the consumer must rely heavily on the financial institution that controls her/his funds. In this manner, banks have a type of forced allegiance. This situation does not apply to grocery stores. There is very little to prevent a customer from balking at a single-service checkout system, should he find it not to his liking and shopping at a nearby store that elected to continue the use of multiple-service line systems.

It is further noted that the general populace has been thoroughly exposed to this type of system and is familiar with it. Therefore, it was hypothesized that shoppers would readily accept

single-service waiting line systems in grocery stores. The researchers' study reveals that shoppers in many situations preferred the multiple server system.

In deciding whether to implement single-service line or maintain multiple-service system, the manager must weigh the advantages and disadvantages of each alternative in relation to his specific marketing strategy and target market. Vinta (1999) stated that a national chain of grocery stores uses queuing models to determine the maximum number of checkout counters needed during its busiest times so that customers will have to wait no more than 15 minutes once they reach the line. Banks and retail stores have conducted several studies using almost any place or service encounter where waiting will be a major part of the time spent, but without much success. What queuing gives us is a model that can predict, before it happens, where the major congestion will occur, how long people or things will have to wait on the average. By changing the arrival rate in the model or the number of service areas, we can see the effect upon average length of the line, the average waiting time, and other factors.

Queuing theory technique presents a simple model with the assumption that all arrivals and services are Poisson distributed, where the number of arrivals per unit of time is grouped fairly close together. For example, consider distribution of arrivals that average one per minute (or hour, day, and so).

The management of waiting lines, or queues, in retailer businesses represents an evolving process of refinement. When grocery stores first opened, a "conventional" lineup was used. The arrangement required customers to line up in single file behind a single cash register, where orders were taken. Experts suggest that no aspect of customer service is more important than the wait in line to be served. The act of waiting – either in person or on the phone – "has a disproportionately high impact" on customers says Maister (1985), a Boston consultant who has

studied the psychology of waiting. "The wait can destroy an otherwise perfect service experience." A customer waiting in line is potentially a lost customer. Recently, many company managers have stepped up efforts to shorten the waits in line or at least make them more tolerable. Among the methods suggested those that were discovered to prove practical and successful are the queuing theory and waiting line techniques. Studies have shown that managers want queues that are short enough so that customers do not become unhappy and either leaves without buying or buy but never return. Smith (1999) stated that managers are willing to allow some waiting if significant savings in service cost balance the waiting. Service costs are seen to increase as a firm attempts to raise its level of service to its customers. Managers in some service centers can vary their capacity by having standby personnel to open up additional check out lanes and/or machines that can be assigned to specific service stations to prevent or shorten excessively long lines.

Literature in operation research dealing with queuing methods of waiting line techniques has improved the way managers implement checkout systems Smith (1999). For example, in banks and airport check-in points, part-time workers may be called in to help. In grocery stores, managers and stock clerks can operate extra checkout counters when needed. To fully understand how the system works, the author explained that managers should be familiar with the characteristics of a waiting line system; arrivals or inputs to the system; queue discipline, the waiting line itself and the service facility. The system explains how customers either arrive at a service facility according to some known schedule (for example, one student for advising every hour) or in a grocery store one customer per every three minutes; or else they arrive randomly. Arrivals are considered random when they are independent of one another and their occurrence

cannot be predicted exactly. Frequently in queuing problems, the number of arrivals per unit of time can be estimated by a probability distribution known as the Poisson distribution.

Clearly, the cost of waiting – in real dollars or lost opportunities – is not the same for everyone. For those who want a change, Friedman and Friedman (1997) propose a new paradigm of waiting: waiting line segmentation. The underlying premise of waiting line segmentation (a waiting line technique) is that some customers are highly sensitive to long waits and are willing to pay a premium to avoid them. These might be individuals with high opportunity costs, such as being made late for an appointment or missing the chance to make a big sale. They might be people for whom excessive waiting imposes a real cost, such as time lost at work. Or, by virtue of their personalities, they simply might not like to wait in line. Dividing lines into customers who are willing to pay a premium for faster service, and those who are not, nets happier customers, higher profits, and improved efficiency.

William, Karaki, and Lammers (2002) present how simulations to determine cashier staffing policy at a retail checkout can help managers improve the waiting line process. The research study involves both queuing theory analysis and discrete-event process simulation that have been often used, sometimes jointly, to analyze and improve the performance of queuing systems. Queuing theory provides closed-form solutions for various canonical queuing configurations, whereas discrete-event process simulation is highly valuable for analysis of many queuing systems beyond the reach of such closed-form solutions. Since queues are extremely ubiquitous, analysts, engineers, and business managers frequently and beneficially use both queuing theory analysis and discrete-process simulation. During the study, discrete-even process simulation was used to analyze, specify, and improve operational policies in a large retail store. Results of the model guided store management toward policies, ultimately proved successful in

practice, governing the thresholds of congestion warranting the opening and closing of cash-register lanes during a retail-business day.

The objective of William, Karaki, and Lammers study (2002), as specified jointly by the simulation analysts and a retail store manager, was to assess staffing policies at checkout counters, and thence to select a policy balancing staffing costs against the costs (e.g., in goodwill and repeat business) of overly long customer delays within the checkout queues. Since traditional, operations-research-based queuing theory methods provided only approximations to the non-canonical queuing configuration within the retail store, the researchers' study relied extensively upon the power of discrete-event process simulation to provide accurate assessments and comparisons among candidate staffing and operational policies. Applications of discrete-process simulation to retail stores seem rare in the literature, although the issues involved are analogous to those arising in analysis of a customer service center receiving orders by mail, facsimile, and telephone (Chin and Sprecher 1990) or analysis of a fast-food restaurant (Farahmand and Martinex 1996).

Aviel (1996) investigates how the queuing theory help managers find how many items should be in a waiting line and how long it should take to process each item. The study considers the following example. A manager of a production shop is about to purchase a new machine that stamps out computer boards. The author was drawn to this study because many U.S. managers have never been exposed to queuing models because they were, until a few years ago, complicated and difficult to use. The spread of PCs (personal computer) and the subsequent introduction of user-friendly software packages, however, make the use of queuing models quite simple. All the manager needs to do is to input the number of units arriving per hour and the number of boards the machine can process. The computer will do the rest, and will provide the

manager with valuable information, including the number of boards waiting, as well as the length of time spent in line and in the system. Queuing theory is a powerful, yet underutilized management tool that can yield impressive results, often beyond expectations. While the theory has been around for many years, managers have avoided using it because it was complicated and cumbersome. Simple queuing models, as well as the widespread use of PCs and user-friendly software, now make this approach beneficial for every manager.

Factors That Influence Managerial Decision-Making Processes

A shopper feels that he or she is in charge when making selections of items to be purchased. The shopper starts to feel the loss of control of this time at the point of joining the queue to pay for the items selected. Consumers expect store management to have in place an adequate checkout system to expedite checkout processes. Customers who cannot immediately access a cashier experience a costly wait if they choose to stay or not to stay in line (Kocas 2000). The traditional approach, especially in the operations research literature, has been to treat this wait time to be of an economic nature. Baker (1986) equates the value of time to its opportunity cost. A typical assessment of opportunity cost is the wage rate, which suggests a linear economic cost to waiting time.

Osuna (1985) contends that besides economic costs there are psychological costs to waiting in queues. Any researchers in the field share this opinion. Osuma defines the psychological cost of waiting as the psychological stress accumulated during the waiting period. He proposes that as individuals wait in idleness, they accumulate stress, where the rate of accumulation at a particular moment is represented by the intensity of stress felt by the individual at the moment.

The process of determining a method of managing queues and choosing between the cashier operated system and the electronic self operated system play a major role in the managerial strategic decision making process. According to Jacob (2004), managers should not overlook the effects of other methods of managing queues that deal with the store's environmental queuing problems. Research indicates that literature in operations research dealing with queuing methods of waiting line techniques has improved the way managers implement checkout systems Smith (1999).

