ANALYSIS OF CONGESTED CLIENTS' FLOWS IN BANKING SYSTEMS:

A CASE STUDY OF STANDARD BANK NAMIBIA

A RESEARCH THESIS SUBMITTED IN PARTIAL FULFILMENT

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ABSTRACT

As competition amongst banks increases customer service becomes the only unique factor to consider staying relevant and forging ahead in business. The most frequent complaint of customers at Standard Bank Namibia is the waiting lines. The queuing model used in the analysis was M/M/s which involved a single line with multiple servers in the system.Customer arrivals were described by a poison distribution and service times by exponential distribution. Descriptive analysis was used to describe the parameters of the queuing system, a radar chart to display the aggregate results and the one way analysis of variance (ANOVA) to establish whether there were significant differences in mean volumes of customers at various banking time periods.

The research observed a high turnout of customers at service consultants with the lowest at withdrawals/deposits. This suggests that the waiting line design of the Withdrawals/Deposits is inefficient and the researcher recommends that their servers be deployed to other queues. Another finding is the gap in service delivery because the perceptions of the delivered service were not as per the expectations of the customers. Consequently, the bank needs to defend and grow their position by offering the best client experience or expectation at the lowest possible cost.

In addition, the ease with which clients can switch to a different bank and the impact of "word of mouth" should be realized by the bank. Increasing the number of servers, managing the arrival rate, and optimizing the service rate will reduce the time of customer queuing and consequently improve the customer satisfaction rate amongst the banks clients.

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DECLARATION

I, Alexia Unotjari Katjivikua hereby declare that this study is a true reflection of my own research, and that this work, or part thereof has not been submitted for a degree in any other institutions of higher learning.

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27/03/2017

Alexia Unotjari Katjivikua   Date

DEDICATION

This thesis is dedicated to my parents, who taught me that even the largest task can be accomplished if it is done one step at a time.

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LIST OF ABBREVIATIONS

ANOVA:	One Way Analysis of Variance
SMS:	Short Message Service
ATM:	Automated Teller Machines
E- Bank:	Electronic Bank
SME Bank:	Small Medium Enterprises
FIFO:	First come first served
DSTV:	Digital Satellite Television
ICU:	Intensive care unit
LCFS:	Last-come-first served
SIRO:	Service in random order
USA:	United States of America
SERQUAL:	Service Quality
STD:	Standard Deviation
LSD:	Least Significant Difference
M/M/s :	Queuing Model
CI:	Confidence Interval

CHAPTER 1

1. ORIENTATION AND BACKGROUND TO THE STUDY

1.1 BACKGROUND

Although queuing, or taking a place in line, is rarely anyone's favourite activity, it is the cornerstone of efficiency and organization for many organisations (Feigenbaum & Media, 2015). Banking is a customer oriented business and good customer service is the key to banks growth and stability. As competition amongst banks increases customer service becomes the only unique factor to consider staying relevant and forging ahead in business. Identifying ways to improve efficiency and reduce costs without compromising the quality of service is a challenge for many financial institutions including Standard Bank Namibia.

A bank is generally understood as an institution which provides fundamental banking services such as accepting deposits, cash management services for customers, reporting transactions of their accounts and provision of loans. There are also non-banking institutions that provide certain banking services without meeting the legal definition of a bank. Banks are a subset of the financial services industry (Bannerman, 2014).

The Standard Bank of British South Africa, Limited was established and its Memorandum of Association signed in London on 13 October 1862 (Wakaba; Mihama-ku; Chiba-shi; Chiba;, 2015). It was incorporated and registered as a limited liability company on 15 October 1862.

In 1988, Standard Bank began re-establishing its African links, expanding operations in sub-Saharan Africa. Today, the Group has operations in Namibia, Lesotho, Swaziland, Botswana, Angola, Kenya, Nigeria, Uganda, the Democratic Republic of Congo, Zambia, Zimbabwe, Mozambique, Mauritius, Ghana, Tanzania, Madagascar and Malawi. It also has a presence in Russia, Brazil, Argentina and Turkey. Standard Bank has been in Namibia since 1915 when it became the first commercial bank to open a branch in Lüderitz. Throughout the years Standard Bank achieved many "firsts" including being the first bank on the diamond fields and on the Witwatersrand gold fields, the first commercial bank to launch an Automated Teller Machine (ATM) and first to establish a full electronic branch.

The most frequent complaint of customers at Standard Bank Namibia is the waiting lines. Whenever customers arrive at a rate that exceeds the processing system rate, a line or queue will form. The level of demand varies not only with the number of requests for service but how long each request takes to process and the bank's clients and management should be in a position to make choices as to where the waiting time should be spent .Consequently, such choices are enabled by the mathematical analysis and the derivation of several performance measures of queuing systems with the application of the queuing theory (Jahn, Theurl, Siebert, & Pfeiffer, 2010).

Many companies are continuously developing new and innovative approaches to reduce, and in some cases totally eliminate, customer waiting time for example banks provide 24-hour service with ATMs, hotels slide bills under guest room doors on the last night of the stay so there is no need to queue to check out at the cashier desk in the morning, and more and more restaurants are offering home delivery.

In general, there are two main types of queues, the physical queues and virtual queues. Physical queues are organized queue areas commonly found at amusement parks in which the rides have a fixed number of guests that can be served at any given time (Bannerman, 2014). (Bannerman, 2014) further enunciates that there has to be some control over additional guests who are waiting, leading to the development of formalized queue areas. In some amusement parks, queue areas are elaborately decorated, with various holding areas fostering anticipation, thus, potentially shortening the perceived wait for some people in the queue. This provides an interesting distraction to customers as they wait for their turn. There is a perception that once customers are intrigued by the huge artifacts and designs, they serve as a threshold of attraction as they wait (Bannerman, 2014).

Queueing theory embodies the full range of such models covering all perceivable systems which incorporate characteristics of a queue. The aim of the study was to review the efficiency of the queuing models in terms of utilization and waiting length and recommend modifications in the system to reduce waiting times for the clients, which should lead to an improved view of the quality of service provided. The queuing theory is a practical operations management technique that is commonly used to determine staffing, scheduling and inventory levels, and to improve customer satisfaction. An organization, such as a bank, needs to stick to its model once it's been determined that maximum efficiency can be achieved, both in labour costs and customers served.

There are two direct approaches to increasing customer satisfaction with respect to queues which is decreasing actual waiting time and managing the customer's expectations of the wait (Davis, & Heineke., n.d.)An individual's decision to wait depends upon perceptions of and expectations about the waiting experience (Maister, 1988). According to (Parasuraman, Zeithaml, Valerie & Berry, 1991) understanding customer expectations is a prerequisite for delivering superior service. Customers compare perceptions with expectations when judging a firm's service quality. Probably the most important determinant of the waiting experience is the desirability, attractiveness, or value of the goal or service that is delayed (Maister, 1984).

Since waiting in a queue may induce both negative and positive effects on people's quality perceptions of which the queue is formed, (Giebelhausen; Robinson; Cronin Jr, 2011) suggest that a better strategy for queuing management practitioners might involve improving waits. It is definitely a valuable and far sighted suggestion however; the existence of an optimal queuing wait for particular services has not been proven yet. The problem in virtually every queuing situation is a trade-off decision. The manager must weigh the added cost of providing more rapid service (i.e., more checkout counters, more production staff) against the inherent cost of waiting (Sherman, 2012).A queuing model is used to determine the main characteristics of the access of customers to banks, such as mean bank occupancy and the probability that a demand for banks is lost because all banks are occupied.

Furthermore, the (Wakaba; Mihama-ku; Chiba-shi; Chiba;, 2015) report illustrates that Standard Bank has 673 branches in South Africa and 337 in the rest of Africa. Standard Bank Namibia is the country's largest commercial bank in terms of size, measured by average total assets of approximately 32%. Commercial banks in Namibia represent 38 % of total financial assets in the country. In Namibia First National and Standard Bank, account for close to 62 percent of the total assets and close to 60 percent of total deposits and loans in the system.

1.2 STATEMENT OF THE PROBLEM

It is believed that organisations should cautiously improve its service quality to remain competitive. However, identifying ways to improve efficiency and reduce costs without compromising the quality of service is a challenge for many financial institutions including Standard Bank Namibia. Waiting times can lead to poor customer service quality and a reduced overall performance and cost-effectiveness (Lieberman, 2001).

It is not desirable to have long queues due to time and money constraints; however queues seem so alive in our day to day activities. In Namibian Banks, the existent problem of long queues causes loss of precious time, limits productivity and makes investment more tedious. In view of the vital role that banks play in the economy of a country, a slight decline in performance may largely have an adverse effect on the country‘s economy.

Queuing in banks has great negative consequences apart from leading to chaos and loss of man hours per day. (Nkrumah, 2014) opined that paying a customer does not mean giving the customer money, rather value for money. It is evident that numerous studies have been undertaken in different areas using the queuing theory but there has not been any single study about the application of queuing theory as performance management system in financial institutions in Namibia. Against this background, there is need to critically analyse the application of queuing theory for improving the flow of clients across the banking system.

1.3 AIM OF THE STUDY

The aim of the study is to investigate the congested clients' flows in banking systems at Standard Bank Namibia.

1.4 OBJECTIVES

The specific objectives are:

- To describe the queuing system at Standard Bank Namibia by defining its population, the nature of arrival, the service time and mechanism, the queuing behaviour, and the queuing discipline.
- To describe and classify the queuing models by arrival process/service, process/number of servers and determine the optimal number of servers at specific days and times.
- To perform the arrival rate analysis and service rate analysis and determine the peak usage hours.

1.5 SIGNIFICANCE OF THE STUDY

This study empirically examines the importance of application of the queuing theory to customer service in the banking industry. In financial institutions, the volume of transactions is extremely important in maximizing revenues and profitability which means queues are critical. Schulz (2015) reiterated that the cost of winning a new customer is five times more than to keep a current one and as a result it is crucial to provide a unique customer experience by proactively anticipating the needs of customers and expectations (Schulz, 2015). Subsequently, organisations need to stay on top of their queuing practices to achieve the unsurpassed results. Furthermore, this work would contribute to new knowledge in the application of the queuing theory in banking institutions.

1.6 LIMITATION OF THE STUDY

There are seven commercial banks in Namibia; however the research focused on Standard Bank Namibia Windhoek branch because of the queuing problems experienced at this branch. The study was limited to banking operations, specifically queuing systems. An opportunity exists for further research on other operations. Due to the nature of the study objective, only tellers, service consultants and customers who were making cash withdrawals and deposits, enquiries and visiting the service consultants at the time of the study were considered. The sort of transactions inside the three primary queues observed for the study was not considered, to maintain a strategic distance from communications or apparently attacking on client's security whilst doing transactions.

At the point when the first customer entered the bank and he was monitored, all other clients were disregarded unless the first one was effectively observed before the next client. This implied that clients selected had no definite pattern.In spite of these limitations, this work would provide very useful insights into the area of customer service quality and its importance to the bank.

1.7 THESIS OUTLINE

This study is in five chapters. Chapter one is the general introduction. It looks at the background to the study, the objectives of the study and the statement of the problem. It also briefly looked at the scope and limitations and organization of the study. Chapter two is the literature review. Literature is reviewed according to the research objectives used in the study. The theoretical and conceptual framework for the study is also outlined. Chapter three is the methodology. It explained the research design. It also gives details about the population, sample and sampling procedures used in the study. It explained the research instruments, methods of data collection, data analysis plan. Chapter four is the data presentation, analysis and discussion. Chapter five presents the summary, conclusions and recommendations for the study

CHAPTER 2

2. LITERATURE REVIEW

2.1 INTRODUCTION

This Chapter examines the application of queuing theory to congested client flows in banking systems. The study describes several common queuing situations and present mathematical models for analysing waiting lines following certain assumptions.

2.2 HISTORY OF QUEUING THEORY

Queuing has existed through hundreds of years and time in remembrance, yet abandons some of its methods and history more endless than the creatures of geology. It has been one of the primitive methods for advancing some genuine issues ahead of the times. The Theory of Probabilities and Telephone Conversations was the first paper on queuing hypothesis distributed by Erlang (1909), now considered the father of the field. His work with the Copenhagen Telephone Company provoked his underlying undertaking into the field. He considered the issue of choosing what number of telephone circuits was imperative to give phone advantages that would keep customers from waiting too long for an accessible circuit. In building up an answer for this issue, he started to understand that the issue of minimizing holding up time was relevant to numerous fields, and started building up the hypothesis further (Bannerman, 2014).This laid the path for modern queuing theory.

Queuing hypothesis turned into a range of research significance to mathematicians after the 1940's. The researcher, Kendall (1953) understood the GI/M/k queue and presented the advanced notation for queues, now known as Kendall's notation. On the other hand, Pollaczek (1957) concentrated on the GI/G/1 utilizing an essential condition.

2.3 DEFINITION OF QUEUING THEORY

A few definitions have been given to queues by various researchers. Waiting lines are formed whenever the current demand for a service exceeds the current capacity to provide that service (Sridhar, 1995). Jumaily & Jobori (2011) defined queueing as the process of moving customers in a specific sequence to a specific service according to the customer need.

According to Jagdish (2008), in his publication on waiting lines and queuing systems, he stated that waiting in lines may be due to overcrowded, overfilling or due to congestion. On the other hand, (Schwartz, 1978) defines a queue as a social structure consisting of elements organized in terms of priority. He further eludes that queuing is an important process that provides structural solutions to the maintenance of social order, making human relationships predictable and peaceful. As such queuing is governed by social norms that help to ensure the legitimacy of the structure and ensure equity in the allocation of services.

(Schwartz, 1978) contention, that queuing is governed by social norms, is consistent with (Heywood, 2014) definition. The informal rule of "first come, first served" is the cognitive component (Heywood, 2002) of the social norm that is widely shared and understood throughout many societies.

According to (Jagdish & Hiray, 2008) a waiting line or queuing system is defined by two important elements namely the population source of its customers and the process or service system. He pointed out that the customer population can be considered as finite or infinite. On the contrary, (Nkrumah, 2014) asserted that, the customer population is finite as the number of customers waiting in line affects potential new customers for the service system.

(Mandia, 2006) also defines queuing theory as being essentially the study of a queue through the use of mathematical modeling to evaluate the efficiency of queues. It is the basis to finding the optimal solution to queue management. More generally, queuing theory is concerned with the mathematical modeling and analysis of systems that provide service to random demands.

Consistent with Wikipedia contributors, Queuing theory is concerned with mathematical study of queues or waiting lines, formulating mathematical models of queues and measuring performance using models. Queuing theory provides tools needed for analysis on systems of congestion which appear in many diverse and complicated ways and can vary in extent and complex. This study adopts a definition of a queue as a waiting line that forms whenever current demand surpasses the existing capacity to serve.

2.4 THE APPLICATION OF QUEUING THEORY

Queues (waiting lines) are a part of everyday life. We all wait in queues to buy groceries, at the post office, to pay DSTV, to transact at the bank, petrol filing stations, at the traffic lights and so on. Queues are formed when customers (human or object) demanding service have to wait because their number surpasses the quantity of servers available; or the facility does not work efficiently or takes more than the time allocated to service a client (Branch, Agyei, Asare-darko, & Odilon, 2015).We have become accustomed to considerable amounts of waiting, but still get annoyed by unusually long waits (Frederick & Lieberman, 2001).Queuing theory became a field of applied probability and many of its results have been used in operations research, computer science, telecommunication, traffic engineering, reliability theory, just to mention some (Sztrik, n.d.).

