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APPLICATION OF WAITING LINE MODEL IN  
GLOBAL TREASURE BANK LIMITED

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Application of Waiting Line Model in  
Global Treasure Bank Limited

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## **ABSTRACT**

This study focuses the aim of assessing the application of waiting line system in Global Treasure Bank. The objectives of the study are to identify the waiting line in Global Treasure Bank and to explore the shorter waiting time for clients and quicker service rate delivered through application of waiting line model. Descriptive research method is used in the study. Secondary data and information are collected from official data and reports from public websites, relevant books and references, articles, literature, previous thesis papers and other people documents from internet. According to the results of waiting line analysis, both the average queue time and the average service time are within the standard time set by the bank (i.e. 15 minutes and 5 minutes respectively). The results indicated the overall performance of the Waiting Line model in Global Treasure Bank are increase of more tellers are added.

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## LIST OF ABBREVIATIONS

CPU	Central Processing Unit
FCFS	first-come, first-served
LCFS	Last-come-first-served
SIRO	Service in Random Order
VIPs	Very Important Persons

# **CHAPTER I**

## **INTRODUCTION**

The banking industry is the important sector of a country's economy. The banks are one of the most important units of the public. The banking industry is facing continuous changes nowadays. The excellent service of bank affects customer's satisfaction and their choice of banking. For banks, the rapid service delivery must be adequately aligned with customer expectations and loyalty is essential for long-term survival of bank. Customer Service is the commitment to providing value added services to external and internal customers, including attitude knowledge, technical support and quality of service in a timely manner. Banks in Myanmar currently operate under the traditional system of banking, with cash being a primary component in everyday transactions.

Myanmar's banking sector is characterized by intense and growing competition. The commercial banks are a major component of the financial system, an intermediary between the surplus and deficit sectors of the economy, they are still the center of attraction of many customers who want to carry out one or the other transaction through the services provided by them. Increasing competition is forcing businesses to pay much more attention to satisfying customers, including by providing strong customer service. The survival of organizations depends on their ability to get closer to their clients and to understand the needs and desires of the client. For a business to succeed, it must focus on meeting the needs of customers by organizing itself to respond to them and target customers more effectively. Banks are among the organizations for which customer satisfaction is the key factor for success and a major source of competitiveness. Poor customer flow keeps customers waiting, leading to dissatisfied customers who are upset with their lost time.

Commercial banks have implemented various measures to manage customer waiting lines which are aimed at improving overall performance and maintaining customer's satisfaction levels through reducing queues in the bank. Queuing theory examines every component of waiting in line to be served, including the arrival process, service process, number of servers, number of system place. As a bank of operations research, Queuing theory can help users make informed business decisions on how to build efficient and cost effective workflow system. Customers waiting in

line to receive services in any service system are inevitable and that is why queue management has been where the manager faces huge challenge.

Waiting line models are important to a bank because they directly affect customer service perception and the costs of providing a service. Several functional areas are affected by waiting line decisions. Quick service or response can be a competitive advantage. Long waits suggest a lack of concern by the organization or can be linked to a perception of poor service quality.

Therefore, this study intends to help decision-makers make optimal decisions, mathematical models are applied to find a solution to organizational problems and to optimize economic techniques. This study seeks to find out the effective waiting line management of customer service in GTB bank.

## **1.1 Rationale of the study**

In Myanmar, banking industry is become more competitive. As more and more foreign banks keep the number rising trend entering into Myanmar market, of course they have a huge impact on Myanmar local banking industry. Customer satisfaction is their key success factor and a major source of competitive edge.

Financial services provided by the local private commercial banks are almost all the same, but the means they provide those services are somewhat different. Local private banks in Myanmar are providing a various kind of financial services. Retail banking provides, accepting deposits in current account, saving deposits account and fixed deposits accounts, providing loans in various term; short term, medium term and long term; in various kinds: term loan, commercial loan, consumer loans, business loans and overdraft; local remittances, issuing Payment Order, issuing certify cheque, and issuing performance guarantee.

Banks' service delivery system is sometimes interrupted by rowdiness of its customers and randomness of their arrival and service time. Financial industries pay close attention to service process and customer experience, and put a high value on service efficiency.

Waiting times are the main source of dissatisfaction. One major recurring problem in Myanmar Banks is the overcrowding banking halls, this had led to the movement of customers from one bank to the other, where they can obtain banking

services without much delay. The number of hours devoted to work determines the individual's wage. Apart from situation of work or leisure, economic agents sometime commit considerable amounts of their time when they come into service stations for service. In situations where facilities are limited and cannot satisfy the demand made upon them, bottlenecks occur which manifest as queue but customers are not interested in waiting in queues. When customers wait in queue, there is the danger that waiting time will become excessive leading to the loss of some customers to competitors.