Self-Checkout System in Retail Stores

It is a common belief that for anything to be done right, you have to do it yourself. To a great extent this saying is true. Consumers want to spend as little time as possible in grocery checkout line. To some extent, they feel that the self-checkout system gives them the control and could reduce the length of time they have to wait in line. According to Roussel-Dupre (2002), consumer influence is not the only factor that prompts retailers to provide more self-service options. With fierce competition from discount superstores, grocers are looking to improve the customer experience while lowering inventory control and labor costs.

At the 2001 Marketechnics Conference PSC Inc., a manufacturer of self-checkout systems conducted a survey, which indicated a strong movement toward the installation of the machines in the grocery sector. In 2001, 25% of survey participants planned to install a system in the next year and another 43% planned to begin evaluating the system. Retailers perceived the benefits of self-checkout as improved customer service, reduced front-end labor costs, and an easing of labor shortage problems. As much as retailers thought installing self-checkout would

benefit the stores, they were unsure of how customers would react to the unmanned checkout lanes (Roussel-Dupre 2002).

Retail Hardware

Smart retailers use technology to fill in the gaps and enlightened retailers understand that they are selling more than just merchandise (Herman & Gioia 2002). The authors further stated that checkout systems in the past had been frustrating when the technology did not work. Some of the equipment was abandoned after a short trial period because it required so much staff attention that clerks were still performing checking-out customers. The new technology, when functioning, places the shopper in control while interacting with the technology, moving very quickly through the process, with built-in safeguards to prevent product theft.

Research indicates that grocers need to update their Point of Service (POS) retail hardware in stores having the NCR cash register. The average life of a POS terminal is five to seven years. Today's newest systems support faster transaction times and faster throughput and can lower costs by supporting new applications. For example, signature captures, already used in other retail channels, is gaining importance for retailer businesses because it lowers costs, particularly when its use is applied to chargebacks. Still, only a handful of retailers have deployed this technology. Reda (1999) contends that the critical issue retailers are facing is the need to upgrade systems in such a way as to amplify customer satisfaction, convenience and service, while still maintaining their own internal controls when it comes to investing capital and handling costs associated with processing.

A recent article of the Food Market Institute stated that the majority of retail businesses seem to be well-prepared with the grocery store technology advancing in preparation for the

Uniform Code Council's (UCC) upcoming January 1, 2005 deadline for North American retailers to be capable of handling the 13-digit European Article Number (EAN-13) at point-of-sale. The UCC also recommends that grocers equip their POS systems to scan EAN-14 bar codes. Fifty-four percent of those surveyed in the Food Marketing Institute's (FMI) Technology Review have stores that are already capable of scanning the EAN-13 symbol at the point-of-sale. Twenty-nine percent of those surveyed said that they were implementing self-checkout in their stores while an additional 24% planned to do so in the near future.

Self-checkout in Retail POS

The article, Self-Checkout Here to Stay, (2003) authored by a staff writer of the Salt Lake Tribune reveals that self-checkout machines have blitzed the retail industry multiplying in grocery and discount stores. By December 2003, when Home Depot began installing them, other huge retailers, such as Wal-Mart, Kroger, Sam's Club and Costco, already had self-checkout machines in place. Typically, each store has four U Scan check out stations monitored by a clerk who helps customers who have questions or problems. Self-checkouts are successful because they appeal to shoppers who want to be out of the store quickly. It is cost saving because one person can oversee the operation of four to eight self-checkout terminals.

The study further explained that industry experts could not give an accurate count on how many self-check out machines are operating in the U.S; the Food Marketing Institute estimates that the number in U.S. retail industry has tripled in the past three years. About one-fifth of the 32, 265 grocery stores had machines at the end of 2001. In 2003, each machine cost about $90,000, and handled 15 to 40 percent of daily transactions in stores where they were offered.

Some experts believe that the reason customers think self-checkout is faster is because they are active, rather than feeling time drag as they wait in a cashier's line. Others contend that self-scanners can save between 15 seconds and 15 minutes, depending on the size of an order. Studies show that store experiences vary depending on location, consumer social economic status, and store setting.

According to Yeldell (2003), food retailers were among the first to use technology to increase productivity by speeding up the shopping experience through the use of self-checkout lanes or "U-Scan" devices. The shopping experience was greatly enhanced because people were used to doing things themselves and slowly in the late 1990s. Grocery stores began adding self-checkout lanes as an alternative for customers to scan their own groceries that theoretically eliminated long lines. This was extremely important because with the onset of the dot-Com jobs, paying big wages in the late 1990s, employees were hard to attract because of the industry's pay scale. Kroger, one of the early pioneers in the automated check out systems, began implementing self-checkout in late 1998 and now most stores have the lanes. In the economy, the greatest impact the self-checkout lanes have is on wages. The industry contends that there are more registers open per cashier, which actually has offered a solution to cashier shortage problems.

The Customer's Experience with Self-checkout System

Consumers dislike the idea of having to stand in line to checkout groceries in stores after they have walked through the aisles selecting their items. Many consumers find this process uncomfortable and a waste of time especially when they have to wait for more than the expected duration of time. Research studies have confirmed that queues are an ubiquitous consumer experience (Zhou & Soma, 2003; Larson, 1987; Hockey-Hull, 2000). Probably the most

frustrating aspect of supermarket shopping is the wait at the checkout queue. No matter how efficient the checkout system may be, or how proficient its operators, it only takes moments during peak periods for lines to develop and waiting times to increase. And without exception, customers perceive waiting time at the checkout as wasted time. The objective of this revolutionary self-service concept was to develop an easy-to-use system that reduces checkout delays and congestion in checkout lines by eliminating front-end checkout cashiers. The challenge was to integrate the design, ergonomics, hardware, and software, relevant retail experience and the partners' contributions to present the shopper with an advanced piece of information technology, in an accessible and user friendly way.

Research indicates that self-checkout systems offer significant advantages to consumers but most of these sophisticated "electronic cashiers" have serious inefficiencies and defects. Simpler systems that shift the job of cashier to the customer are easier and more pleasant to use. Observation of four stores with electronic self-checkouts: Meijer, Walmart, Kroger, and Kmart, reveals that with the exception of Kmart, all of them have more-or-less the same voice, menus, scale checks, and physical setup. Kmart's self-checkout machine was overall different. Nevertheless, the systems offer these advantages to the consumer: (1) They create smaller and faster lines. (2) They remove unnecessary interaction with the cashier and bagger. (3) They allow self-pacing.

Self-pacing gives the consumer time to verify prices. Human cashiers tend to quickly move the merchandise past the UPC scanner; this rarely allows the customer the time to see if he/she is being charged the correct amount for each item. Self-scanners not only allow you to go slower, but they constrict you to think about every item or menu interaction. This is excellent for consumers who hate being overcharged. The reason consumers like Kmart's self-checkout

system is that it discourages (but does not prevent) interaction with the machine until after all items have been scanned. The designers placed the monitor away from the scanner (where the consumer is at the beginning of the transaction) and toward the bags (where the consumer is at the end of the transaction). This way, the system does not impose its use until it is needed at checkout. This is a brilliant, but simple, system constraint. There is no need for a "press here to start" or pauses for instruction. The machines are so simple, in fact, that they require no separate self-checkout manager. Rarely does a customer run into any problem with the Kmart system. The machine should be a functional tool. In other words, the machine should not be programmed to be a cashier; rather, it should be programmed to enable the customer to be the cashier (Chilabs 2002).

Americans have become accustomed to serving themselves. We enjoy the convenience of banking at the ATM and filling up at gas stations where we can pay at the pump. People get frustrated when they have to wait in line in a grocery store, supermarket, or retail outlet. They feel that they should be able to access the checkout system, and pay for the items selected without having to go through the hassle of waiting in a slow or stagnant store checkout line. (Wolfrom 2001) noted that when a slow cashier is tending the checkout counter, customers standing in the lane remark in frustration, that they could check themselves out faster than the cashier.