Queuing theory applications can be discovered in many walks of life including; transportation, manufacturing, telecommunications, computer systems and more. More so, queuing theory has been used extensively in the banking industry to increase business by careful placement of merchandising materials while at the same time alleviating both the actual and perceived amount of time a customer spends waiting in line. Finally, queuing theory has been applied to computer simulation models to help with business decisions and problems. The application of basic queuing principles and models to the hospital inpatient admitting process has been studied by Green (2003). (Shmueli, Sprung, & Kaplan, 2003) used the queuing modeling to analyze the impact of various admissions policies to ICU facilities.

A study conducted by (Giglio & Green, 2005) illustrated how data analysis and queuing models can be used to identify staffing changes that can decrease the delays in being seen by a provider and, thus, the fraction of patients who leave without being seen, without necessarily increasing capacity. It also highlighted the need to classify people based on their need for immediate medical treatment as compared to their chance of benefiting from such care to maximize the number of survivors with limited medical resources.

Waiting time from the viewpoint of service industry has an effect on the number of customers that are willing to visit a particular bank. The repercussions of poorly-executed line management has noteworthy drawbacks such as the passing of a Wal-Mart employee who made national headlines because of a charge by customers on "The shopping extravaganza following Thanksgiving" in November 2008. A site or occasion with poor line management can make miserable patrons which can bring about potential lost business. Be that as it may, if these patrons 'attitudes move beyond unhappiness into anger or rage, crowd management problems could result in negative publicity or even, in extreme cases, public scenes which could bring about distress, physical threat, and claims.

(Nosek, & Wilson, 2001) stated that queuing theory utilizes mathematical models and performance measures to assess and hopefully improve the flow of customers through a queuing system. Queuing theory has many applications and has been used extensively by the service industries. Queuing theory has been used in the past to assess such things as staff schedules, working environment, productivity, customer waiting time, and customer waiting environment.

2.5 ADVANTAGES AND LIMITATIONS OF QUEUING THEORY

Queuing theory has been used for many real life applications to a great advantage. It is not possible to accurately determine the arrival and departure of customers when the number and types of facilities and requirements of the customers are not known. Queuing theory techniques, in particular, can help us to:

1. Provide models that are capable of determining arrival pattern of customers or most appropriate number of service stations.
2. Creates balance between the two opportunity costs for optimization of waiting costs and service costs.
3. Provides better understanding of waiting lines so as to develop adequate service with tolerable waiting.
4. The main limitations of queuing theory are:
5. Most of the queuing models are very complex and cannot be easily understood. The element of uncertainty exists in almost all queuing situations.
6. These uncertainties are caused by:
7. Researchers may not know the form of theoretical probability distribution which applies.
8. And might also not know the parameters of the process even when the particular distribution is known.
9. The researcher would simply only know the probability distribution of out-comes and not the distribution of actual outcomes even when (i) and (ii) are known.

10. In addition to the above complications, queue discipline may also impose certain limitations. If the assumption of "First come first served" is not a true one (and this happens in many cases) queuing analysis becomes more complex.
11. In many cases, the observed distributions of service times and time between arrivals cannot be fitted in the mathematical distributions of usually assumed in queuing models. For example, the Poisson distribution which is generally supposed to apply may not fit many business situations.
12. In multi-channel queuing, the departure from one queue often forms the arrival of another. This makes the analysis more difficult.

2.6 THE MANAGEMENT OF QUEUES

The management of queues has received increased attention recently, owing in part to the fact that speed of service has been shown to provide a firm with a competitive advantage in the marketplace. This emphasis on speed of delivery can be attributed both to the increasingly intense competition that is associated with the emergence of a single global economy and the increased criticality of time to consumers, especially in highly developed countries with high standards of living. As the standard of living in these countries increases, the value of customers' time also increases, and consequently they seek out those goods and services which will minimize the expenditure of their time (Davis & Heineke., n.d.)

The real issue in queue management is not only the actual amount of time that the customer waits in a queue, but also the customer's perception of that wait and his or her associated level of satisfaction. Providing a high level of customer satisfaction is the true objective of effective queue management. . Understanding the nature of lines or "queues" and learning how to manage them is one of the most important areas in operations management (Feigenbaum & Media, 2015).

Several studies documenting customer dissatisfaction in pharmacy practice indicates that long waiting times is a pervasive problem and cause a common source of anxiety and dissatisfaction among customers and, in many cases, pharmacists (Wilson & Nosek, 2015). Problematic queuing systems such as long lines can lead to the customer's perceptions of excessive, unfair, or unexplained waiting time resulting in significant detrimental effects on the customer's overall satisfaction with the service transaction.

There are numerous unsupported healthcare division misguided judgments about how to approach and manage queuing problems .A common argument by most researchers is that demand in general is greater than capability hence the reason for queuing. But if demand is greater than capability then the waiting list will grow open-endedly (Wilson & Nosek, 2015).

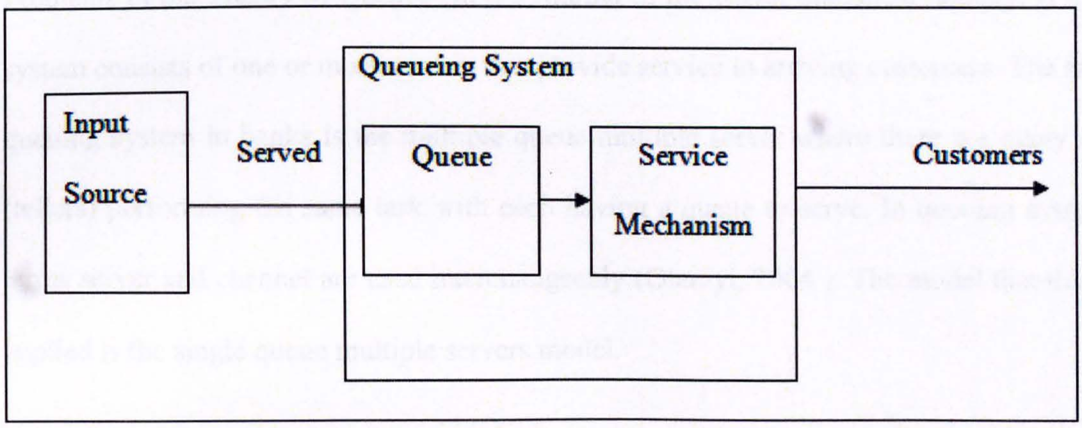
Silvester *et al.* (2004) further opined that waiting lists are relatively stable and growing waiting lists are fairly unusual in reality. Some authors believe that queues help to make certain that costly resources are fully utilized. They therefore, argue that it is beneficial from a productivity viewpoint, to have a queue. This is deemed not to be precise evaluation since patients travel through a few activities in their clinical journey where only one movement tends to be a bottleneck which governs the patient process output rate.

Another dispute is that queues discourage people from using scarce healthcare resources. In a case that queues cause medical systems to appear overburdened then it is easy to understand why numerous clinicians think that waiting lists remain their last protection from what is seen as unreasonable demands as opposed to attempting to comprehend the genuine causes behind queuing problems (Zeithaml, Bitner , Gremler, 2006). They further concluded that the most understandable and frequent approach towards dealing with waiting times is to allocate more resources. Contrary to that (Kenis, 2006) opined that adding more resources will not improve accessibility and decrease queuing but rather, a need exist to understand the mechanism behind queuing, the mismatch between capacity and demand.

2.7 BASIC STRUCTURE OF QUEUING MODELS

The basic process assumed by most queuing models starts where the input source generates the customers that enters the queuing system and joins a queue seeking service. At certain times, an individual from the queue is chosen for service by some principle known as the queue discipline. The queuing disciplines include first-come-first served (FIFO) or last-come-first served (LCFS) and service in random order (SIRO). The required service is then performed for the client by the service mechanism, after which the client leaves the queuing framework. This process is depicted in the diagram below.

Figure 2.1: The Basic Queuing Process



Source: Olaniyi (2004)

The queuing disciplines are applied using the waiting line priority rule (scheduling algorithm) to govern the order in which clients are served. Albeit each priority rule has merit, it is imperative to use the priority rule that supports the overall organization strategy better (Abedi, Mousakhani & Hamidi, 2009). For example, modern banking use rules like best customers first, high-test profit customer first, emergencies first, and so on. The priority rule used affects the performance of the waiting line system.

The sociology literature of (Schwartz, 1978) recognized that waiting lines are a social system governed by standards and guidelines such as the First in First out (FIFO) rule. He further eluded that the disruptions to the rule are caused by the pressure between social norms and economic thinking, the latter going about as a force that pushes clients to break the norms. (Schwartz, 1978) also pointed out that orderly queues do not necessarily assume consensual devotion to FIFO, but may instead give more direct expression to the mutual interest of accommodation between the more and less impatient.

The term "queuing system" was first used by Kendall (1951) in his article published "Some Problems in the Theory of Queues" in the Journal of the Royal Statistical Society. A queuing system consists of one or more servers that provide service to arriving customers. The frequent queuing system in banks is the multiple queue multiple server where there are many servers (tellers) performing the same task with each having a queue to serve. In queuing system, the terms server and channel are used interchangeably (Olaniyi, 2004). The model that this study applied is the single queue multiple servers model.

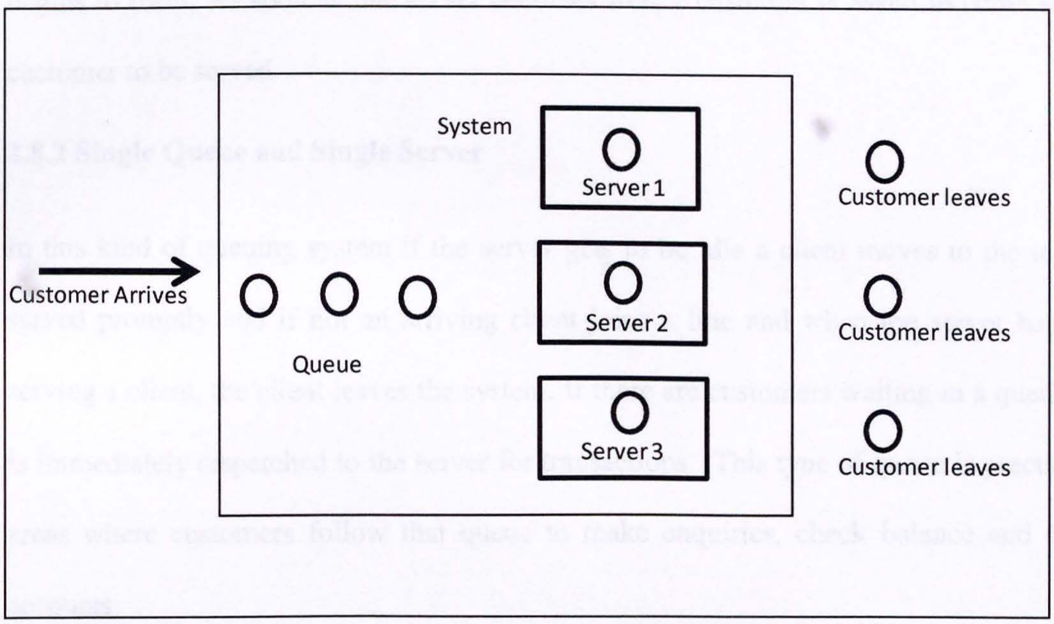
2.8 TYPES OF QUEUE MODELS

Queuing models provide researches with a powerful tool for designing and evaluating the performance of queuing systems.

2.8.1 Single Queue and Multiple Servers

This is the type of queue model practiced at Standard Bank Namibia, Windhoek branch. This type of models contains single queues with multiple servers. The research is limited to only three different single queues with multiple servers.

Figure 2.2: Single Queue Multiple Servers



Source: Olaniyi (2004)

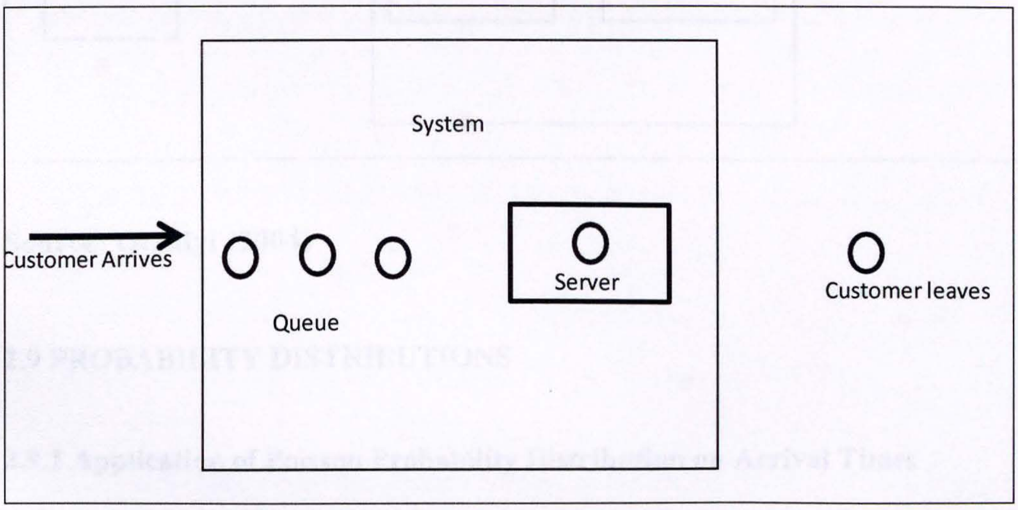
If a customer arrives and at least a teller is available, then the customer will be served immediately. This paper describes a queuing model of a single queue multiple server process which contains three main single queues with multiple servers. The bank has many different types of queues, however this research is only limited to enquiries, withdrawals/deposits and service consultants queues. At enquiries there are four servers, withdrawals and deposits have nine servers and the service consultants have four servers in terms of Queuing Theory. A queue forms whenever current demand exceeds the existing capacity to serve when each counter is so busy that arriving customers cannot receive immediate service facility. So each server process is done as a queuing model in this situation.

The queue discipline of first come first served applies to all the three queues. Some servers perform the same tasks and thus if more than one server is available, it makes no difference which server is chosen for the customer to be served. If all the servers are occupied, a queue begins to form. As soon as one server becomes free, a customer is asked to come so that the customer to be served.

2.8.2 Single Queue and Single Server

In this kind of queuing system if the server gets to be idle a client moves to the teller to be served promptly and if not an arriving client joins a line and when the server has finished serving a client, the client leaves the system. If there are customers waiting in a queue, a teller is immediately dispatched to the server for transactions. This type of queue is practices at the areas where customers follow that queue to make enquiries, check balance and open new accounts.