Two years after the self-checkout system was introduced, consumer interest and acceptance developed. The reason the self-checkout system is preferred is that customers like the control. Today's consumers are given more and more opportunities to be in control of their transactions. In fact, they are demanding it. According to the National Association of Convenience Stores' 1999 State of the Industry report, the percentage of convenience stores with

self-checkout technology increased from fewer than 5% in 1990 to 50% in 1998. Research indicates that this trend continues with time.

What about the customer fear factor? Some consumers are just too intimidated by the system to even try it. If you don't use your ATM card, then you probably won't use a self-checkout terminal. However, sometimes the cashiers scan so fast that customers can't keep track of whether or not they're being charged accurately. Therefore, some customers, like the elderly, might be more apt to use the self-checkout terminal so they can take control of the checkout process. The U-Scan system also gives computer illiterates the opportunity to try technology without spending any money on it. Plus, the supervising attendant is available to help self-checkout novices. With the level of U.S. unemployment rates low, retailers are looking for dependable and economical alternatives to cashiers manning registers at the checkout lanes.

Grocery Store experience shows that about four U-Scan stations will handle 120 to 140 customers per hour, thus increasing throughput during peak periods. The system is also beneficial to stores that are open 24 hours, where finding cashiers to run conventional terminals at 2 a.m. is difficult. Unemployment has definitely been a motivating factor for retailers to at least try self-checkout. The labor rate has been a Trojan horse in getting retailers to make self-checkout a higher priority than they otherwise would have. With a U-Scan system, a store can reduce front-end labor costs. This benefit is another factor that has accelerated stores' adoption of the system. The four self-checkout terminals and the one supervisor station take up the same footprint as two to three conventional lanes, thereby saving space (Wolfrom 2001), yet another benefit.

According to a Channel 3000 WISCTV, (2003) technology report, the dreaded, weekly grocery-shopping trip is getting shorter for shoppers who take advantage of new technology

present at some Madison, WI, food-store locations. Several grocery, home improvement, and department stores are now allowing shoppers to scan, bag and pay for purchases all by themselves. Shoppers have probably spent many hours of their lives waiting in the checkout line at a grocery store. However, a new do-it-yourself fast lane may speed up the routine process.

Retailers believe that consumers like the self-checkout system better than the regular cashier operated system. Studies show that the self-checkout process speeds up checkout time. Nevertheless, some customers seem intimidated by the machines and sometimes may require help through the process. The problem is getting the person to use the system for the first time. Retail researchers recommend first-time scanners start with a small load. Studies have shown that many customers are amazed at how easy it is to use the new technology.

The Future of Checkout Systems

The NCR Survey carried out by the research firm IDS on the article "Study sees Growth of Self-check System" reported that about 70% of consumers in five countries including Australia would be likely to use self-checkout systems. The study involved a telephone survey of 1,000 consumers each in the U.S., UK, Germany, Italy, and Australia to ask their preference about a checkout system. The research firm, IDS, issued a note of caution in the study saying that because of a small sample size and the quantitative nature of the retailer interview, the data has not been weighted but can be used to identify emerging trends across early adopters of self-checkout systems. The study further yielded the following results: (1) Grocery Stores, hypermarkets, and department stores are the top three store formats where consumers would like to see self-checkout systems installed. (2) The top reason why retailers are implementing self-checkout systems is to improve customer service. (3) Almost 80 percent of self-checkout system implementations went at the rate expected or even faster. (4) An average of 20 percent of total

store transactions go through self-checkout systems where they are installed, with some stores seeing self-checkout volume as high as 40 percent. (5) No retailer interviewed for the study had seen an increase in shrinkage related to the installation of self-checkout systems. (5) The overwhelmingly positive response to self-checkout systems from retailers interviewed for the study combined with their expressed intentions to roll out additional systems over the next 18 months indicates an accelerated growth rate for self-checkout systems in the near term.

Fujitsu's Self-Checkout System Reduces Costs and Increases Shoppers' Convenience According to the article in Dallas's Business Wire News Wire (2003), Fujitsu Transaction Solutions Inc. and Optimal Robotics Corp (Nasdaq: OPMR) formed a partnership to develop, market and service self-checkout stations that would significantly reduce store labor costs and provide a demonstrable return on investment. The new self-checkout system is designed for retailers who want to provide business-differentiating customer service and relentlessly reduce cost at the point of sale.

Fujitsu will offer its new self-checkout system in both express and full-order configurations. It will combine Optimal's U-Scan® products with software enhancements and SmartPoS peripherals from Fujitsu that increase system availability and the retailer's return on investment. Unlike competitive offerings, Fujitsu's self-checkout system will preserve the retailer's current investment and focus new investments on adding business-differentiating functionality. In the article, Fujitsu's management focuses to relentlessly drive cost out of retailers' operations and help to improve their performance. This is a powerful value proposition for grocery retailers.

The self-checkout system will offer numerous benefits to retailers. For example, a single operator can serve four checkout lanes, reducing annual labor cost and offering customers the

privilege of being in control. Four self-checkout lanes can be installed in the space of three traditional lanes, providing an additional lane per store without reducing selling space and improving customer service by offering faster checkout at peak times. The new systems will also include developed lane management software that monitors and provides real-time store manager alerts via Internet communications to a wireless device, e-mail or mobile workstation whenever self-checkout lanes are under-used. The self-checkout will incorporate the industry's first electronic check conversion with check imaging, eliminating the need for operator intervention and according to a recent study by the Food Marketing Institute, providing savings to the retailer.

The self-checkout system will be available with an optional dual-belt take away that will allow one bagger to simultaneously serve two checkout stations or use self-checkout on high volume lanes. The SmartPoS peripherals allow retailers to increase asset utilization by monitoring self-checkout components for usage and failure conditions either internally or through a managed service organization. Asset management software automatically alerts the help desk of failures or anticipated failures to reduce system downtime eliminate store personnel involvement and reduce help desk intervention.

According to the Nashville Business Journal (2003), the annual dollar value of transactions through self-service kiosk technologies will approach $1 trillion annually in North American by 2007. A recent study from Franklin-based IHL Consulting Group states that self-service technologies are pervading all aspects of our lives in North America today. Self-checkout systems at the supermarket, ticketing kiosks for transportation and entertainment and new self-service technologies being introduced into fast food/quick service are rapidly growing

in acceptance. The growth rate is dramatically accelerating in transportation and government sectors, and in the retail industry as a way to lower transaction costs.

Managerial Decisions on POS Equipment

Managers assess that waiting time is a critical factor in customer evaluation of many store services because one of the characteristics of services is that they cannot be stored or carried in inventory and the demand cannot be predicted. Research indicates that customers for services often overestimate the time that they spend waiting in line and as the perception of waiting time increases, customer satisfaction tends to decrease. Traditionally, firms have attempted to minimize customer dissatisfaction with waiting by managing the actual wait time through operations management. However, many services are inherently prone to peak demand fluctuations, such as theme parks, restaurants, airports, super markets and retail outlets (Katz, etal 1991). The literature cited by McDonnell drew attention to the perceived differential costs to consumers and the different value of time to different consumers. An approach to enable self-scanning of items in a store was pioneered in Europe and continues to undergo trials in Australia, and the United States. Self-scanning can eliminate or reduce waiting at checkouts and gives the customer a greater sense of control of the service encounter. Managers make great efforts to include in their store's strategic planning any factors that can reduce the length of time customers' wait in line. Among these factors is the choice of checkout method.

Consumers love convenience and are drawn to outlets that can give them control and are current with technology. Merchants that had installed self-checkout technology reported that between 20% and 40% of total transaction volume in the equipped stores was going through the self-checkout terminals (Lucas 2002). Businesses that do not install self-checkout terminals find

themselves competed out of the market. One of the emerging problems with the self-checkout system is credit card fraud.