Figure 2.3: Single Queue Single Server



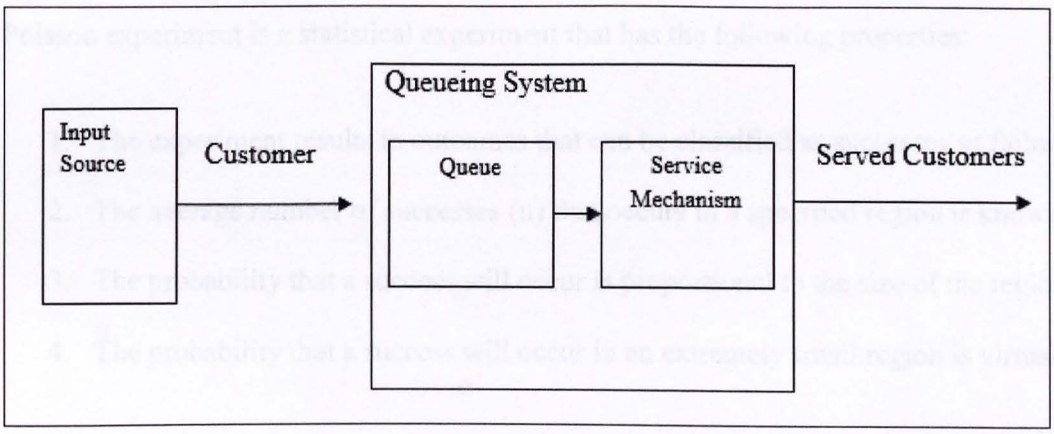
Source: Olaniyi, (2004)

This diagram depicts a single channel queue, for example all customers entering the system must pass through the one channel. When more customers arrive at the facility, it is necessary for the system to have multiple channel queues to serve the customers.

2.8.3 Multiple Queue and Multiple Servers

This model is similar to that of Single Queue Server Queue, only that there are many servers (tellers) performing the same task with each having a queue to be served.

Figure 2.4: Multiple Queue Multiple Server



Source: Olaniyi (2004)

2.9 PROBABILITY DISTRIBUTIONS

2.9.1 Application of Poisson Probability Distribution on Arrival Times

According to Kendall (1953) waiting line models assume that customers arrive according to a Poisson probability distribution. The Poisson distribution specifies the probability that a certain number of customers will arrive in a given time period. In many queuing situations the arrivals occur in a random fashion; that is, each arrival is independent of other arrivals, and one cannot predict when an arrival will occur.

In such cases, the Poisson probability distribution is used to describe the arrival pattern. The Poisson distribution with parameter λ is given by $\frac{(\lambda t)^n \ e^{-\lambda t}}{n!}$ where n is the number of arrivals. We find that if we set n = 0, the Poisson distribution gives $e^{-\lambda t}$ which is equal to P (T > t) from the exponential distribution as these two are related.

Poisson experiment is a statistical experiment that has the following properties:

1. The experiment results in outcomes that can be classified as successes or failures.
2. The average number of successes (μ) that occurs in a specified region is known.
3. The probability that a success will occur is proportional to the size of the region.
4. The probability that a success will occur in an extremely small region is virtually zero.

Note that the specified region could take many forms. For instance, it could be a length, an area, a volume, a period of time, etc.

The following notation is usually adopted for the Poisson distribution.

- *e*: A constant equal to approximately 2.71828. (Actually, *e* is the base of the natural logarithm system.)
- μ: The mean number of successes that occur in a specified region.
- *x*: The actual number of successes that occur in a specified region.

- P(x; μ): The Poisson probability that exactly x successes occur in a Poisson experiment, when the mean number of successes is μ.

Using the Kendall notation, the single-channel queuing model with Poisson arrivals and exponential service times is classified as an M/M/1 model. The two-channel queuing model with Poisson arrivals and exponential service times would be classified as an M/M/2 model.

The study will not cover the other queuing models as a result of time impediment and the similarity of the equations for the working attributes.

2.9.2 Application of Exponential Probability Distribution on Service Time

According to Kendall (1953) service times are described by an exponential distribution. The exponential distribution describes the service times as the probability that a particular service time will be less than or equal to a given amount of time. The service time is the time the customer spends at the service facility once the service has started. Service time normally varies according to the individual situations.

The exponential distribution with parameter λ is given by λe−λt for t ≥ 0. If T is a random variable that represents inter-arrival times with the exponential distribution, then $P(T \leq t) = 1 - e^{-\lambda t}$ and $P(T > t) = e^{-\lambda t}$. This distribution lends itself well to modeling customer inter arrival times or service times for a number of reasons. The first is the fact that the exponential function is a strictly decreasing function of t. This means that after an arrival has occurred, the amount of waiting time until the next arrival is more likely to be small than large (Kendall,1953).

Another important property of the exponential distribution is what is known as the no-memory property. The no-memory property suggests that the time until the next arrival will never depend on how much time has already passed. This makes intuitive sense for a model where we're measuring customer arrivals because the customers' actions are clearly independent of one another (Kendall,1953).

2.9.3 Little's Queuing

According to (Berry, 2002) , it is useful in many queues to determine various waiting times and queue sizes for particular components of the system in order to make judgments about how the system should be run. This is determined by using the little's queuing formula. The L is defined as being the average number of customers in the queue at any given moment of time assuming that the fixed-state has been reached. This is broken down into Lq the average number of customers waiting in the queue, and Ls, the average number of customers in service. Since customers in the system can only be either in the queue or in service, it goes to show that

L = Lq + Ls Likewise, W is defined as the average time a customer spends in the queuing system. That is further broken down into Wq; the average amount of time spent in the queue itself and Ws is the average amount of time spent in service. As was the similar case before,

W = Wq + Ws. Defining λ as the arrival rate into the system, that is, the number of customers arriving the system per unit of time, it can be shown that:

$L = \lambda W$

$Lq = \lambda w$

$Ls = \lambda Ws$

2.9.4 Fitting Empirical Data into Probability Distribution

In practice it often occurs that the only information of random variables that is available is their mean and standard deviation, or if one is lucky, some real data. To obtain an approximating distribution it is common to fit a phase-type distribution on the mean, E(X), and the coefficient of variation, C_X of a given positive random variable X.

2.9.5 Server Utilization Factor

Basic queuing theory assumes customer arrivals are Poisson distributed with rate λ. Service times are exponentially distributed with rate μ. The ratio λ/μ is called utilization ρ. If this ratio is greater than 1, that says customers are arriving faster than they can be served, and so the line will grow without bound. If the ratio is less than 1, the line will reach some steady state on average.

The average waiting time is $W = 1/(\mu-\lambda)$. Now assume the service time μ is fixed and the arrival rate $\lambda = \rho\mu$. Then $W = 1/\mu(1-\rho)$ and so the wait time is proportional to $1/(1-\rho)$. As the utilization ρ approaches 1, the wait time goes to infinity.

2.9.6 Application of Chi-Square Test to Assess Goodness - of - Fit

(Gosall, 2012) illustrated, by indicating that variables chi-square formula are actual concepts of observed frequency and expected frequency. The expected count from the observed count is subtracted to find the difference between the two (also called the "residual"). You calculate the square of that number to get rid of positive and negative values (for example the squares of 5 and -5 are, of course, both 25). Then, you divide the result by the expected frequency to normalize bigger and smaller counts (because we don't want a formula that will give us a bigger Chi-square value just because we are working with a bigger set of data). The huge sigma sitting in front of all that is asking for the sum of every *i* for which we calculate this relationship - in other words, you calculate this for each cell in the table, then add it all together.

Assumption for using chi-square:

- Simple random sample – The sample data is a random sampling from a fixed distribution or population where every collection of members of the population of the given sample size has an equal probability of selection. In the case of this study, customers are selected as and when they arrive in the banking hall to make their transactions
- Sample size (whole table) – A sample with a sufficiently large size is assumed. If a chi squared test is conducted on a sample with a smaller size, then the chi squared test will yield an inaccurate inference. The study used a large customer population of 650.
- Expected cell count – Adequate expected cell counts. Some require 5 or more, and others require 10 or more. A common rule is 5 or more in all cells of a 2-by-2 table, and 5 or more in 80% of cells in larger tables, but no cells with zero expected count. When this assumption is not met, Yates's Correction is applied.
- Independence – The observations are always assumed to be independent of each other. This means chi-squared cannot be used to test correlated data (like matched pairs or panel data). In those cases you might want to turn to McNamara's test.

2.10 CUSTOMER SATISFACTION AND WAITING TIME

A service is any act or performance that one party can offer to another that is basically immaterial and does not result in the ownership of anything (Kotler , 2006). Various studies has indicated that service quality is increasingly recognized as a critical factor in the success of any business(Parasuraman , Zeithaml & Berry, 1988), and the banking industry in this case is not exceptional. Given the intensity of competition today, a customer waiting too long in line is potentially a lost customer. Understanding the nature of lines or "queues" and learning how to manage them is one of the most important areas in operations management (Feigenbaum & Media, 2015).

The perception of the queuing experience is an important element of the service encounter which can often be effectively managed to increase a customer's overall satisfaction. When process analysis demonstrates that there are opportunities to shorten waits without adding costs, there is no question that in most situations shorter waits will improve satisfaction (Katz & Larson, 1991). Customer satisfaction provides the necessary link between the level of service that a firm provides, the customer's perception of that service, and the customer's future behavior towards the firm. Simply stated, a highly satisfied customer will continue to provide repeat business and perhaps even increase revenues through increased frequency of visits and positive word-of-mouth advertising which translates into increased profits.

According to (Abubakar & Mavondo, 2014), negative words-of-mouth is another negative effect of dissatisfaction. Therefore, it is important for commercial banks to ensure maximum customer satisfaction. Nevertheless, great efforts have been pursued by commercial banks to increase their service efficiency and customer satisfaction but most of them are facing a serious problem of waiting line of customers. This appears due to the low competency of the queuing system, which reflects the lack of the business philosophy of customer centric and a low service rate of the system (Kashap & Sheikh 2013).

According to Berry (2005), dominant attributes of customer satisfaction are an understanding of client financial needs, an active offer of attractive products and feeling to be appreciated in a bank. Customer satisfaction is a vital element in banks because higher customer satisfaction means lower intention for customers to switch banks.

Arguably, customers own several accounts with different banks for a reason that at any point in time even on short notices they will have a fast track service. A study conducted by (Nkrumah , 2014) revealed that there is a positive significant relationship between processor errors and queue intensity as well as the restoration time of a broken down server among banks. He further illustrates that the lengthier the time spent by the customer in a system the more his/her intention to quit the service and conclude that there is a significant positive correlation between customer cost of transaction and switching behaviour.

Chakrabarty (2006) defined four factors of customer satisfaction related with the branch (speed of service, attitude of employees, privacy, opening hours), economic satisfaction (level of charges, interest rates), satisfaction with remote access (dial-up or internet banking) and availability of ATMs.

While waiting in a service queue has been verified to have a negative effect on customer's quality perception and satisfaction of their pursued services empirically (Houston, Bettencourt, Wenger, 1998; Van Riel, Semeijn, Ribbink & Bomert-Peters, 2012) , its positive effect has also been substantially revealed by some experimental studies. An optimal queuing wait not only means a required wait which is long enough and not too long to have a positive effect on the pursued service but also simply refers to customers' well-accepted standard of a certain period of waiting time in a queue for a particular service (Yeh, Aliana & Zhang, 2012).

A customer waiting in line for service is potentially a lost customer (Sheu, Mc Haney & Babbar, 2003). As such, managers of service operations constantly strive to shorten customer waiting time during service delivery (Durrande-Moreau, 1999; Jones & Peppiatt, 1996). Firms across a variety of industries have introduced numerous peripheral service elements to the service package experience of their customers, in an attempt to shorten customer waiting times. More recently, new technology offers even more opportunities to improve service process and thus customer service in various industries. For instance, the practice of e-ticketing in the airline business has definitely made a huge impact on ticket purchasing as well as airport check-in processes (Sheu, McHaney & Babbar, 2003).

Other examples include electronic check-in and check-out systems in the hotel industry, automatic toll booths in transportation, collating copy machines, electronic funds transfer in financial services, wireless order from waiters to the kitchen in restaurants, optical checkout scanners and self-service checkout in supermarkets and telephone switching systems in communication (Haksever & Render, 2000).Waiting line models are important to a business because they directly affect customer service perception and the costs of providing service.

(Olaniyi ,2004) also argued that if the system average utilization is low, it means that the waiting line design is inefficient. Poor system design can result in over staffing. Long waits suggest a lack of concern by the organization or can be viewed as a perception of poor service quality. Queuing analysis has changed the way businesses use to run and has increased efficiency and profitability of businesses.

Research done by (AL-Jumaily & AL-Jobori, 2011) concluded that in a queue system, the balance between dealing with all customers fairly and the performance of the system is very important and acknowledged that at times the performance of the system is more important than dealing with the customers fairly.

2.10.1 Assessment of Customer Satisfaction with SERVQUAL Model

According to (Parasuraman, Zeithaml, Valerie & Berry, 1991) service quality is an accomplishment in customer service. It reflects at each service encounter. Customers form service expectations from past encounters, word of mouth and promotion. Choudhury (2013) state that customers distinguish four dimensions of service quality: behavior, reliability, tangibles and convenience. The SERVQUAL instrument consists of 22 statements for assessing consumer perceptions and expectations regarding the quality of a service. Perceived service quality results from comparisons by consumers of expectations with their perceptions of service delivered by the service providers (Zeithaml, Berry & Parasuraman, 1996).

It can be argued that the factor underpinning the delivering of good excellent service quality is exceeding the customers" expectations. (Zeithaml, Bitner & Gremler, 2006) proposed that customer expectations are beliefs about a service that serve as standards against which service delivery is judged. On the other hand (Parasuraman, Zeithaml, & Berry, 1988) opined that client desires are what the clients think a service ought to offer as opposed to what may be on offer. They identified four factors that influence customers" expectations: word-of-mouth communications; personal needs; past experience; and external communications.

A gap is created when the impression of the delivered service is not according to the desires of the customer. This gap is addressed by identifying and implementing strategies that influence perceptions, or expectations, or both (Parasuraman, Zeithaml & Berry, 1988). They expressed that SERVQUAL had been intended to be "material over a wide range of services" and the arrangement could be adjusted to fit particular needs, and that it would be most important when used to track service quality patterns occasionally. They proposed that the SERVQUAL model could be extended to measure gaps in quality and could therefore be used as a diagnostic tool to enable management to identify service quality shortfalls.

The gap score is calculated by the perception statements being deducted from the expectation statements. If any gap scores turn out to be positive then this implies that expectations are actually being exceeded. This allows service managers to review whether they need to re-deploy resources to areas of underperformance (Wisniewski, 2001).The SERVQUAL instrument ascertains the level of service quality based on the five key dimensions and also identifies where gaps in service exist and to what extent.

2.10.2 Dimensions of SERVQUAL Model

SERVQUAL scale is designed to measure service quality perceived by the respondents from five different service categories: retail banking, long-distance telephone, securities brokerage, appliance repair and maintenance firm, and credit cards, (Chen & Chang 2009). According to (Chen & Chang 2009),SERVQUAL model is based on a comparison of customer's expectations with perceptions of the service actually received. They developed SERVQUAL on a five-dimension scale which represents Tangibles, Reliability, Responsiveness, Assurance, and Empathy. The five dimension scale has been listed below;

(1) Reliability: The ability to perform the promised service dependably and accurately;

(2) Responsiveness: The willingness to help customers and provide prompt service;

(3) Assurance: The knowledge and courtesy of employees and their ability to convey trust and confidence;

(4) Empathy: The caring, individualized attention the firm provides its customers. Reliability largely concerns whether the outcome of service delivery was as promised.