In his study, Lucas further stated that despite the impressive volume moving through self-checkout systems, there was a delay time with customers paying with credit cards. The system makes it easier for criminals to make a purchase with a stolen card since a cashier is not on duty to compare the signature on the card against that on the receipt. Some store managers typically assign approximately two employees to monitor the self-checkout areas. They recognized that the only way to speed up the process of paying with checks and credit cards in a self-service lane was to have a check truncation or check-imaging terminal built into the system. It was perceived that check truncation captured the bank routing number and account number off a blank check as it was fed into a POS terminal. Once the information is captured, it was placed on an electronic receipt along with the date, the total amount of the purchase and in some cases, a line description of each item purchased. The consumer then signed an electronic copy of the receipt just as he would a credit card receipt. This added feature helped in limiting the theft of credit cards. As the types of businesses using self-checkout terminals become broader, other issues on the horizon, include controlling the sale of restricted products to minors and preventing fraudulent purchases, could be added to the system. With the increasing comfort level of consumers with POS, technology is already prompting vendors to begin looking at ways to enhance self-checkout systems while grocery stores and retail outlet management continue to evaluate upgrade alternatives.

To further enhance customer satisfaction, management utilizes the First-in First-out (FIFO) queuing technique to guard against misuse of the system. The FIFO queuing technique ensures that customers who join the queue first have the opportunity of being served first or have

the first choice of the self-checkout machine. The FIFO queuing technique calls for strict adherence of queue discipline. Queue discipline is the rule of determining the formation of the line or queue and the sequential order in which jobs (customers' arrival and checkout) are processed. Customer satisfaction has been defined as the difference between the customer's perceptions of the experience and his or her expectations, which is often based on past experience. A customer does not like to see other customers cut line. Managers have consistently employed the FIFO queuing technique to enhance queuing discipline in store checkout lines (Ross, Westerfield, & Jordan 2000).

Summary of Literature Review

The literature reviewed in this research study unanimously agreed that time is a very significant and a critical component in a consumer decision-making process especially when evaluating his or her time spent in a store checkout service encounter. (Taylor 1994; Tom and Lucey 1995; Haynes 1990; and Hornik 1984). Researchers in the field also agreed that opportunity cost, economic cost and psychological cost are important factors that influence customers' reactions (Baker 1986; Osuna 1985; and Kocas 2000). Hui, Thakor and Gill (1998) concluded that the service stage at which a delay occurs can influence affective response perceived by a customer while waiting in a checkout line. Taylor (1994), Tom and Lucey (1995) concluded that customers' attribution to the cause of delay significantly affected their emotional reactions.

Literature reviewed in this research also indicated that queuing theory and waiting line techniques improved the way managers managed queues to reduce the length of lines in retail stores (Smith 1999). Finally, studies show that managers who incorporated queuing discipline/techniques (for example FIFO technique) in their store checkout line plans were able

to enhance their management strategies towards implementing the queuing processes (Ross, Westerfield and Jordan 2000).

The issue of improving customers' checkout process is of paramount importance to grocery stores and supermarket managers. Previous studies in the area have shown that consumer buying patterns are influenced by several factors. Among some of these important factors are the length of time the customer spends in the checkout line and a speedy/convenient easy checkout process.

The literature reviewed in this study concludes that time and convenience are among the most important factors managers should consider when selecting and implementing checkout processes for their stores. Lucas (2002) found that demand is at an all time high for POS technology that can reduce queue time and give customers convenience and control. In the attempt to meet this demand, managers in the retail industry are exploring different techniques and evaluating current technology in checkout systems to help them improve their current customer checkout process.

My interest to conduct research that compares the cashier checkout process and the electronic checkout system stems from the above research findings. Grocery store and supermarket mangers can enhance their decision-making process when deciding on which checkout system to use in their stores if they have suggestions from research studies in the area.

CHAPTER 3: METHODOLOGY

The purpose of this study is to investigate whether the electronic self-checkout system is better than the cashier operated checkout system for a store and its customers under certain market conditions. To determine how each system compares to the other, the researcher investigates what is required to implement each system and how cost effective each system is to the store management. The researcher also looks at how friendly the systems are to the customers. The comparative study between these two checkout systems evaluates such factors as: the number of items checked out by customers in each system within a specified time period and the average time it takes to check out each customer within each system. The study also evaluates factors dealing with error rates, managers' and customers' affective reactions and confidence. The study in addition, assesses and compares acquisition, implementation and operational costs for each system within the specified period of time. The data utilized in this study were gathered from sampling of customers who enter the queue, complete their checkout process, and exit the checkout line. Additional data were also generated from responses to a survey questionnaire disseminated to customers as they exit the lines. This chapter describes the sampling design, research design, survey instrument, survey hypothesis, data collection and data analysis.

Sample Design

The population for this study consists of all likely shoppers at retail stores such as Wal-Mart Super Center Stores all over the United States of America. This study is conducted in Jackson, Mississippi and the population under study comprises of all likely shoppers in the area Wal-Mart Super Center Stores. The researcher selects to conduct the study on Wal-Mart chains for the following reasons: (1) Wal-Mart is the largest retail chain in America. (2) Wal-Mart

stores are typical of all retail stores in the country. (3) Wal-Mart customers consist of a variety of shoppers across the country and are representative of the shopping public. (4) Wal-Mart attracts a diverse group of multicultural shoppers. (5) The company employees are comprised of a multicultural group of citizens. (6) It can be inferred that a probability sample of shoppers drawn from Wal-Mart stores can be used as representative of typical America retail shoppers (Fortune 2003). The stores randomly selected for the research study are the West Jackson Greenway Street Wal-Mart Super Center, Madison Wal-Mart Super Center, and Clinton Wal-Mart Super Center.

The sample frame for this study consists of all consumers shopping in the selected stores, entering the selected checkout lines, and completing the checkout of their merchandise during the survey process. To make up the two samples sets required for the study, the researcher will select 30 customers from the electronic self-checkout lane and 30 customers from the cashier checkout lane in each of the selected stores. A total of 90 consumers will be selected for each sample set (checkout system) required for the study from the three stores. The researcher will select every customer that enters the selected lanes and the required data will be generated from responses and observations gathered from the consumers in the samples. It is important to ascertain that data collected is valid and reliable and that information gathered or observed come from participants at real time. Each customer who enters the selected checkout lanes has an equal chance of being selected as part of the samples unless the individual voluntarily wants to be excluded.

A pilot test of a small sample consisting of 20 consumers will be conducted to assure that the survey instrument designed for this study is appropriate. The statistical analysis conducted on collected data will be tested using a .05 significance level to validate the research findings.

The study will investigate the following research questions: The dissertation research question is as follows: Is there a significant difference between the electronic self-checkout system and the cashier operated checkout system? The research sub questions are as follows: (1) Is there a significant difference in the number of items checked out by the two systems over a stipulated time frame? (2) Is there a significant difference in the times that it takes to check out a customer between the two systems over the specified time period? (3) Is there a significant difference in the error rates between the two systems over a stipulated time frame? (4) Is there a significant difference in the amount of operating cost between the two systems within the stipulated period of time? (5) Is there a significant difference in the level of customers' affective reactions and confidence between the two systems? (6) Is there a significant difference in managers' affective reactions and confidence between the two systems?

Research Design

This research will be a comparative study. Primary data will be gathered by the researcher with the help of three assistants. The instruments to be used for the research will consist of two stop watches, paper, pens or pencils and the survey questionnaires. The research condition will be conducive and controlled because pre-authorization will be obtained from the selected store management teams. The participating customers will be pre-informed of the simple nature of the survey and objective of the research. Participation in the study will be voluntary and participants will not be required to personally sign or complete the survey questionnaires. Questionnaires will be completed from the responses of the participants by the researcher or the assistants. The participant's privacy and safety will be maintained. Participation will be brief, with minimal interaction with participating customers.

Research Instrument

Part of data to be used in this research will be generated from a fifteen question instrument or survey questionnaire. A copy of this questionnaire is included in the Appendix of the dissertation's final draft. The questionnaire is designed by the researcher since there is no known existing survey questionnaire on this research topic. The questionnaire will be pre-tested to ascertain its validity, reliability and appropriateness.

Research Hypothesis

The following hypotheses are stated in the forms of null and alternate hypotheses: Ho1 (null hypothesis): There is no significant difference between the electronic self-checkout system and the cashier operated checkout system. Ha1 (Alternate hypothesis): There is a significant difference between the electronic self-checkout system and the cashier operated checkout system.

Sub Research Hypotheses

(1) Ho1 (null hypothesis): There is no significant difference in the average number of items checked out by the two systems over a stipulated time frame. Ha1 (alternate hypothesis): There is a significant difference in the average number of items checked out by the two systems over a stipulated time frame. (2) Ho2 (null hypothesis): There is no significant difference in the average time that it takes to check out a customer between the two systems over a specified time period. Ha2 (alternate hypothesis): There is a significant difference in the average time that it takes it takes to check out a customer between the systems over a specified time period. (3) Ho3 (null hypothesis): There is no significant difference in the error rates between the two systems over a stipulated time frame. Ha3 (alternate Hypothesis) There is a significant difference in the error rates between the two systems over a stipulated time frame.

(4) Ho4 (null hypothesis): There is no significant difference in the amount of operating cost between the two systems within the stipulated time period. Ha4 (alternate hypothesis): There is a significant difference in the amount of operating cost between the two systems within a stipulated time period. (5) Ha5 (null hypothesis): There is no significant difference in the mean customers' affective reactions and confidence between the two systems. Ha5 (alternate hypothesis): There is a significant difference in the mean customers' affective reactions and confidence between the two systems. (6) Ho6 (null hypothesis): There is no significant difference between managers' mean affective reactions and confidence between the two systems. Ha6 (alternate hypothesis) There is a significant difference between managers' mean affective reactions and confidence between the two systems.

Data Collection

Data for the study will be collected by the researcher using a survey sampling method. Additional data will be gathered using a survey questionnaire. Each customer entering the selected queues will be given a brief handout explaining the objective of the study and a request for participation. Participation is completely voluntary. Data will be collected by recording the length of time it takes to check out each customer who enters the electronic or the cashier checkout line. The recorded time is the number of minutes from the time a customer enters the line, completes the checkout process, and exits the line. In addition to these recorded times, the number of items checked out for or by each customer will be recorded. The researcher will also record the error rates for each checkout lanes. Finally, as the customer exits the line, the researcher or the assistants request the customer to respond a short questionnaire to collect information to be used in the assessment of the customer's opinion and confidence in the system selected. The same questionnaire is presented to the store managers and attendants to help with

the assessment of how the employees feel about replacing the cashier operated system with the electronic self-checkout system. The responses and data collected during the entire sampling process will be assembled, coded and analyzed using SPSS 12.0 for windows.

Data Analysis

The statistical analysis that will be conducted with data collected for this research will employ SPSS 12.0. The data collected and the six hypotheses formulated in this research will be tested and analyzed using the independent samples t-test respectively. Assessment will be made to determine if there is a difference between the two systems. A .05 level of significance will be utilized for each test to help the researcher assess the significance of the factors of interest. In addition to the statistical analysis of the hypotheses formulated, the calculated means of each system will be tested to investigate if there is a significant difference between the two systems at 5% significant level.

Chapter 4

Data Collection, Analysis and Presentation of Findings

To begin the data gathering process for this research study, a pilot study with ten shoppers was conducted at the stores in each of the shopping locations. The pilot study instrument consists of questions to help assess the appropriateness of the survey questions in the questionnaire and questions to help assess what type of demographic shoppers were expected to participate in the actual research sampling process. Results of the pilot study revealed that 97% of the survey participants thought that the questions in the survey instrument were good, appropriate, and understandable. Furthermore, the pilot study results showed that 32% of the survey participants came from suburbs outside the shopping area. The results also indicated that the survey participants came from multi-racial backgrounds and had diversified social backgrounds.

Analysis and Presentation of Findings

In this chapter, the researcher reports in a more detailed format the outcomes of the primary data gathering process. The chapter also reports the statistical analysis conducted on the data for each hypothesis formulated. Finally, the chapter presents results of the statistical analysis and findings.

The purpose of this study is to investigate whether the electronic self-checkout system is better (faster and /more efficient) than the cashier checkout system in retail stores in the Jackson, Mississippi, area. To carry out this study, the following hypotheses were formulated and tested:

Research Hypothesis, Ho1 (null hypothesis): There is no significant difference between the electronic self-checkout system and the cashier operated checkout system. Ha1 (Alternate

hypothesis): There is a significant difference between the electronic self-checkout system and the cashier operated checkout system.

Sub Research Hypotheses

(1) Ho1 (null hypothesis): There is no significant difference in the mean number of items checked out by customers in the two systems over a stipulated time frame. Ha1 (alternate hypothesis): There is a significant difference in the mean number of items checked out by customers in the two systems over a stipulated time frame. (2) Ho2 (null hypothesis): There is no significant difference in the average time that it takes to check out a customer between the two systems over a specified time period. Ha2 (alternate hypothesis): There is a significant difference in the average time that it takes to check out a customer between the systems over a specified time period. (3) Ho3 (null hypothesis): There is no significant difference in the error rates between the two systems over a stipulated time frame. Ha3 (alternate Hypothesis) There is a significant difference in the error rates between the two systems over a stipulated time frame.

(4) Ho4 (null hypothesis): There is no significant difference in the amount of operating cost between the two systems within the stipulated time period. Ha4 (alternate hypothesis): There is a significant difference in the amount of operating cost between the two systems within a stipulated time period. (5) Ha5 (null hypothesis): There is no difference in the average customers' affective reactions and confidence between the two systems. Ha5 (alternate hypothesis): There is a difference in the average customers' affective reactions and confidence between the two systems. (6) Ho6 (null hypothesis): There is no difference between the average managers' affective reactions and confidence between the two systems. Ha6 (alternate hypothesis) There is a difference between the average managers' affective reactions and confidence between the two systems.

Data Collection

To obtain the required data for the hypothesis tests, the following information gathering process and statistical descriptive processes were performed. Data collection for this study was conducted at three Wal-Mart Super Centers in the Jackson, Mississippi, shopping area. The sampling process to obtain the required data was conducted over a two week period and required four survey sampling exercises at each of the three stores to complete the process and obtain the required data. Data for 90 shoppers for the cashier checkout system and 90 shoppers for the electronic self-checkout system were collected. The number of items each shopper checked out and the length of time the shopper spent in line to complete the checkout process were also recorded.

During the process, the error rates observed for each system was also recorded. For this study the researcher expected some errors, and errors were identified when a cashier retracted a scanned item and made verifications and correction or when the attendant was asked to rectify a shopper's problem at the electronic self-checkout process. Data for the study were obtained by the researcher by random selection of a line from the cashier checkout lanes or the electronic self-checkout lanes during each visit to the stores, and based on the number of shoppers in the line, a starting point was determined. A customer was observed joining the line and his/her time of entry into the line was recorded. The time the checkout process (scanning of items) began was recorded and the number of items the shopper checked out was recorded. In addition, the time the shopper completed the checkout process and obtained his/her payment receipt was also recorded. Starting with the first customer, the researcher observed and recorded the number of items and the error rates for each customer in the line until the pre-established time had expired.

As the shoppers exited the line, the research assistant requested their participation to complete the supplemental survey questionnaire.

This process was repeated at each visit and at each store until the desired sample sizes were obtained for both systems. A total of 102 of the 180 shoppers (90 from the cashier checkout system and 90 from the electronic checkout system) who exited the checkout lanes voluntarily completed the supplemental questionnaire, thereby yielding a 57% survey response level for completion of the survey questionnaire.