CHAPTER 3

3. RESEARCH DESIGN AND METHODOLOGY

3.1 INTRODUCTION

This research methodology is the central component of the study as it presents the procedures followed by the researcher to collect, manage and analyze data. This basically comprised of the research design, the philosophical assumptions, data collection methods, sampling procedures and ethical considerations considered in this research. It was deemed appropriate to use quantitative methods of collecting data because of the objectives of this study which were:

- To describe the queuing system at Standard Bank Namibia by defining its population, the nature of arrival, the service time and mechanism, the queuing behaviour, and the queuing discipline.
- To describe and classify the queuing models by arrival process/service, process/number of servers and determine the optimal number of servers at specific days and times.
- To perform the arrival rate analysis and service rate analysis and determine the peak usage hours.

3.2 RESEARCH DESIGN

The study used the quantitative method of data collection to achieve its objectives. The research instrument was conducted through observations where observation sheets and checklists were used to collect data and included both preset questions and responses. In addition data was derived from administered questionnaires and time cards.The research method allowed the researcher to see what people do rather than relying on what people say they do.

3.3 POPULATION

The research is focused on Standard Bank Namibia in the City of Windhoek .The bank has an extensive branch network of 51 branches across the country. Within the City of Windhoek there are five branches and six agencies. The researcher will only focus on the Windhoek, main branch as this is the branch with long queues. The clients were split into three mutually exclusive subgroups namely withdrawals/deposits, enquiries and service consultants and the staff (tellers/counters, service consultants) was considered as a study population. In this study, the calling population (incoming arrivals) was infinite. The researcher considered the provision discipline as FIFO/FCFS (First come first out/First come first served).

3.4 SAMPLE & SAMPLING METHODS

(Saunders, Lewis & Thornhill, 2003) assert that sampling provides a variety of techniques that enable a researcher to reduce the data that you need to collect by examining only data from a subgroup rather than the whole population.

Random sampling will be used to ensure that all members of the population have equal chances of being selected as the starting point or initial subject.The researcher will not calculate the sample size as the calling population (incoming arrivals) will be infinite. A total sample of 285 clients was randomly selected to complete the questionnaires and 19 servers/staff members.

3.5 DATA COLLECTION & RESEARCH INSTRUMENTS

The mode by which a queue is formed and the service is provided was analyzed based on building a mathematical model and formulas representing the process of arrival of bank clients who join the queue, the rules by which they are allowed into service, and the time it takes to serve them. The model was utilized to simulate the impacts of different proposed operating strategies on the waiting times and throughput rates for customers at Standard Bank Namibia. Numerical data was collected and analyzed using statistical methods.

Only three queues were considered for the study namely enquiries, deposits/withdrawals and service consultants. A queue forms whenever current demand exceeds the existing capacity to serve when each counter is so busy that arriving customers cannot receive immediate service facility. So each server process is done as a queuing model in this situation. The observations for number of customers in a queue, their arrival-time and departure-time were taken without distracting the employees. The whole procedure of the service unit each day was observed and recorded using a time-watch during the same time period for each day for a period of three weeks. In addition, the questionnaires were handed to clients as well as to the bank servers.

3.6 VARIABLES UNDER STUDY

The key variables refer to the length of service queue or number of clients waiting in the service queue, the service channels expressed as one or more servers, daily arrival of clients at the bank, service utilization, client waiting time, number of waiting people or average over a specific period or current time, the percentage of time the server or unit is busy, the probability (% of time) system is empty, the effective arrival rate, average server utilization, number of customers in the system per specific hour or time period, waiting time in the queue, time in the system and the number of servers.

Throughout the analysis, an hour (01:00:00) will be taking as 1.00, in order to have simple average calculations. The rate of customer arrival at the banks fluctuates throughout the day and there might be differences in arrival from day to day but we assume that they are independent and identically distributed.

3.7 PROCEDURE

Customers requiring service will be generated over time by an input source. These customers enter the queuing system and join a queue. At certain times, a member of the queue will be selected for service by some rule known as the queue discipline. The required service is then performed for the customer by the service mechanism, after which the customer leaves the queuing system. The researcher will use overt observations as the basic research instrument.

3.8 DATA ANALYSIS

The researcher used the descriptive analysis to describe the parameters of the queuing system. Descriptive analysis was in the form of frequency tables, simple and multiple bar charts, and measures of centrality and dispersion. Customer service satisfaction was based on the LIBQUAL+ approach which made use of arithmetic means and standard deviations for the Minimum Required (Expectation), Desired Maximum Expectation, and Current situation to derive Service Adequacy gap Scores and Service Superiority Gap scores.

A radar chart was used to display the aggregate results. One way Analysis of Variance (ANOVA) was used to establish whether there were significant differences in mean volumes of customers at various banking time periods. Queuing models were assessed on the basis of various summary measures such as the average service utilization of servers, average number of customers in the waiting line, average number of customers in the system, probability of no customers in the queue etc.

Customer arrival and service times were tested for goodness of fit using the Kolmogorov Smirnov test. The bank has a queuing model of a single queue multiple server process which contains three main single queues with multiple servers. Although the bank has different types of queues the study only considered the three types of queues namely enquiries, withdrawals/deposits and service consultant's .The customers at Standard Bank Windhoek branch are served on a first –come, first-served (FIFO) basis as a teller becomes free. The data has been collected from the 13th day of the month until the 1st day of the next month by administering questionnaires to bank clients and servers (staff) as well as completing observation sheets.

For the analysis, unless otherwise noted, the following standard terminology and notation will be used:

State of system: number of customers in queueing system.

Queue length: number of customers waiting for service to begin or state of system *minus* number of customers being served.

$N(t)$: number of customers in queuing system at time t ($t \geq 0$).

$P_n(t)$: probability of exactly n customers in queuing system at time t, given number at time 0.

S: number of servers (parallel service channels) in queuing system.

λ_n: mean arrival rate (expected number of arrivals per unit time) of new customers when n customers are in system.

μ_n: mean service rate for overall system (expected number of customers completing service per unit time) when n customers are in system.

Note: μ_n *represents combined* rate at which all *busy* servers (those serving customers) achieve service completions.

Pn: *probability* of exactly n customers in queuing system.

L: *expected* number of customers in queueing system $= \sum nPn$.

Lq: expected queue length (excludes customers being served) $= \sum (n \_ s) Pn$

W: waiting time in system (includes service time) for each individual customer.

Wq: *waiting* time in queue (excludes service time) for each individual customer.

In all analyses, a p-value of less than 0.05 will be considered statistically significant and SPSS software will be used in all analyses.

3.9 RESEARCH ETHICS

(Saunders, Lewis & Thornhill, 2003) explained that research raised numerous ethical considerations such as plagiarism; honesty in reporting and the way people were treated. This research adhered to the informed consent and considered confidentiality and anonymity. Respect for the right to privacy among the participants and respondents were also considered.

Ethical issues were addressed by ensuring that the data collection techniques did not cause any emotional or physical harm to the respondents. Confidentially regarding details of sources was given to the targeted population as an express guarantee, in addition before interviews commenced, the researcher emphasized anonymity by assuring respondents that their names will not be mentioned in the study. The research data was kept in a lockable cabinet in the researcher's office and only the researcher will have access to the data. The data will be destructed through shredding.

CHAPTER 4

4. DATA ANALYSIS AND RESULTS

4.1 INTRODUCTION

This chapter introduces the analysis of the model and discuss the findings. The queuing model used in the analysis is M/M/s which involves a single line with multiple servers in the system.

The following assumptions are made:

- The population is infinite
- Customer arrivals are described by a Poison distribution with a mean rate of λ (lambda).This means that the time between successive customer arrivals follows an exponential distribution with an average of 1/ λ.
- The waiting line priority rule used is first-come, first served.

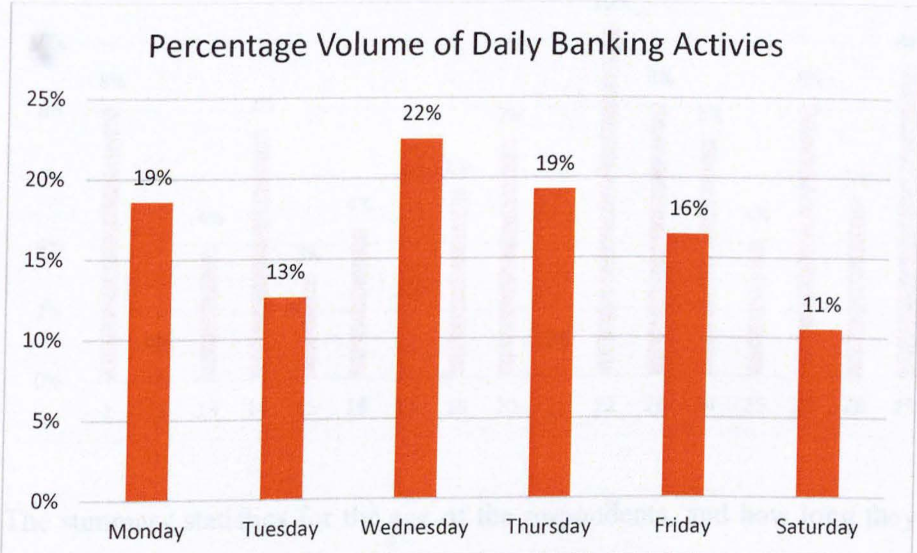
The operating characteristics of a waiting line system can be derived from using these assumptions.

4.2 DESCRIPTIVE ANALYSIS OF DATA

During the collection of the data it was found that bank clients entered the bank frequently on specific dates and less frequently on some other dates within the month. The study shows that many people visit the bank between 20th and the 1st day of the next month due to the payment of salaries and other transactions around these times of the month.

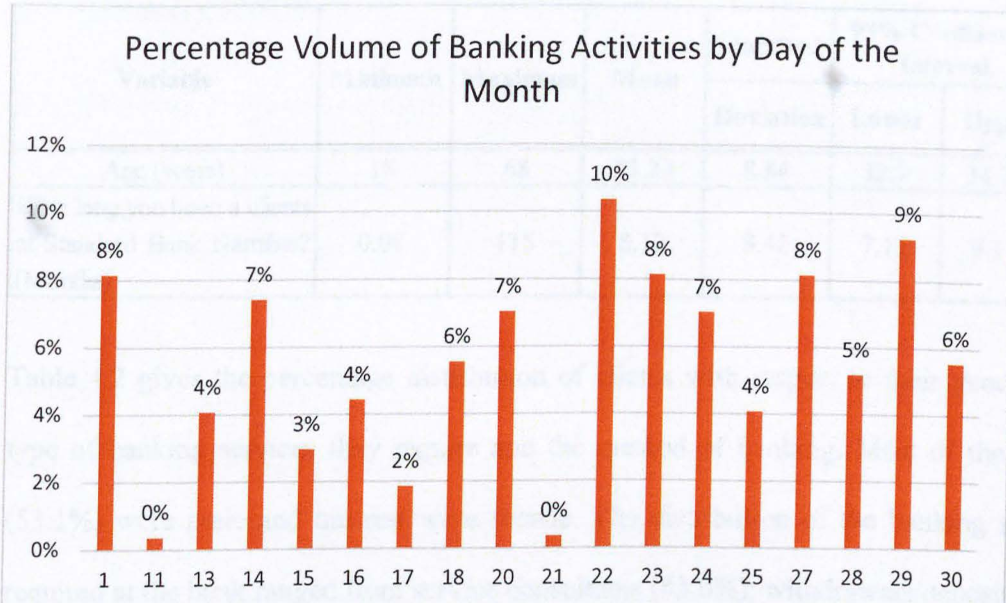
Figure 4.1 shows the percentage volumes of banking activities by day. Wednesday seems to be the busiest day (22%) followed by Monday (19%) and Thursday (19%).

Figure 4.1: Percentage Volume of Daily Banking Activities



The distribution of banking activities by day of the month is shown in Figure 2. The bar chart has a peak on the 22nd of the month but does not seem to paint a very clear pattern. Other relatively busy days include the 29th, 1st, the 23rd, and the 27th day of the month. No records were available for the 2nd to the 10th day of the month.

Figure 4.2: Percentage volume of banking activities by day of the month



The summary statistics for the age of the respondents, and how long they had been clients at Standard Bank Namibia are presented in Table 4.1. The respondents' ages ranged from 18 to 68 with a mean of 33.73 years and a standard deviation of 8.84 (95% CI: 32.70-34.76). These respondents had been clients at Standard Bank for as little as 3 weeks to as long as 115 months.

Table 4.1: Age & Time Period as Standard Bank Clients

Variable	Minimum	Maximum	Mean	Standard Deviation	95% Confidence Interval	
					Lower	Upper
Age (years)	18	68	33.73	8.84	32.7	34.76
How long you been a clients at Standard Bank Namibia? (Months)	0.08	115	8.12	8.42	7.13	9.11

Table 4.2 gives the percentage distribution of clients with respect to their gender, the daily type of banking services they require and the method of banking. Most of the respondents (53.1%) were male and the rest were female. The distribution of the banking services they required at the bank ranged from service consultants (43.0%); withdrawals/deposits (36.3%) to Enquiries (20.8%). Other than physically visiting the bank for services, most of the respondents also use internet banking (73.2%) while the remainder use cellphone banking / Blue wallet (26.8%).

Table 4.2: Distribution of Clients and Banking Services

Variable	Frequency	Percentage
Gender		
Female	134	46.9
Male	152	53.1
For what services are you visiting the bank today?		
Enquiries	59	20.8
Withdrawals/ Deposits	103	36.3
Service Consultant	122	43
What other method of banking do you make use of?		
Internet Banking	161	73.2
Cell phone Banking/ Blue wallet	59	26.8

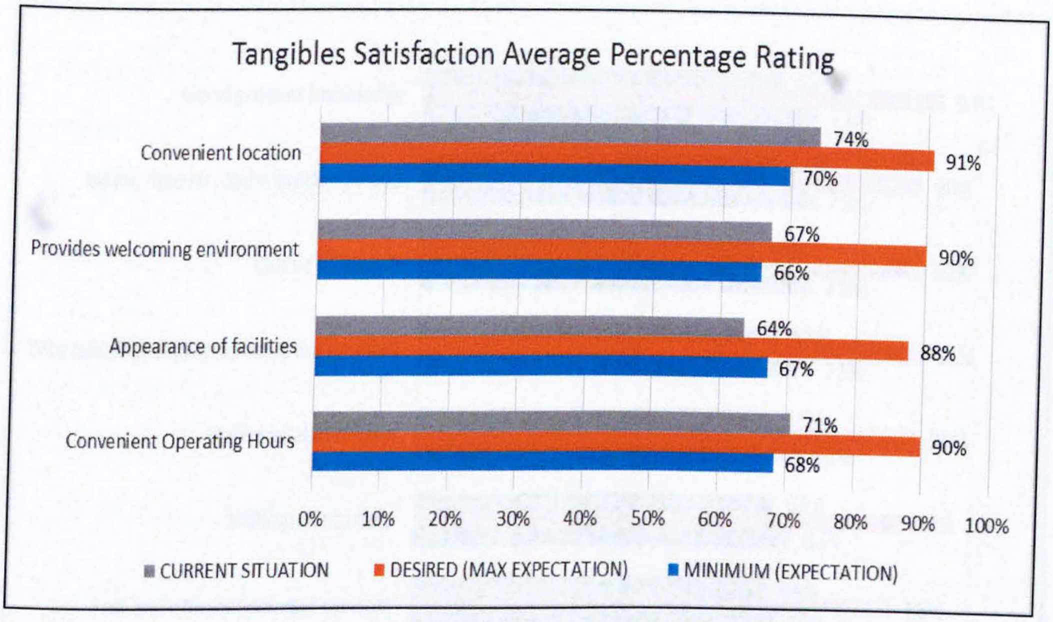
4.3 ASSESSMENT OF CLIENT SATISFACTION LEVELS

4.3.1 Summary Statistics

Average scores for minimum expectations, Desired (Maximum) Expectations and the current situation on the ground for various services dimensions such as tangibles, responsiveness, reliability, empathy and assurance are presented in the multiple bar charts in Figures 4.3 to Figure 4. 7. With regard to tangibles, all the service attributes are barely exceeding the minimum client expectations and by far fall short of the desired (maximum) level. The appearance of facilities even fails to meet the average minimum expectations rating (minimum=67%, current =64%). Chavan & Ahmad (2013) stated that the eight most important attributes of customer satisfaction of being individual attention to every customer, staff behavior leading to trust, attractive environment in a bank branch, outstation cheques free of charge, error-free records, online banking possibilities, safety of transactions, employees' willingness to answer the questions even during the busy periods.

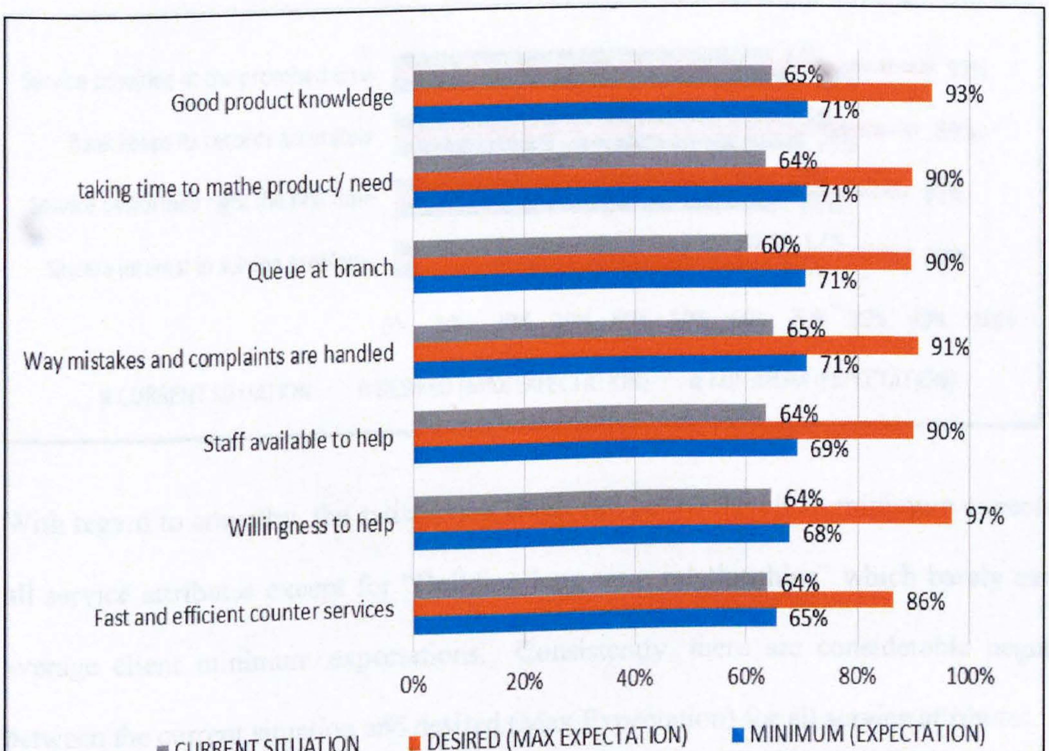
The survey of Ernst & Young (2012) indicates that banks do not really recognize customer needs and do not adjust bank products to these needs according to customer opinions. The reason to suggest so is that only 44% of respondents worldwide believe that their bank adjusts their products to their needs. The most important impulse to change the bank is the amount of charges as 53% of European clients would change their main bank precisely because of this fact. The second most important reason is bad experience in a bank's branch.

Figure 4.3: Tangibles Satisfaction Average Percentage Rating



Responsiveness satisfaction levels barely exceeded the client minimum expectations. There are considerable gaps between the current situation and desired (Max Expectation) for all service attributes.

Figure 4.4: Responsiveness Satisfaction average percentage rating

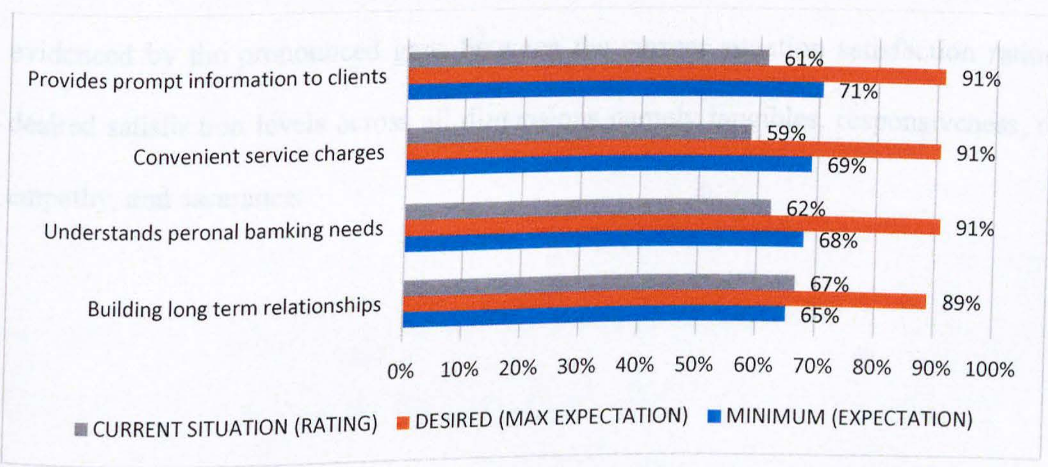


Again, on the issue of reliability, satisfaction levels barely exceeded the client minimum expectations for all service attributes except for "Service performed right the first time". For this service attribute the mean client satisfaction level for current situation even falls below the minimum expectation. Further, there are considerable negative gaps between the current situation and desired (Max Expectation) for all service attributes.

Figure 4.5: Reliability Satisfaction Average Percentage Rating

With regard to empathy, the satisfaction levels fall below the client minimum expectations for all service attributes except for "Building long term relationships" which barely exceeds the average client minimum expectations. Consistently, there are considerable negative gaps between the current situation and desired (Max Expectation) for all service attributes.

Figure 4.6: Empathy Satisfaction Average Percentage Rating



When it comes to assurance attributes, the satisfaction levels fall below the client minimum expectations for 2 out of the 3 service attributes except for "Feel safe with transactions", where average satisfaction ratings for the current situation are exactly meeting the average client minimum expectations. Consistently, there are considerable negative gaps between the current situation and desired (max expectation) for all service attributes with the client desired levels far above the current situation ratings.

Figure 4.7: Assurance Satisfaction Average Percentage Rating

Overall clients do not seem to be satisfied with the service that Standard bank is providing as evidenced by the pronounced gaps between the current situation satisfaction rating and the desired satisfaction levels across all dimensions namely tangibles, responsiveness, reliability, empathy, and assurance.

4.3.2 The LIBQual Approach to Customer Satisfaction Assessment

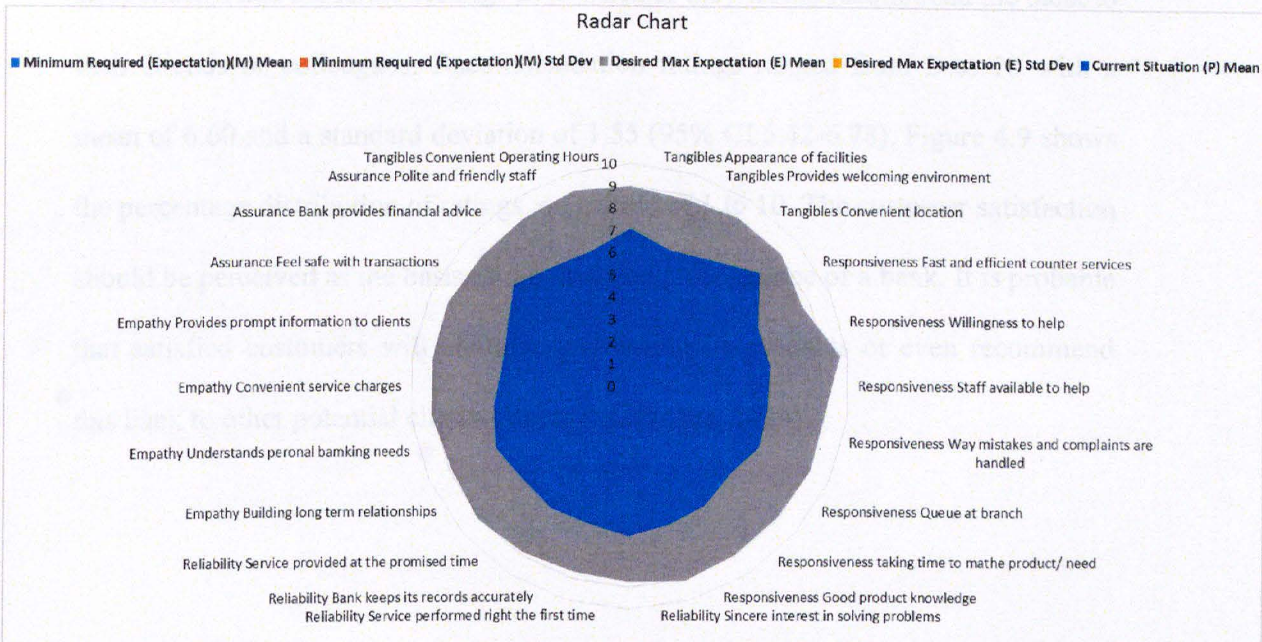
The LIBQual+ approach to customer satisfaction is used for examining gaps existing in the expectation and perceptions of customers. This gap is known as the service superiority gap. The service superiority gap is an indicator of the extent to which the bank is extending the desired expectations of its users. These gaps are calculated by subtracting the perceived value of service (P) – Expected value of service (E).

The negative results indicate the room for improvement, whereas positive results indicate the service is good and beyond the expectations of users. It means the Higher the score, the higher the perception of quality. The Service Adequacy Gap Score is calculated by subtracting the minimum score (M) from the perceived score (P) on any given attribute for each customer. In general, service adequacy is an indicator of the extent to which the bank is meeting the minimum expectations of its customers. A negative adequacy gap score indicates that the customers' perceived level of service quality is below their minimum level of service quality.

The means and standard deviations of the Service Superiority Gap Scores and Service Adequacy Gap Scores for Standard Bank are indicated in Appendix B. With regard to the Service Adequacy Gap, most scores except for "Convenient Operating Hours"," Convenient location", "Sincere interest in solving problems", "Building long term relationships" and "Feel safe with transactions" have negative scores. This indicates that the bank is generally failing to meet most of the minimum expectations of its customers. All Service Superiority Gap Scores are negative. These negative results indicate that the bank has failed to meet the customers' desired expectation and there is a lot of room for improvement and are also summarized by the radar chart (Figure 4.8).

Figure 4.8: Radar Chart for Customer Satisfaction at Standard Bank Namibia

Figure 4.8: Radar Chart for Customer Satisfaction at Standard Bank Namibia

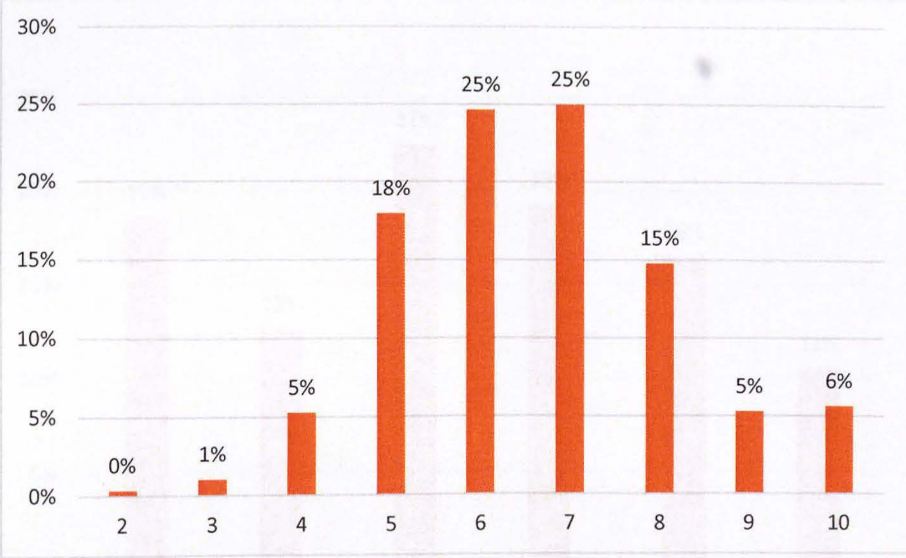


The radar chart or "spider chart" displays the aggregate results to show the several factors related to each dimension. Variations in the data are shown by the distance from the center of the chart. Lines connect the data points for each series forming a spiral around the center. Points close to the center indicate low values, while points near the edge indicate a high value.

4.3.3 Recommendation of Standard Bank to Others

Respondents had moderate feelings as to whether they would recommend the bank to their friends or colleugues. Recommendation ratings ranged from 2 to 10 with a mean of 6.60 and a standard deviation of 1.55 (95% CI:6.42-6.78). Figure 4.9 shows the percentage distribution of ratings on a scale of 1 to 10. The customer satisfaction should be perceived as the basis of the financial performance of a bank. It is probable that satisfied customers will continue purchasing its products or even recommend this bank to other potential clients (Belas & Gabcova, 2014).

Figure 4.9: Recommendation of Standard Bank to Others



4.4 DESCRIPTIVE ANALYSIS FROM THE OBSERVATION SHEET

From the observation sheets, the distribution of banking activities by day of the week was as follows: Monday (27%), Tuesday (15%), Wednesday (24%), Thursday (15%), Friday (12%) and Saturday (6%). The busiest days were Mondays and Wednesdays.