Descriptive Statistics

Data collected and assembled for this study were organized according to the research questions. Tables were designed to include information and data appropriate for answering and testing each research question. The tables listed were generated from statistics resulting from computations of several descriptive statistical manipulations. Time was a major factor in this research study. The data collected on the number of items checked out by each timed shopper were coded, identified, described, analyzed using SPSS 12.0, and results were presented in Table 1-1. Also, the data collected on the length of checkout time for each of the 180 shoppers, the first 90 from the cashier checkout lanes and the second 90 from the electronic self-checkout lanes, were analyzed and results were presented Table 2-1.

Tables A-1 in the appendices presents a contingency table containing data utilized in conducting a Chi Square statistical test to investigate whether there is a significant difference in the error rates between the two systems. The result of the Chi Square test is presented in Table 3-1.

Table A-2 listed in the appendices shows data on customers' affective reaction. This table reflects participants' preferences on choice of checkout system based on how fast they

checked out their merchandise, how user friendly the system was to the shopper, and who, they felt, would benefit more from future installation of either system, the consumer or the store. The result of the statistical analysis on these data is presented in Table 4-1.

Finally, Table A-3 listed in the appendices presents data gathered on managers' affective reaction on the systems. The result of the analysis on these data is presented in Table 5-1.

Analysis and Findings

In this analysis section of the research study, the researcher decided to present the statistical tests of the research hypotheses and the results in sequence, beginning with Sub Hypothesis 1. The researcher considered this sequence necessary because conclusions from sub hypotheses 1 through 6 were considered important for drawing conclusions on the main research hypothesis.

Analysis of participants' responses to the store's supplemental survey revealed that over 78% of the shoppers surveyed indicated that they shopped at Wal-Mart stores regularly. The analysis of survey responses also revealed that about 76% of the shoppers used the same type of checkout system during their shopping trips. These percentages shown above support the appropriateness of the survey samples. About 62% of the surveyed shoppers indicated that the time a shopper expects to spend in line is a key factor in determining which checkout system to use. It was also revealed in this supplemental survey analysis and supported by previous research studies that time is an important factor consumers consider as they make decisions about which retail store in which they shop. Therefore, the length of time a shopper spent in a checkout line or how long he or she anticipates spending in a checkout line influences his or her opinion about the store.

Consumer attributions to the lengths of their waiting time in line may be numerous and varied. Nevertheless, the length of empty time a consumer spends waiting in line emerged as one of the most attributed factors influencing shoppers' behavior (Weiner, 1985; Osuna, 1985; Taylor, 1994; Bennett, 1998; Kostecki, 1996; Larson and Larson, 1991; and Hui, Thakor and Gill, 1998).

Sub Hypothesis One

Sub Hypothesis, Ho1 (null hypothesis): There is no significant difference in the average number of items checked out by customers in the two systems over a stipulated time frame. Table 1-1 summarizes the result of the statistical analysis conducted on the average number of items checked out by each customer in the two checkout systems. The result from the Levene's Test for Equality of Variances presented in Table 1-1 had a p-value of .291 which is over the established significance level of .05. This result indicated that equal variances are assumed.

The t-test for independent samples had a p-value of .829 which is well over the established significance level of .05. As a result, the null hypothesis is not rejected. The researcher could not find any significant difference between the average number of items checked out by customers in the two systems. This result is supported by the mean values of 8.74 items and 8.48 items computed respectively on the average number of items for the cashier checkout system and the electronic self-checkout system.

Table 1-1: Results on Average Number of Items Checked Out

		Levene's Test for Equality of Variances	
		F	Sig.
Number of items checked out	Equal variances assumed	1.120	.291
	Equal variances not assumed		

	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
						Lower	Upper
Resv Equal variances assumed							
Equal variances	.217	178	.829	.289	1.334	-2.344	-2.921
Not assumed	.217	178	.829	.289	1.334	-2.344	-2.921

Sub Hypotheses Two

Sub Ho2 (null hypothesis): There is no significant difference in the average time that it takes to check out a customer between the two systems over a specified time period. Table 2-1 summarizes results for the independent samples t-test conducted on the average length of check out time between the cashier checkout system and the electronic self-checkout system. The Levene's Test for Equality of Variances had a p-value of .008 which is well below the established significance level of .05; therefore, the result indicates that equal variances are not assumed. Therefore, it can be concluded that there are significant variances between the length of time it takes to checkout customers between the two systems. The independent samples t-test

conducted had a p-value of .000, which is less than the established significance level of .05. As a result, the null hypothesis is rejected, and it can be concluded that there is a significant difference between the average length of checkout time between the two checkout systems. The mean length of checkout time of 5.92 minutes for the cashier system is less than the mean length of checkout time of 11.22 minutes for the electronic self-checkout system. The mean values of checkout time for the systems show a shorter average length of checkout time for the cashier system.

Table 2-1: Results on Average Length of Checkout Time

		Levene's Test for Equality of Variances	
		F	Sig.
Length of Checkout Time	Equal variances assumed	7.233	.008
	Equal variances not assumed		

	T	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
						Lower	Upper
Resv Equal variances assumed							
Equal variances	-6.361	178	.000	-5.300	.833	-6.944	-3.656
Not assumed							
	-6.361	178	.000	-5.300	.833	-6.944	-3.656

Sub Hypothesis Three

Sub Ho3 (null hypothesis): There is no significant difference in the error rates between the two systems over a stipulated time frame. During the sampling survey process, the researcher recorded 15 errors in 787 cashier-scanned products and 50 errors in 761 items self-scanned. These data were analyzed using the Chi Square test for independence. The researcher

dichotomized the error rates using, 0 = No Error versus 1 and higher = Error to derive the 2 by 2 cross tabulation table for errors for the cashier and electronic self-checkout systems. The Chi Square test result presented in Table 3-1 had a p-value of .001 which is less than the established significance level of .05. As a result, the null hypothesis is rejected, and it can be concluded that there is a significant difference between the error rates in the cashier checkout system and the electronic self-checkout system within the stipulated time frame. The error rate of .019 in the cashier checkout system is less than the error rate of .066 in the electronic self-checkout system.

Table 3-1: Chi Square Test for Independence on Error Rates.

Cashier or Electronic System Crosstabulation

		Cashier or Electronic System		
		Casher system	Electronic system	Total
Error2	no errors	78	59	137
	Errors	12	31	43
Total		90	90	180

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	11.030[b]	1	.001		
Continuity Correction[a]	9.900	1	.002		
Likelihood Ratio	11.336	1	.001		
Fisher's Exact Test				.001	.001
Linear-by-Linear Association	10.969	1	.001		
N of Valid Cases	180				

a. Computed only for a 2x2 table

b. 0 cells (.0%) have expected count less than 5. The minimum expected count is 21. 50.

Sub Hypothesis Four

Sub Ho4 (null hypothesis): There is no significant difference in the amount of operating cost between the two systems within the stipulated time period. The researcher was unable to

collect any information related to the operating cost. In the Jackson, Mississippi, area, the use of electronic self-checkout systems is in the infancy stage of development, and very few retail stores have actually installed this system in their stores.

Sub Hypothesis Five

Sub Ho 5 (null hypothesis) states that there is no difference in the mean customers' affective reactions and confidence between the two systems. The researcher wants to test whether there is a difference in the average customers' affective reactions and confidence. Table 4-1 presents results of the analysis conducted on data gathered on customers' affective reaction and confidence. The Levine's Test for Equality of Variances had a p-value of .607, which is higher than the established significance level of .05. The result indicates that equal variances are assumed. The independent sample t-test conducted had a p-value of .071, which is over the established significance level of .05. As a result, the null hypothesis is not rejected. No significant difference was found between customers' feelings on the two systems.

Table 4-1: Customers' Affective Reactions and Confidence

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Dif-ference	Std. Error Dif-ference	95% Confidence Interval of the Difference	
									Lowe r	Upper
Responses from shoppers	Equal variances assumed	.282	.607	2.022	10	.071	22.833	11.294	-2.332	47.999
	Equal variances not assumed			2.022	10	.071	22.833	11.294	-2.565	48.232

Sub Hypothesis Six

Sub Ho 6 (null hypothesis) states that there is no difference in the mean managers' affective reactions and confidence between the two systems. Table 5-1 presents results of the analysis conducted on data gathered on managers' affective reaction and confidence. The Levine's Test for Equality of Variances had a p-value of 1.00, which is higher than the established significance level of .05. The result indicates that equal variances are assumed. Therefore, it can be concluded that there are no significant variances between how managers feel about the two systems. The independent sample test conducted had a p-value of .000, which is less than the established significance level of .05. As a result, the null hypothesis is rejected. Therefore, there is sufficient evidence to conclude that there is a difference between managers' feelings on the two systems. The average mean values calculated for the two systems showed a higher positive value for the cashier system than the electronic self-checkout system.

Table 5-1: Result of Responses from Managers

		Levene's Test for Equality of Variances	
		F	Sig.
Length of Checkout Time	Equal variances assumed	.000	1.00
	Equal variances not assumed		

	T	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
						Lower	Upper
Resv Equal variances assumed							
Equal variances	9.238	8	.000	3.200	.346	2.401	3.999
Not assumed	9.238	8	.000	3.200	.346	2.401	3.999

Research Hypothesis

Research Hypothesis, Ho1 (null hypothesis): There is no significant difference between the electronic self-checkout system and the cashier operated checkout system. In this study, the researcher formulated six sub-hypothesis to evaluate if there is a significant difference between the cashier checkout system and the electronic self-checkout system. The researcher's objective was to determine if the cashier checkout system is better (faster and/more efficient) than the electronic checkout system.

In Sub Hypothesis 1, the researcher showed that no significant difference was found between the average number of items checked out by shoppers in the two systems within the stipulated time period. In Sub Hypothesis 2, the test result showed that there is a significant difference between the average length of checkout time between the two checkout systems In Sub Hypothesis 3, the researcher concluded that there is a significant difference between the error rates in the cashier checkout system and the electronic self-checkout system within the stipulated time frame. The cashier checkout system was found to have less error rate. In Sub Hypothesis 5, the researcher found no difference in how consumers feel about the length of time they spend during the checkout process in the Jackson, Mississippi, area. Sub Hypothesis 6 showed that there is sufficient evidence to conclude that managers feel that there is a significant difference between the two systems.

Chapter 5

Summary, Conclusions, and Recommendations

In this chapter, the researcher systematically presents the results of the statistical tests and analysis conducted and shows how they support or do not support the hypotheses formulated for the research study. The purpose of this study is to investigate whether the electronic self-checkout system is better (faster and /more efficient) than the cashier checkout system in retail stores in the Jackson, Mississippi, area. To adequately conduct this research study, the following research questions were formulated and investigated. The main research question: Is there a significant difference between the electronic self-checkout system and the cashier operated checkout system? The research sub questions are as follows: (1) Is there a significant difference in the number of items customers checked out by the two systems over a stipulated time frame? (2) Is there a significant difference in the times that it takes to check out a customer between the two systems over the specified time period? (3) Is there a significant difference in the error rates between the two systems over a stipulated time frame? (4) Is there a significant difference in the amount of operating cost between the two systems within the stipulated period of time? (5) Is there a difference in the level of customers' affective reactions and confidence between the two systems? (6) Is there a difference in managers' affective reactions and confidence between the two systems?

The current competitive market and the development of a dizzying array of electronic payment technologies in recent years, however, has dramatically raised the profile of point of sales systems as key competitive weapons within the retail industry. Managers are frequently confronted with the problem of deciding whether to increase the number of cashier checkout counters or replace them with the new electronic self-checkout machines. Moreover, businesses

are very concerned about how efficiently their checkout systems work and are always in search of ways to improve them. Further, consumers want fast checkout lanes; consequently, the length of time a customer waits in line to be checked out may influence the choice of a store in which he or she shops. In this research study, the length of time a shopper spends waiting in a checkout line emerged as a prominent factor of interest. The researcher feels that the answers to the research questions would help to address some of the host of factors that can help managers decide which customer checkout system is better or best for their store and the customers.

Research shows that studies have been done in the area of how customers' time spent in waiting lines affects customers' behavior. Other studies examine factors that could cause extended waiting time in checkout lines. Also, there are limited studies on how managers choose appropriate checkout systems for their businesses. Nevertheless, the researcher was unable to find any study that compared the cashier checkout system and the electronic self-checkout system. Hkust and Hkust (2002), in their study expressed that limited research has been conducted to determine how service waits can be controlled. They suggested that, to control the time customers' wait in line, researchers must determine the factors that cause more than expected wait time in checkout lines. Some researchers argue that service waits can be controlled by two techniques: operations management or perception management (Katz, Larson, & Larson, 1991). The researcher in this study feels that retail store customers vary as do their social backgrounds, and they have complex needs and wants. Moreover, shoppers differ by demography and location. Therefore, it is obvious that shoppers in some parts of the country have more exposure to recent advancement in retail technology than do those in other areas. By conducting this research, "A Comparative Study of the Electronic Self-Checkout System and the

Cashier Operated checkout System," managers will have available some added information to help them in their decisions when choosing among checkout systems.

Research Findings

Sub Hypothesis 1: There is no significant difference in the mean number of items customers checked out by the two systems over a stipulated time frame. The result obtained from testing this hypothesis was that the null hypothesis is not rejected. The researcher could not find any significant difference between the average number of items checked out by customers in the two systems.

Sub Hypothesis 2: There is no significant difference in the average length of time it takes to checkout a customer over a specified time period. The independent samples test conduct had a p-value of .000, which is less than the established significance level of .05. Therefore, the null hypothesis is rejected, and it can be concluded that there is a significant difference between the average length of checkout time between the two systems. The test hypothesis evaluated how fast the checkout systems checked out customers surveyed during the research process. The independent samples t-test result and the statistics calculated for the mean length of checkout time of 5.92 minutes for the cashier system and the mean length of checkout time of 11.22 minutes for the electronic self-checkout system show a shorter average length of checkout time for the cashier system. Based on this test result, the researcher finds sufficient evidence to conclude that the cashier system is faster than the electronic self-checkout system in the Jackson, Mississippi, area. The researcher also felt that the result was because shoppers had more interest in learning how to manipulate the new electronic self-checkout machines than the length of time they spend waiting in the checkout lines. Consequently, they spent more time checking out their

merchandise because they were more interested in learning how to operate the new electronic self-checkout machines.

The researcher notes that there are some implications of this test result that the cashier checkout system is faster than the electronic self-checkout system in the Jackson, Mississippi, area. If a similar test is conducted in a different shopping area and under a different market condition, the result could be different. A different result is possible because consumers' shopping preferences, needs, and exposure to retail technology vary from area to area.

Sub Hypothesis 3: There is no significant difference in the error rates between the two systems over a stipulated time frame. The Chi Square test for independence conducted had a p-value of .001, which is well below the established significance level of .05; therefore, the null hypothesis was rejected. The researcher in testing for efficiency, sub hypothesis 3 test results indicated that the null hypothesis was rejected, and it was concluded that there was a significant difference in the error rates between the two systems. Furthermore, the error rate of .019 for the cashier checkout system is less than the error rate of .066 observed for the electronic self-checkout system; therefore, based on this test result, the researcher concluded that the cashier checkout system is more efficient than the electronic self-checkout system in the Jackson, Mississippi, area. The researcher notes the implication of this test result because of the unique market setting in the Jackson, Mississippi, area. Consumers in shopping areas that have longer and more experience with modern retail technology would have fewer problems using the electronic self-checkout machines, less error rates, and thereby higher efficiency ratings.