Figure 4.10: Percentage Distribution of Banking Activities by Day of the Week

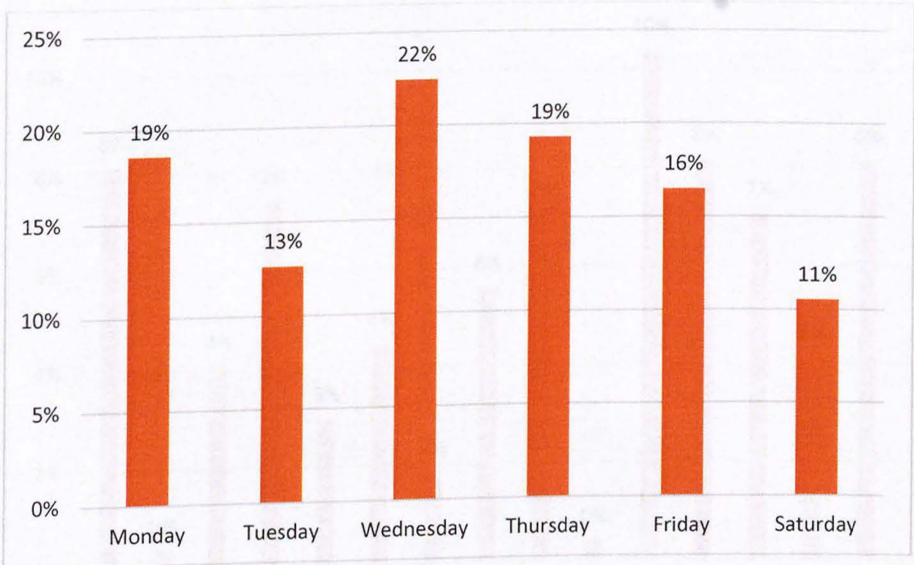
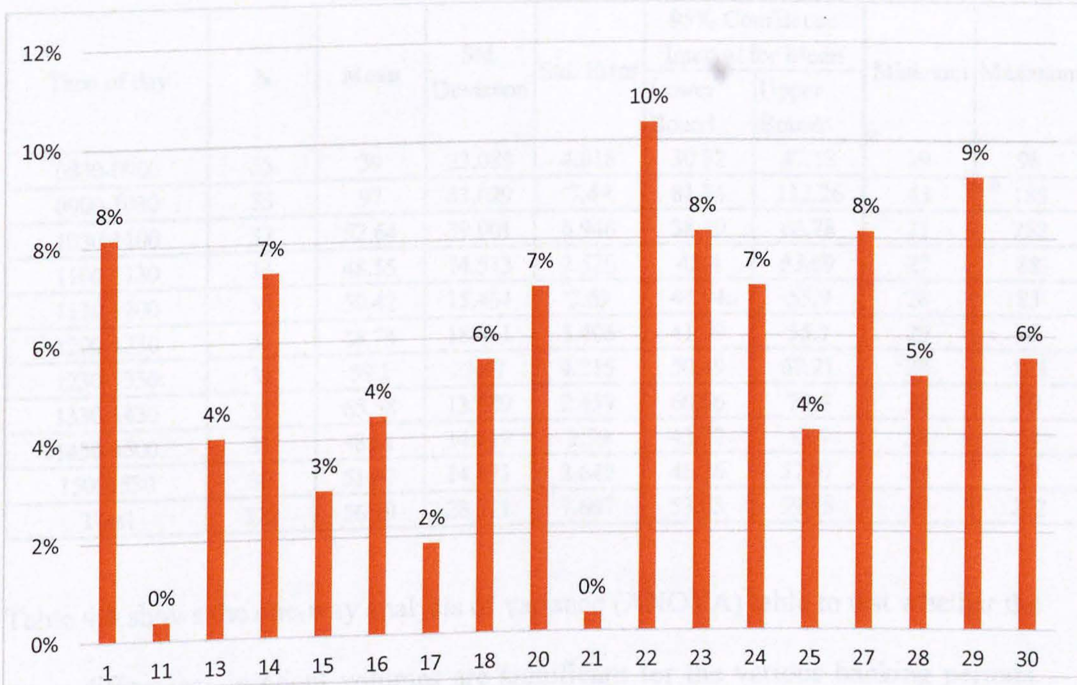


Figure 4.11 shows the distribution of banking activities by day of the month. The highest activity levels were observed on the 20^{th}, 22^{nd}, 23^{rd}, 24^{th}, 28^{th}, and 29^{th} days of the month.

Figure 4.11: Distribution of Banking Activities by Day of the Month



4.5 ANALYSIS OF BANK OPERATING PERIODS

The descriptive summary statistics of the number of clients served daily during the indicated time periods are presented in Table 4.3. The highest number of clients is observed during the time period 0930-1030.

Table 4.3: Descriptive Statistics Number of Clients at Specific Time Slots

Time of day	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
0830-0900	33	39	23.083	4.018	30.82	47.18	19	98
0900-1030	33	97	43.029	7.49	81.74	112.26	45	185
1030-1100	33	52.64	39.901	6.946	38.49	66.78	21	252
1100-1130	33	48.55	14.513	2.526	43.4	53.69	27	88
1130-1200	33	50.42	15.454	2.69	44.94	55.9	28	83
1200-1230	31	48.74	18.961	3.406	41.79	55.7	29	89
1230-1330	31	59.1	23.47	4.215	50.49	67.71	28	123
1330-1430	31	65.58	13.689	2.459	60.56	70.6	38	90
1430-1500	31	48.61	14.419	2.59	43.32	53.9	28	74
15001530	30	51.67	14.471	2.642	46.26	57.07	29	79
Total	319	56.19	28.711	1.607	53.03	59.35	19	252

Table 4.4 shows the one-way analysis of variance (ANOVA) table to test whether the mean differences in client volumes are significant for the various banking periods. Results indicate that the mean client volumes are different for at least one of the banking periods ($F=13.828$, $p<0.001$). The null hypothesis is rejected if the p-value is less than a predetermined level, α. α is called the significance level, and is the probability of rejecting the null hypothesis given that it is true (a type I error). It is usually set at or below 5% as was done in this study. It can also be set at 1%, 10% etc. and the null hypothesis was tested accordingly.

Table 4.4: Analysis of Variance (ANOVA)

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	75262.621	9	8362.51	13.828	0.0000
Within Groups	186868.09	309	604.751		
Total	262130.72	318			

Analysis of variance (ANOVA) is a collection of statistical models used to analyze the differences among group means and their associated procedures (such as "variation" among and between groups). The one-way ANOVA is used to determine whether there are any statistically significant differences between the means of three or more independent groups. It compares the means between the groups you are interested in and determines whether any of those means are statistically significantly different from each other. Specifically, it tests the null hypothesis:

$$H_O: \mu_1 = \mu_2 = \mu_3 = \cdots = \mu_k$$

where μ = group mean and k = number of groups. If, however, the one-way ANOVA returns a statistically significant result, we accept the alternative hypothesis (H_A), which is that there are at least two group means that are statistically significantly different from each other. In the ANOVA setting, the observed variance in a particular variable is partitioned into components attributable to different sources of variation. In its simplest form, ANOVA provides a statistical test of whether or not the means of several groups are equal, and therefore generalizes the t-test to more than two groups. ANOVAs are useful for comparing (testing) three or more means (groups or variables) for statistical significance. The one-way ANOVA is an omnibus test statistic and cannot tell you which specific groups were statistically significantly different from each other only that at least two groups were. To determine which specific groups differed from each other, a post hoc test needs to be used.

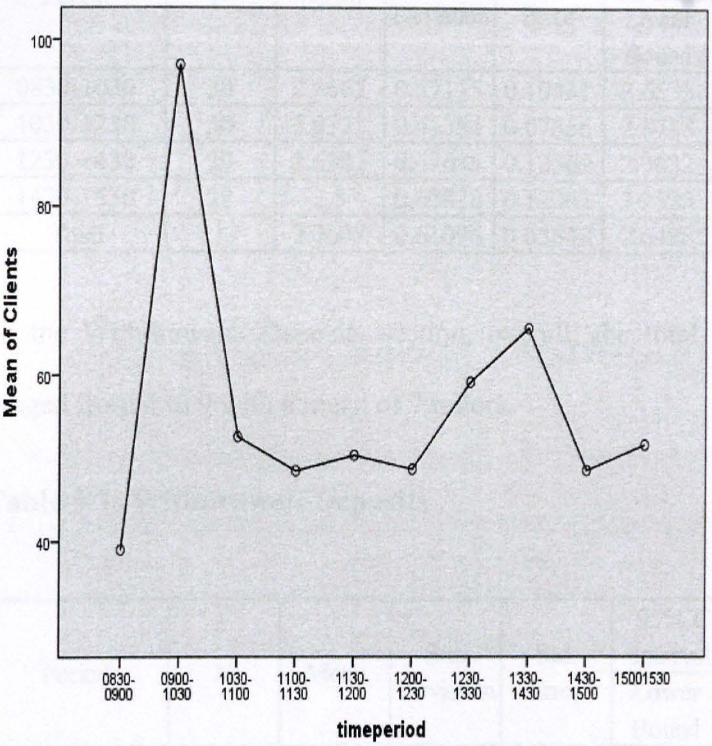
Post-hoc tests to assess which means in particular are different for combinations of pairs of banking periods based on the LSD were carried out. The detailed post-hoc Multiple Comparisons table is given in Appendix A. The means plot is presented in Figure 4.12. Results indicate that, compared to all other time periods, client volumes are significantly higher during period 0930-1030 and to a lesser extend during period 1330-1430 at 5% level of significance. Period combinations with significant differences in mean client volumes are summarized in Table 4.5. This also clearly evident in the means plot (Figure 4.12) where considerable peaks were observed at period 0930-1030 and period 1330-1430.

Table 4.5: Bank Operating Periods with Significant Differences in Mean Client Volumes

Period	0830-0900	0900-1030	1030-1100	1100-1130	1130-1200	1200-1230	1230-1330	1330-1430	1430-1500	1500-1530
0830-0900	na	***	*				**	***		*
0900-1030		na	***	***	***	***	***	***	***	***
1030-1100			na					*		
1100-1130				na				**		
1130-1200					na			*		
1200-1230						na		**		
1230-1330							na			
1330-1430								na	**	*
1430-1500									Na	
1500-1530										na

*p<0.05, **p<0.01, ***p<0.001

Figure 4.12: Means Plots of Number of Clients per Period



4.6 ANALYSIS OF OPERATING COUNTERS

Table 4.6, Table 4.7 and Table 4.8 show the descriptive summary statistics for the total number of servers/tellers operational at the three counters namely Enquiries, Deposits/Withdrawals, and Service consultants during the time periods 0830-1030, 1030-1230, 1230-1330, and 1330 -1430. At the Enquiries counter, the total number of servers/tellers ranged from 2 to 4 with a mean of 3.

Table 4.6: Enquiries

Period	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
0830-1030	30	2.8667	0.57135	0.10431	2.6533	3.08	2	4
1030-1230	30	3.0333	0.41384	0.07556	2.8788	3.1879	2	4
1230-1430	29	2.6207	0.67685	0.12569	2.3632	2.8782	2	4
1430-1530	28	2.5	0.63828	0.12062	2.2525	2.7475	2	4
Total	117	2.7607	0.61096	0.05648	2.6488	2.8726	2	4

At the Withdrawals/ Deposits section, overall, the total number of servers/tellers ranged from 4 to 9 with a mean of 7 tellers.

Table 4.7: Withdrawal/ Deposits

Period	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
0830-1030	30	7.0333	0.88992	0.16248	6.701	7.3656	5	8
1030-1230	30	6.3333	1.56102	0.285	5.7504	6.9162	4	9
1230-1430	29	6.6897	1.13715	0.21116	6.2571	7.1222	5	9
1430-1530	28	7.25	0.96705	0.18276	6.875	7.625	6	9
Total	117	6.8205	1.20784	0.11167	6.5993	7.0417	4	9

At the Service Consultants section, overall, the total number of servers/tellers ranged from 2 to 4 with a mean of 3 tellers.

Table 4.8: Consultants

Period	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Min	Max
					Lower Bound	Upper Bound		
0830-1030	30	3.0333	0.61495	0.11227	2.8037	3.263	2	4
1030-1230	30	2.9667	0.66868	0.12208	2.717	3.2164	2	4
1230-1430	29	2.7241	0.45486	0.08447	2.5511	2.8972	2	3
1430-1530	28	2.7857	0.41786	0.07897	2.6237	2.9477	2	3
Total	117	2.8803	0.55959	0.05173	2.7779	2.9828	2	4

4.7 ASSESSMENT OF THE QUEUING MODELS AT COUNTERS

From the observation sheets (monitoring of customer arrivals, waiting time, service time and departure times to the nearest whole number), the arrival rates (in number of customers per hour) were as follows: Withdrawals and Deposits (14), Service consultants (13) and Enquiries (16). The average service rates (number of customers/per hour) were 10, 4, and 5 respectively. This information, together with the associated models and assumptions for the three counters are summarized in Table 4.9. To assess the performance levels of the queuing systems at the three sections, summary measures of the models were computed.

Table 4.9: Queuing Models for Withdrawals and Deposits; Service Consultants; and Enquiries Counters

Queue Characteristic	Withdrawals/ Deposits	Service Consultants	Enquiries
Arrival Distribution	Poisson	Poisson	Poisson
Arrival Rate (per hour)	14	13	16
Service Time Distribution	Exponential	Exponential	Exponential
Service rate (per Hour)	10	4	5
Servers Type	Multiple	Multiple	Multiple
Number of servers	9	4	4
Population	Infinite	Infinite	Infinite
Queue Discipline	First Come First Served(FCFS)	First Come First Served(FCFS)	First Come First Served(FCFS)

Table 4.10 shows the results of goodness of fit tests for the hypothesized arrivals and service times. The Poisson process is one of the most important random processes in probability theory. It is widely used to model random points in time and space, such as the times of radioactive emissions, the arrival times of customers at a service center, and the positions of flaws in a piece of material. Several important probability distributions arise naturally from the Poisson process such as the Poisson distribution, the exponential distribution, and the gamma distribution. The process has a beautiful mathematical structure, and is used as a foundation for building a number of other, more complicated random processes.

Table 4.10: Kolmogorov Smirnov Goodness of Fit Tests for the Hypothesized Arrivals and Service Times

Variable	Hypothesized distribution	Kolmogorov Smirnov z Test Statistic	p-value
Withdrawal/Deposits Arrivals	Poisson	0.622	0.834
Enquiries Arrivals	Poisson	1.142	0.147
Service Consultant Arrivals	Poisson	0.769	0.595
Withdrawal/Deposits service times	Exponential	0.942	0.338
Enquiries Service times	Exponential	1.357	0.05
Service Consultant Service Times	Exponential	1.096	0.181

At 5% level of significance we fail to reject the null hypotheses that waiting times belong to the Poisson distribution and service times are exponentially distributed.

The summary measures of the analysis of the Withdrawals and Deposits queuing system are presented in Table 4.11. Results indicate that the average service utilization of the server is 15.6%. The average number of customers in the queue is 0. The average number of customers in the system is 1.4 (one customer). The average waiting time in the queue is 0 hours, while the average time waiting in the system is 0.1 hours (i.e. 6 minutes). The probability of an empty system is 0.246. The percentage of customers who wait in the queue is 0% (i.e. the percentage who do not wait in the queue is 100%).