Sub Hypothesis 5: There is no difference in the average customers' affective reaction and confidence between the two systems. The independent sample t-test conducted had a p-value of .071, which is over the established significance level of .05. As a result, the null

hypothesis is not rejected. The result of the independent samples test revealed that there is no significant difference in customers' affective reaction and confidence. Consequently, no significant difference was found between customers' feelings on the two systems.

Sub Hypothesis 6: There is no difference in the average managers' affective reactions and confidence between the cashier checkout system and the electronic self-checkout system. The independent samples test conducted had a p-value of .000, which is less than the established significance level of .05. As a result, the null hypothesis is rejected. Therefore, there is sufficient evidence to conclude that there is a difference between managers' affective reactions and confidence in the two systems. The average mean values calculated for the two systems showed a higher positive value for the cashier system than the electronic self-checkout system; therefore, these statistics indicate that managers feel that there is a significant difference between the systems and would want to know these differences. The implication of this test result is that managers in other shopping areas could have different affective reactions and experiences because they would be dealing with different market environments.

Research Hypothesis: There is no significant difference between the electronic self-checkout system and the cashier operated checkout system in the retail stores, in the Jackson, Mississippi, area. The researcher was interested in investigating which checkout system is currently better (faster and/more efficient) for the stores and their customers in the Jackson, Mississippi, area. In measuring efficiency, the test result obtained from sub hypothesis 3 indicated that there was a significant difference in the error rates between the two systems. The test result also indicated that the cashier system had 15 errors, which were less than the 50 errors observed for the electronic self-checkout. Therefore, the researcher concluded that the cashier checkout system had a lower error rate than the electronic self-checkout system. The researcher,

from this result, further concluded that the cashier checkout system is currently more efficient than the electronic self-checkout system in the Jackson, Mississippi, area. Further, the result obtained from sub hypothesis two on system speed of customer checkout, the researcher concluded that the cashier checkout system is faster than the electronic self-checkout system in the Jackson, Mississippi, area.

Conclusively, the researcher inferred that test results derived from sub hypotheses two, three, and six support the evidence that there is a significant difference between the cashier checkout system and the electronic self-checkout system in the Jackson, Mississippi, area. Yet, it cannot be conclusively determined which system is better. Although, findings of this research show that the cashier checkout system is better (faster and/more efficient) than the electronic self-checkout system, the researcher notes that there is a host of other factors apart from the six factors investigated in this research study that can influence the speed and the operational efficiency of either system. Further, the researcher notes that research studies conducted in other locations, conditions and/or settings could yield different results. The results obtained from this research study can be very useful to retailers and consumers in sub urban communities and those areas that have similar market setting as Jackson, Mississippi. Further, findings of this research study can help retail store managements improve on their investigation of managers' and shoppers' affective reactions and confidence before replacing the cashier checkout system with the electronic self-checkout systems in their community.

Suggestions for Further Research

This research study was conducted in the Jackson, Mississippi, shopping area, and results may not be typical of other areas. Nevertheless, the factors that influence customers' shopping behavior investigated in this study remain universal. Since technological advancement does

reach every region or location at the same time, implementation process of a new POS technology is important. Further research on how a system is introduced to a new location is necessary, and the introduction process should be differentiated according to the needs of the consumers in the area, their social settings, economics, and demography. Further research is also recommended on how managers should determine what shopping areas will or will not benefit from the introduction of new technology. Additionally, further research is needed in areas to help managers efficiently compare cost of operations between systems.

Appendices

Table A-1: Contingency Table on System's Number of Errors

	Error	No Error	Total
Cashier Checkout System	15	772	787
Electronic Self- Checkout System	50	711	761
Total	65	1483	1548

Table A-2: Customers' Affective Reaction and confidence

Customer's Opinion	Cashier System	Self-Check System
Customer's preference of checkout system.	58.0	21.0
Customer's opinion on speed of checkout	31.0	43.0
Opinion on user friendliness to store and management	49.0	29.0
Opinion on user friendliness to consumers	21.0	51.0
Customer's preference on which system to interact with.	61.0	11.0
Shopper's opinion on number of shoppers who prefer to use the system.	82.0	10.0

Table A-3: Managers' Affective Reaction and Confidence

Manager's Response	**Codes**
5	.00
4	.00
5	.00
5	.00
4	.00
1	1.00
2	1.00
1	1.00
1	1.00
2	1.00

Supermarket Checkout System Survey Questionnaire

Please rate the following statements regarding your experience with the supermarket checkout system you use when you shop in this store.

Please make sure you rate each statement according to your level of agreement or disagreement.

To the best of your knowledge, rate each of the following statements using the scale below.

SCALE SD = Strongly Disagree
D = Disagree
N = Neutral/No Opinion
A = Agree
SA = Strongly Agree

	STATEMENT	SD	D	N	A	SA
1.	I shop at this store regularly (at least once a week).	1	2	3	4	5
2.	When I shop, I frequently use the checkout system I used today.	1	2	3	4	5
3.	How long I think I will stand in line in a store determines my choice of checkout system to use.	1	2	3	4	5
4.	Most of the time, when I shop, I prefer the cashier checkout system.	1	2	3	4	5
5.	Most of the time, when I shop, I prefer the electronic self-checkout system.	1	2	3	4	5
6.	I can checkout faster by using a self-checkout lane than by using a cashier checkout lane.	1	2	3	4	5
7.	Installing more self-checkout machines to replace the cashier checkout lanes would be better for the store management.	1	2	3	4	5

8.	Installing self-checkout machines to replace the cashier checkout system would be better for the customer.	1	2	3	4	5
9.	I enjoy the personal interaction with a cashier more than the interaction with an electronic machine.	1	2	3	4	5
10.	When I visit the store, I always find more customers in the cashier checkout lane than in the electronic checkout lane.	1	2	3	4	5

Select one of the following answers based on how the statement applies to you.

11. If I have 5 or fewer items, I would prefer to checkout with:
    (a) the cashier (b) the electronic checkout (c) either one is equally acceptable to me

12. If I have 5 to 10 items, I would prefer to checkout with:
    (a) the cashier (b) the electronic checkout (c) either one is equally acceptable to me

13. If I have 11 to 15 items, I would prefer to checkout with:
    (a) the cashier (b) the electronic checkout (c) either one is equally acceptable to me

14. If I have 16 to 20 items, I would prefer to checkout with:
    (a) the cashier (b) the electronic checkout (c) either one is equally acceptable to me

15. If I have more than 20 items, I would prefer to checkout with:
    (a) the cashier (b) the electronic checkout (c) either one is equally acceptable to me

Pilot Study Instrument

Please **rate** the questions in the attached survey questionnaire according to your overall perception of the questions indicating your rating by circling **yes** or **no** after the statements in the pilot study instrument based on your agreement or disagreement to the statements. You do not have to answer the questions in the survey questionnaire if you choose not to.

1. The questions are clear.	Yes	No
2. The questions are easy to understand.	Yes	No
3. Customers should understand the questions.	Yes	No
4. The customers in the store should understand the questions the same way when presented to them at anytime.	Yes	No
5. The questions are not too long.	Yes	No
6. The questions are not too short.	Yes	No
7. The questions are appropriate.	Yes	No
8. The questions are appropriate to seek customers' opinion about their choices toward the two checkout systems.	Yes	No
9. Are you a resident of this shopping area?	Yes	No

10 What is your highest education level completed?

A. Some High School
B. High School Diploma
C. Some College
D. College Degree
E. Graduate Degree
F. Others (identify) _____

11. Which best describes your income level?

A Less than - $15,000
B. $15,000 - $25,000
C. $ 25,000 - $35000
D. $35,000 - $45,000
E. $45,000 - $55,000
F. Over - $55,000

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