Table 4.11: Analysis of the Withdrawals and Deposits Queuing System

Model for Widrawals and Deposits :			
Multiple servers, Infinite population, Poisson arrival, FCFS, Exponential service time, Unlimited waiting room			
Yellow cells need user inputed values			
Inputs			
Unit of time	hour		
Arrival rate (lambda)	14	customers per	hour
Service rate (mu)	10	customers per	hour
Number of identical servers (s)	9	servers	
Outputs			
Direct outputs from inputs			
Mean time between arrivals	0.071	hour	
Mean time per service	0.1	hour	
Traffic intensity	0.155555556		
Summary measures			
Average utilization rate of server	15.6%		
Average number of customers waiting in line (Lq)	0.00000	customers	
Average number of customers in system (L)	1.40000	customers	
Average time waiting in line (Wq)	0.00000	hour	
Average time in system (W)	0.10000	hour	
Probability of no customers in system (P0)	0.24660	(this is the probability of empty system)	
Probability that all servers are busy	0.0%	(this is also the "percentage who wait in queue")	
Probability that at least one server is idle	100.0%	(this is also the "percentage who don't wait in queue")	
Distribution of number of customers in system			
n (customers)	P(n in system)		
1	0.345236		
Distribution of time in queue			
t (time in queue)	P(wait > t)		
0.333333333	0.000000		

The summary measures of the analysis of the Service consultants queuing system are presented in Table 4.12. Results indicate that the average service utilization of the server is 81.3%. The average number of customers in the queue is 2.7 (about 3 customers). The average number of customers in the system is 5.9 (about 6 customers). The average waiting time in the queue is 0.21 hours (about 12.6 minutes), while the average time waiting in the system is 0.46 hours (i.e. 27.6minutes). The probability of an empty system is 0.025. The percentage of customers who wait in the queue is 61.9%.

Table 4.12: Analysis of the Consultants Queueing System

Queuing Model for Consultants :			
Multiple servers, Infinite population, Poisson arrival, FCFS, Exponential service time, Unlimited waiting room			
Yellow cells need user inputed values			
Inputs			
Unit of time	hour		
Arrival rate (lambda)	13	customers per	hour
Service rate (mu)	4	customers per	hour
Number of identical servers (s)	4	servers	
Outputs			
Direct outputs from inputs			
Mean time between arrivals	0.077	hour	
Mean time per service	0.25	hour	
Traffic intensity	0.8125		
Summary measures			
Average utilization rate of server	81.3%		
Average number of customers waiting in line (Lq)	2.68283	customers	
Average number of customers in system (L)	5.93283	customers	
Average time waiting in line (Wq)	0.20637	hour	
Average time in system (W)	0.45637	hour	
Probability of no customers in system (P0)	0.02497	(this is the probability of empty system)	
Probability that all servers are busy	61.9%	(this is also the "percentage who wait in queue")	
Probability that at least one server is idle	38.1%	(this is also the "percentage who don't wait in queue")	
Distribution of number of customers in system			
n (customers)	P(n in system)		
1	0.081158		
Distribution of time in queue			
t (time in queue)	P(wait > t)		
0.333333333	0.227760		

The summary measures of the analysis of the Enquiries queuing system are presented in Table 4.13. Results indicate that the average service utilization of the server is 80.0%. The average number of customers in the queue is 2.4 (about 2 customers). The average number of customers in the system is 5.6 (about 6 customers). The average waiting time in the queue is 0.15 hours (about 9 minutes), while the average time waiting in the system is 0.35 hours (i.e. 21 minutes). The probability of an empty system is 0.027. The percentage of customers who wait in the queue is 59.6%.

Table 4.13: Analysis of the Enquires Queuing System

Queuing Model for Enquiries:			
Multiple servers, Infinite population, Poisson arrival, FCFS, Exponential service time, Unlimited waiting room			
Yellow cells need user inputed values			
Inputs			
Unit of time	hour		
Arrival rate (lambda)	16	customers per	hour
Service rate (mu)	5	customers per	hour
Number of identical servers (s)	4	servers	
Outputs			
Direct outputs from inputs			
Mean time between arrivals	0.063	hour	
Mean time per service	0.2	hour	
Traffic intensity	0.8		
Summary measures			
Average utilization rate of server	80.0%		
Average number of customers waiting in line (Lq)	2.38573	customers	
Average number of customers in system (L)	5.58573	customers	
Average time waiting in line (Wq)	0.14911	hour	
Average time in system (W)	0.34911	hour	
Probability of no customers in system (P0)	0.02730	(this is the probability of empty system)	
Probability that all servers are busy	59.6%	(this is also the "percentage who wait in queue")	
Probability that at least one server is idle	40.4%	(this is also the "percentage who don't wait in queue")	
Distribution of number of customers in system			
n (customers)	P(n in system)		
1	0.087368		
Distribution of time in queue			
t (time in queue)	P(wait > t)		
0.333333333	0.157218		

4.8 DESCRIPTIVE ANALYSIS OF SERVERS DATA

The sample of 19 servers comprised 63% female with the rest being male. Their distribution by current work station was Enquiries teller (50%), withdrawal/deposits (44.4%) and service consultants (5.6%). With regard to their highest educational level, the majority had completed Grade 12 (63.2%), 21% had completed a Diploma while the remaining 15.8% were degreed. Their ages ranged from 18 to 28 years with a mean of 24 and a standard deviation of 3.07 years (95% CI: 22.52-25.48). They had worked for the bank for periods ranging from 0.25 (one week) to 60 months (5 years) with a mean of 19 months and a standard deviation of 17.06 months (95% CI: 10.79-27.24).

4.9 RESULTS SUMMARY

The study shows that many people visit the bank between 20^{th} and the 1^{st} day of the next month due to the payment of salaries and other transactions around these times of the month. There is no clear pattern of the highest activities on those days as pay days are scattered between different time periods for different business sectors. The busiest days of the week are mostly on Mondays and Wednesdays. The majority of people visit the bank during the time period of 09h00-10h30 and a few people visit the bank between 14h30 and 15h00.

The bank clients are relatively young with a mean of 33 years. Most of the respondents (53.1%) were male which suggest that men engage more in banking activities compared to woman. Omar (2008) did a research on determinants of retail bank choice in Nigeria with respect to gender. The results showed that there are some differences in choice factors used by male and female customers in selecting a retail bank for patronage. For example, men are risk loving than women.

From the three types of queues service consultants are the busiest (43%) followed by withdrawals/deposits (36.3%) and enquiries (20.8%). Most of the respondent's use internet banking and only 26.8% make use of the cellphone banking services. This could be because of the recent introduction of the cellphone banking services to the clients and a lack of awareness how the application works. A study conducted by Kombo (2015) on customer satisfaction in the Kenyan banking industry revealed that

E-banking presence (45%) is the second most important factor of satisfaction while quality of products and services (24%) is the least important factor of satisfaction.

The client service satisfaction levels for various dimensions such as the tangibles, responsiveness, reliability, empathy and assurance barely exceed the minimum client expectation and by far fall short of the desired (maximum) level. The appearance of facilities even fails to meet the average minimum expectations rating (minimum = 67%, current = 64%).

On the attribute of reliability the mean client satisfaction level for current situation even falls below the minimum expectation. This paints a picture that the overall bank clients do not seem to be happy with the service they receive from Standard Bank Main Branch as evidenced by the pronounced gaps between the current situation satisfaction rating and the desired satisfaction levels across all dimensions. At the same time respondents had moderate feelings in recommending the bank to their friends or colleagues with an average of 6 out of 10 people. The customer satisfaction should be perceived as the basis of the financial performance of a bank. It is probable that satisfied customers will continue purchasing its products or even recommend this bank to other potential clients (Belas & Gabcova, 2014).

The one-way analysis of variance (ANOVA) table was compiled to test whether the mean differences in client volumes are significant for the various banking periods. Results indicate that the mean client volumes are different for at least one of the banking periods ($F=13.828$, $p<0.001$). The results also indicate that, compared to all other time periods, client volumes are significantly higher during period 0900-1030 and to a lesser extend during period 1330-1430 at 5% level of significance.

The statistics showed that the total number of servers/tellers operational during the different time periods at enquiries ranged from 2 to 4 with a mean of 3. At the withdrawals/ deposits section, overall, the total number of servers/tellers ranged from 4 to 9 with a mean of 7 tellers. At the service consultants section, overall, the total number of servers/tellers ranged from 2 to 4 with a mean of 3 tellers.

The results from the analysis of the withdrawals and deposits queuing system indicates that the average service utilization of the server is 15.6%. The average number of customers in the queue is 0. The average number of customers in the system is 1.4 (one customer). The average waiting time in the queue is 0 hours, while the average time waiting in the system is 0.1 hours (i.e. 6 minutes). The probability of an empty system is 0.246. The percentage of customers who wait in the queue is 0% (i.e. the percentage who do not wait in the queue is 100%).

On the contrary, the results of the Service consultants queuing system indicate that the average service utilization of the server is 81.3%. The average number of customers in the queue is 2.7 (about 3 customers). The average number of customers in the system is 5.9 (about 6 customers). The average waiting time in the queue is 0.21 hours (about 12.6 minutes), while the average time waiting in the system is 0.46

hours (i.e. 27.6 minutes). The probability of an empty system is 0.025. The percentage of customers who wait in the queue is 61.9%.

The enquiries queuing system results indicates that the average service utilization of the server is 80.0%. The average number of customers in the queue is 2.4 (about 2 customers). The average number of customers in the system is 5.6 (about 6 customers). The average waiting time in the queue is 0.15 hours (about 9 minutes), while the average time waiting in the system is 0.35 hours (i.e. 21 minutes). The probability of an empty system is 0.027. The percentage of customers who wait in the queue is 59.6%.

The sample of 19 servers comprised 63% female with the rest being male. Their distribution by current work station was Enquiries teller (50%), withdrawal/deposits (44.4%) and service consultants (5.6%). With regard to their highest educational level, the majority had completed Grade 12 (63.2%), 21% had completed a Diploma while the remaining 15.8% were degreed. Their ages ranged from 18 to 28 years with a mean of 24 and a standard deviation of 3.07 years (95% CI: 22.52-25.48). They had worked for the bank for periods ranging from 0.25 (one week) to 60 months (5 years) with a mean of 19 months and a standard deviation of 17.06 months (95% CI: 10.79-27.24).

CHAPTER 5

5. SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 INTRODUCTION

The main aim of the study was to investigate the congested clients' flows in banking systems at Standard Bank Namibia. This chapter deliberates the findings from Chapter 4 by linking them to the literature reviewed in chapter 2 as well as present the conclusions and recommendations.

5.2 SUMMARY

As competition amongst banks increases customer service becomes the only unique factor to consider staying relevant and forging ahead in business. The most frequent complaint of customers at Standard Bank Namibia is the waiting lines. The relevant literature in the area on queuing systems or models was reviewed. Various authors had similar definitions of queuing theory .They defined queuing theory as the mathematical modeling and analysis of systems that provide service to random demands. Further literature on the history, application, and management of queuing theory and its models as well customer satisfaction versus waiting time was reviewed.

One of the challenges faced by Standard Bank Namibia is the rise in competition in Namibia and Africa at large as global and regional banks are expanding their presence in the market. Consequently, Standard Bank Namibia needs to defend and grow their position by offering the best client experience or expectation at the lowest possible cost. In addition, the bank needs to realize the ease with which clients can switch to a different bank and the impact of "word of mouth" of clients negative experience by channeling their focus to clients expectations.

The utilization factors of the Service Consultants is the highest followed by the enquiries and lastly the withdrawals/deposits. This entails that the service consultants reported a high turnout of customers. (Olaniyi, 2004) also argued that if the system average utilization is low, it means that the waiting line design is inefficient. This suggests that the waiting line design of the Withdrawals/Deposits is inefficient. The servers for this queue can be deployed to other queues as the probability of an empty system is 0.246 and there are no clients on average who waits in that specific queue. Long waits suggest a lack of concern by the organization or can be viewed as a perception of poor service quality.

5.3 CONCLUSION

The thesis examined the efficiency of the queuing models in terms of utilization and waiting length and recommended modifications in the system to reduce waiting times for the clients, which should lead to an improved view of the quality of service provided.

The study revealed the materialness and degree of utilization of queuing models in achieving customer satisfaction as well as allowing the Leadership team of the bank to make better decisions relating to tellers and potential waiting times for customers. The average time a customer spends in the system for enquiries is 0.35 hours , 0.1 hours at withdrawals/deposits and 0.46 hours at service consultants. Furthermore, the distribution of servers by current workstation are more for withdrawals/deposits and very minimal for service consultants evidenced by the long queues in the system at service consultants. There should be more servers available to help ease build up queues and flexibility of servers who are less busy to assist in reducing the queue and get back to their work when the length of the queue eases.

Increasing the number of servers, managing the arrival rate, and optimizing the service rate will reduce time of customer queuing and consequently improve the customer satisfaction rate amongst the banks clients. It was proved that this optimal queuing model is feasible.

5.4 RECOMMENDATIONS

The provision of good customer service as a key strategy for firm profitability, contrary to what Standard Bank Windhoek branch has to offer. The research found a gap in service delivery because the perceptions of the delivered service were not as per the expectations of the customer.

Thus, it is recommended that Standard Bank addressed this gap through identifying and implementing strategies that affect perceptions, or expectations, or both (Parasuraman *et al.*, 1985; Zeithaml *et al.*, 1990, 2007). One of the challenges faced by Standard Bank Namibia is the rise in competition in Namibia and Africa at large as global and regional banks are expanding their presence in the market. Consequently, Standard Bank Namibia needs to defend and grow their position by offering the best client experience or expectation at the lowest possible cost. In addition, the bank needs to realize the ease with which clients can switch to a different bank and the impact of "word of mouth" of clients negative experience by channeling their focus to clients expectations.

The utilization factors of the Service Consultants is the highest followed by the Enquiries and lastly the withdrawals/deposits. This entails that the service consultants reported a high turnout of customers. (Olaniyi , 2004) also argued that if the system average utilization is low, it means that the waiting line design is inefficient. This suggests that the waiting line design of the Withdrawals/Deposits is inefficient. The servers for this queue can be deployed to other queues as the probability of an empty system is 0.246 and there are no clients on average who waits in that specific queue. Long waits suggest a lack of concern by the organization or can be viewed as a perception of poor service quality

There are several possible ways of improving clients flow, and thereby reducing waiting time for the customers. These entail increasing the number of servers; managing the arrival rate; and optimizing the service rate. The number of servers can be increased by hiring more consultants. This is the most obvious by not necessarily the best decision. Although increasing the number of servers provides immediate results, the most effective approach to improvement should involve optimization of all three variables mentioned above. The arrival rate should be decreased during busy times and increased during "slow" periods. Scheduling arrivals would modify the arrival rate to the necessary degree.

It was equally observed that while some customers had to wait for as much as 0.20 hours before service, some spent no time in queues. Introduction of an additional server at the service consultant is capable of reducing the number of customers as well as requesting other staffs who are less busy to assist in reducing the queue and get back to their work when the length of the queue eases. It was also noticed that teller points were opened and closed at will leading to client's confusion and complaints because their waiting time was higher than expected. The poor system design can result in over staffing. Queuing analysis has changed the way businesses use to run and has increased efficiency and profitability of businesses.

Research done by (AL-Jumaily & AL-Jobori, 2011) concluded that in a queue system, the balance between dealing with all customers fairly and the performance of the system is very important and acknowledged that at times the performance of the system is more important than dealing with the customers fairly. It may be beneficial for inspiration of banking executives to improve attributes of satisfaction and loyalty of bank employees.

Fram & McCarthy (2011) on their research on how to retain customer satisfaction in turbulent times, state that success in maintaining satisfaction levels involves undertaking customer-focused corrective actions which include; more frequent customer meetings, improved electronic or print mail communications and the provision of more friendly financial information. The authors also state that bank managers should continue to focus on the basics of customer focus, use of existing and emergent technology to provide customer friendly support, and constantly review and update their financial value proposition offered to customers in order to maintain customer satisfaction during turbulent times.

A study conducted by Kombo (2015) on customer satisfaction in the Kenyan banking industry revealed that E-banking presence (45%) is the second most important factor of satisfaction while quality of products and services (24%) is the least important factor of satisfaction. Although Standard Bank has cellphone banking it is not widely promoted to instill confidence in its clients to make use of the service. The efficiency of Standard Bank can be improved by the following three measures: the queuing number, the service stations number and the optimal service rate as investigated by means of the queuing theory.

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7. APPENDICES

7.1 APPENDIX A: ANOVA POST HOC TEST RESULTS.

(I) timeperiod	(J) timeperiod	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
0830-0900	0900-1030	-58.000*	6.054	0.0000	-69.91	-46.09
	1030-1100	-13.636*	6.054	0.0250	-25.55	-1.72
	1100-1130	-9.545	6.054	0.1160	-21.46	2.37
	1130-1200	-11.424	6.054	0.0600	-23.34	0.49
	1200-1230	-9.742	6.151	0.1140	-21.84	2.36
	1230-1330	-20.097*	6.151	0.0010	-32.2	-7.99
	1330-1430	-26.581*	6.151	0.0000	-38.68	-14.48
	1430-1500	-9.613	6.151	0.1190	-21.72	2.49
	15001530	-12.667*	6.204	0.0420	-24.87	-0.46
0900-1030	0830-0900	58.000*	6.054	0.0000	46.09	69.91
	1030-1100	44.364*	6.054	0.0000	32.45	56.28
	1100-1130	48.455*	6.054	0.0000	36.54	60.37
	1130-1200	46.576*	6.054	0.0000	34.66	58.49
	1200-1230	48.258*	6.151	0.0000	36.16	60.36
	1230-1330	37.903*	6.151	0.0000	25.8	50.01
	1330-1430	31.419*	6.151	0.0000	19.32	43.52
	1430-1500	48.387*	6.151	0.0000	36.28	60.49
	15001530	45.333*	6.204	0.0000	33.13	57.54
1030-1100	0830-0900	13.636*	6.054	0.0250	1.72	25.55
	0900-1030	-44.364*	6.054	0.0000	-56.28	-32.45
	1100-1130	4.091	6.054	0.5000	-7.82	16
	1130-1200	2.212	6.054	0.7150	-9.7	14.12
	1200-1230	3.894	6.151	0.5270	-8.21	16
	1230-1330	-6.46	6.151	0.2940	-18.56	5.64
	1330-1430	-12.944*	6.151	0.0360	-25.05	-0.84
	1430-1500	4.023	6.151	0.5140	-8.08	16.13
	15001530	0.97	6.204	0.8760	-11.24	13.18
1100-1130	0830-0900	9.545	6.054	0.1160	-2.37	21.46
	0900-1030	-48.455*	6.054	0.0000	-60.37	-36.54
	1030-1100	-4.091	6.054	0.5000	-16	7.82
	1130-1200	-1.879	6.054	0.7570	-13.79	10.03
	1200-1230	-0.196	6.151	0.9750	-12.3	11.91
	1230-1330	-10.551	6.151	0.0870	-22.65	1.55
	1330-1430	-17.035*	6.151	0.0060	-29.14	-4.93
	1430-1500	-0.067	6.151	0.9910	-12.17	12.04
	15001530	-3.121	6.204	0.6150	-15.33	9.09

(I) timeperiod	(J) timeperiod	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
1130-1200	0830-0900	11.424	6.054	0.0600	-0.49	23.34
	0900-1030	-46.576*	6.054	0.0000	-58.49	-34.66
	1030-1100	-2.212	6.054	0.7150	-14.12	9.7
	1100-1130	1.879	6.054	0.7570	-10.03	13.79
	1200-1230	1.682	6.151	0.7850	-10.42	13.79
	1230-1330	-8.673	6.151	0.1600	-20.78	3.43
	1330-1430	-15.156*	6.151	0.0140	-27.26	-3.05
	1430-1500	1.811	6.151	0.7690	-10.29	13.91
	15001530	-1.242	6.204	0.8410	-13.45	10.96
1200-1230	0830-0900	9.742	6.151	0.1140	-2.36	21.84
	0900-1030	-48.258*	6.151	0.0000	-60.36	-36.16
	1030-1100	-3.894	6.151	0.5270	-16	8.21
	1100-1130	0.196	6.151	0.9750	-11.91	12.3
	1130-1200	-1.682	6.151	0.7850	-13.79	10.42
	1230-1330	-10.355	6.246	0.0980	-22.65	1.94
	1330-1430	-16.839*	6.246	0.0070	-29.13	-4.55
	1430-1500	0.129	6.246	0.9840	-12.16	12.42
	15001530	-2.925	6.298	0.6430	-15.32	9.47
1230-1330	0830-0900	20.097*	6.151	0.0010	7.99	32.2
	0900-1030	-37.903*	6.151	0.0000	-50.01	-25.8
	1030-1100	6.46	6.151	0.2940	-5.64	18.56
	1100-1130	10.551	6.151	0.0870	-1.55	22.65
	1130-1200	8.673	6.151	0.1600	-3.43	20.78
	1200-1230	10.355	6.246	0.0980	-1.94	22.65
	1330-1430	-6.484	6.246	0.3000	-18.77	5.81
	1430-1500	10.484	6.246	0.0940	-1.81	22.77
	15001530	7.43	6.298	0.2390	-4.96	19.82
1330-1430	0830-0900	26.581*	6.151	0.0000	14.48	38.68
	0900-1030	-31.419*	6.151	0.0000	-43.52	-19.32
	1030-1100	12.944*	6.151	0.0360	0.84	25.05
	1100-1130	17.035*	6.151	0.0060	4.93	29.14
	1130-1200	15.156*	6.151	0.0140	3.05	27.26
	1200-1230	16.839*	6.246	0.0070	4.55	29.13
	1230-1330	6.484	6.246	0.3000	-5.81	18.77
	1430-1500	16.968*	6.246	0.0070	4.68	29.26
	15001530	13.914*	6.298	0.0280	1.52	26.31

(I) timeperiod	(J) timeperiod	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
1430-1500	0830-0900	9.613	6.151	0.1190	-2.49	21.72
	0900-1030	-48.387*	6.151	0.0000	-60.49	-36.28
	1030-1100	-4.023	6.151	0.5140	-16.13	8.08
	1100-1130	0.067	6.151	0.9910	-12.04	12.17
	1130-1200	-1.811	6.151	0.7690	-13.91	10.29
	1200-1230	-0.129	6.246	0.9840	-12.42	12.16
	1230-1330	-10.484	6.246	0.0940	-22.77	1.81
	1330-1430	-16.968*	6.246	0.0070	-29.26	-4.68
	15001530	-3.054	6.298	0.6280	-15.45	9.34
1500-1530	0830-0900	12.667*	6.204	0.0420	0.46	24.87
	0900-1030	-45.333*	6.204	0.0000	-57.54	-33.13
	1030-1100	-0.97	6.204	0.8760	-13.18	11.24
	1100-1130	3.121	6.204	0.6150	-9.09	15.33
	1130-1200	1.242	6.204	0.8410	-10.96	13.45
	1200-1230	2.925	6.298	0.6430	-9.47	15.32
	1230-1330	-7.43	6.298	0.2390	-19.82	4.96
	1330-1430	-13.914*	6.298	0.0280	-26.31	-1.52
	1430-1500	3.054	6.298	0.6280	-9.34	15.45

*. The mean difference is significant at the 0.05 level.

7.2 APPENDIX B: SERVICE ADEQUACY AND SUPERIORITY SCORES

Dimension	Customer Service Satisfaction Attributes	Minimum Required (Expectation)(M)		Desired Max Expectation (E)		Current Situation (P)		Service Adequacy Gap (P-M)		Service Superiority GAP (P-E)	
		Mean	Std Dev	Mean	Std Dev	Mean	Std Dev	Mean	stdev	Mean	Stedv
Tangibles	Convenient Operating Hours	6.83	1.25	8.99	0.76	7.07	0.97	0.32	1.56	**-1.91**	1.34
	Appearance of facilities	6.71	1.09	8.78	0.74	6.36	1.53	-0.25	1.79	**-2.33**	1.66
	Provides welcoming environment	6.8	1.06	9.01	0.85	6.73	1.44	-0.01	1.64	**-1.99**	1.55
	Convenient location	6.98	1.14	9.08	0.87	7.77	1.82	0.68	2.03	**-1.4**	1.88
Responsiveness	Fast and efficient counter services	6.54	1.21	8.63	1.26	6.38	1.26	-0.09	1.7	**-2.21**	1.73
	Willingness to help	6.78	1.17	9.68	1.01	6.44	1.53	-0.23	1.85	**-2.92**	1.01
	Staff available to help	6.91	1.26	8.98	1.1	6.36	1.55	-0.49	1.74	**-2.44**	1.7
	Way mistakes and complaints are handled	7.09	1.18	9.07	1.13	6.49	1.73	-0.47	1.93	**-2.32**	1.82
	Queue at branch	7.06	1.12	8.95	1.33	6.03	1.63	-0.9	1.9	**-2.8**	1.82
	taking time to mathe product/ need	7.08	1.16	8.96	1.18	6.35	1.53	-0.65	1.73	**-2.46**	1.66
	Good product knowledge	7.1	1.08	9.1	1.17	6.45	1.71	-0.66	1.83	**-2.59**	1.71
Reliability	Sincere interest in solving problems	6.33	1.12	8.78	1.02	6.7	1.11	0.43	1.57	**-2.01**	1.59
	Service performed right the first time	6.63	1.13	8.69	0.98	6.41	1.14	-0.17	1.49	**-2.21**	1.47
	Bank keeps its records accurately	6.91	1.11	8.87	1.12	6.5	1.46	-0.4	1.53	**-2.31**	1.65
	Service provided at the promised time	6.9	1.15	9.09	1.03	6.36	1.58	-0.45	1.77	**-2.58**	1.7
Empathy	Building long term relationships	6.51	1.28	8.89	1.11	6.66	1.52	0.23	1.8	**-2.05**	1.62
	Understands peronal bamking needs	6.79	1.27	9.09	1.35	6.23	1.46	-0.39	1.75	**-2.6**	1.79
	Convenient service charges	6.9	1.25	9.07	1.03	5.87	1.85	-0.83	1.98	**-2.9**	2.08
	Provides prompt information to clients	7.06	1.3	9.13	1.17	6.13	1.72	-0.73	1.85	**-2.74**	1.92
Assurance	Feel safe with transactions	6.96	1.33	8.97	1.11	7.01	1.68	0.01	1.87	**-1.92**	1.8
	Bank provides financial advice	7.09	1.18	9	1.12	6.42	1.49	-0.57	1.71	**-2.39**	1.66
	Polite and friendly staff	7.05	1.24	9.17	0.97	6.33	1.58	-0.55	1.77	**-2.59**	1.66
	Average	**6.86**		**9.00**		**6.50**		**-0.28**		**-2.35**	

7.3 APPENDIX C: QUESTIONNAIRE FOR CLIENTS

Instructions: Please indicate your choice by marking (X) in the appropriate box.

1. Day of the week

Monday	Tuesday	Wednesday	Thursday	Friday	Saturday

2. Day of the Month

1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30	31				

3. Gender: Female ☐ Male ☐

4. Age: ☐

5. How long have you been a client at Standard Bank Namibia? ☐

6. For what type of service are you visiting the bank today?

(a) Enquiries ☐ (b)Withdrawals/Deposits ☐

(c)Service Consultant ☐

7. What other method of banking do you make use of?

(a) Internet Banking ☐ (b) Cell phone Banking/Blue Wallet ☐

8. Customer Satisfaction File

DIMENSIONS	SERVICE ATTRIBUTES	MINIMUM REQUIRED(EXPECTATION)											DESIRED(MAX. EXPECTATION)											CURRENT SITUATION RATING										
		0	1	2	3	4	5	6	7	8	9	10	0	1	2	3	4	5	6	7	8	9	10	0	1	2	3	4	5	6	7	8	9	10
Tangibles	Convenient operating hours																																	
	Appearance of facilities																																	
	Provides a welcoming environment																																	
	Convenient Location																																	
Responsiveness	Fast and efficient counter services																																	
	Willingness to help																																	
	Staff available to help																																	
	Way mistakes and complaints are handled																																	
	Queue at branch																																	
	Taking time to match product/need																																	
	Good product knowledge																																	
Reliability	Sincere interest in solving problems																																	
	Service performed right the first time																																	
	Bank keeps its records accurately																																	
	Service provided at the promised time																																	
Empathy	Building long term relationships																																	
	Understands personal banking needs																																	
	Convenient service charges																																	
	Provide prompt information to clients																																	
Assurance	Feel safe with transactions																																	
	Bank provides financial advice																																	
	Polite and friendly staff																																	

8. How likely is it that you would recommend this bank to a friend or colleague?

Not at all likely — extremely likely

1	2	3	4	5	6	7	8	9	10

7.4 APPENDIX D: QUESTIONNAIRE FOR SERVERS AT STANDARD BANK NAMIBIA

Instructions: Please indicate your choice of marking (X) in the appropriate box.

1. Gender: Female [ ] Male [ ]

2. Age: [ ]

3. At the moment where are you stationed? Circle the correct answer.

   (a) Enquiries Teller

   (b) Withdrawals/Deposits Teller

   (c) Service Consultant

4. What is your highest level of Qualification?

Grade 12 [ ] Diploma [ ] Degree [ ]

Other ______________________________

5. How long have you been working for the bank?

____

Thank you very much for your participation!

7.5 APPENDIX E: OBSERVATION SHEET- QUEUE MODEL

1. Day of the week

Monday	Tuesday	Wednesday	Thursday	Friday	Saturday

2. Day of the Month

1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30	31				

3. How many clients are in the bank during the time slots below?

Time Period	08h30 - 09h00	09h00 - 10h30	10h30 - 11h00	11h00 - 11h30	11h30 - 12h00	12h00 - 12h30
Total Clients						
Time Period	12h30 - 13h30	13h30 - 14h30	14h30 - 15h00	15h00 - 15h30		
Total Clients						

4. Total number of Servers/Tellers operational?

(a) Enquiries

Time Period	08h30-10h30	10h30-12h30	12h30-14h30	14h30-15h30
Total Clients				

b)Withdrawals/Deposits

Time Period	08h30-10h30	10h30-12h30	12h30-14h30	14h30-15h30
Total Clients				

(c) Service Consultants

Time Period	08h30-10h30	10h30-12h30	12h30-14h30	14h30-15h30
Total Clients				

7.6 APPENDIX E1: OBSERVATION SHEET

CLIENT NO.	SERVICE TYPE	ARRIVAL TIME	WAITING TIME IN QUEUE	SERVICE TIME(MIN)	DEPARTURE TIME(MIN)	INTERVAL BETWEEN TWO CLIENTS
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						
13						
14						
15						
16						
17						
18						
19						
20						
21						
22						
23						
24						
25						
26						
27						
28						
29						
30						

7.7 APPENDIX F: OBSERVATION SHEET – MULTIPLE SERVERS AT ENQUIRIES

DATA SOURCE: STANDARD BANK NAMIBIA : WINDHOEK					
QUEUING SYSTEM : MULTIPLE SEVERS - ENQUIRIES					
1 JUNE 2016, 08H30 - 09H30					
NO. OF CUST.	ARRIVAL IN MINUTES	ENQ.1	ENQ.2	ENQ. 3	ENQ 4