Therefore, banks need to monitor their performance in terms of customer satisfaction and waiting time and have reached an excellent level of customer satisfaction for the quality of its service. The problem in this regard had been that though bank customers for instance, have always been desirous of spending the least possible time in banking transactions, this age-long desire is yet to be met by the banks. Banks on the other hand, want to attract, retain customers and at the same time optimize profit. Profit making in banks is a function of management ability to provide efficient services to customers at little or no time wastage.

Most commercial banks need to manage their waiting lines through placing physical barriers aimed at guiding queue formation and organizing it in the most efficient way. Therefore, to maintain customers and to get long term loyalty, GTB Bank really needs to know customers' feedback on its services to create customer values and satisfactions for the long run success of the GTB Bank. This study attempts to solve the waiting line problem in GTB banks to eliminate queues and the effect of queuing model as a technique of queue solution in Myanmar Banking Industry.

## **1.2 Objectives of the Study**

The objectives of the study are as follows;

- (1) To identify the waiting line practices in Global Treasure Bank and
- (2) To explore the shorter waiting time for clients and quicker service rate delivered through application of waiting line model.

### **1.3 Scope and Methods of the Study**

The method of data collection is through direct observation. The recording of related information such as; the arrival time, waiting time and service time. The observation was recorded during the working hours (9:00 am – 3:00 pm). The recorded information was used to calculate average waiting time, average service time and the utilization factor. The method of analysis for this study will use the multi-server queuing modeling system which follows (M/M/K): ( $\infty$ /FCFS) specification. This study focuses on customers who deal with GTB Bank (Yangon Branch) and sampling method during the banking hours within October 2019. One day finished banking transaction such as saving deposit & withdrawal, remittance and current account opening. Secondary data and information are collected from official data and reports from public websites, relevant books and references, articles, literature, previous thesis papers and other people documents from internet.

### **1.3 Organization of the Study**

The study is formally organized with five chapters. Chapter I is the introduction that explains rationale of the study, objectives of the study, scope and method of the study and organization of the study. Chapter II, conceptual framework, theoretical framework of queuing system in banks. Chapter III is the profile of GTB Bank Limited, it describes foundation of the bank, it's vision, mission, objectives, core values and motto, expansion of branches and financial services rendered by the bank within (23) years of its business life. Chapter IV describes the effect of queuing system in bank. Chapter V concluded with the findings, suggestions and recommendation, and need for future research to maintain existing customers and to persuade new customers to create its customer values.

## **CHAPTER II**

### **THEORETICAL BACKGROUND**

This chapter mainly focuses on the concept of the waiting line system in the banking sector. The related literatures reviewed from different sources are submitted in this chapter. The other researchers performed the research in the same field of the study. The literatures are collected and organized under theoretical review & conceptual framework.

#### **2.1 Definition of Waiting Line (or) Queuing Theory**

Queuing theory is basically a mathematical approach applied to the analysis of waiting lines. It uses models to represent the various types of queuing systems. Formula for each model indicates how the related queuing system should perform, under a variety of conditions. The queuing model are very powerful tool for determining that how to manage a queuing system in the most effective manner. The queuing theory is also known as the random system theory, which studies the content of: the behavior problems, the optimization problem and the statistical inference of queuing system.

Queuing theory is suitable to be applied in the banking system. Since it is associated with queue or waiting line where customers who cannot be served immediately have to queue (wait) for service for a long time and time being a resource ought to be managed effectively and efficiently because time is money. Queuing theory has become one of the most important, valuable and arguable one of the most universally used tool by an operational researcher.

Queuing theory can also be applied to a variety of operational situations where it is not possible to accurately predict the arrival rate (or time) of customers and service rate (or time) of service facility of facilities. Some of the analysis that can be derived using queuing theory include the expected waiting time in the queue, the average waiting time in the system, the expected queue length, the expected number of customers served at one time, the probability of balking customers, as well as the probability of the system to be in certain states, such as empty or full (Patel, R. et al 2012)

Queuing Theory is a collection of mathematical models of various queuing systems that take as inputs parameters of the above elements and that provide quantitative parameters describing the system performance. Because of random nature of the processes involved the queuing theory is rather demanding and all models are based on very strong assumptions (not always satisfied in practice). Many systems (especially queuing networks) are not soluble at all, so the only technique that may be applied is simulation.

Nevertheless, queuing systems are practically very important because of the typical trade-off between the various costs of providing service and the costs associated with waiting for the service (or leaving the system without being served). High quality fast service is expensive, but costs caused by customers waiting in the queue are minimum. On the other hand, long queues may cost a lot because customers (machines e.g.) do not work while waiting in the queue or customers leave because of long queues. So a typical problem is to find an optimum system configuration (e.g. the optimum number of servers). The solution may be found by applying queuing theory or by simulation.

Queuing models are used to represent the various types of queuing systems that arise in practice, the models enable in finding an appropriate balance between the cost of service and the amount of waiting ( Nafees, 2007). Queuing models provide the analyst with a powerful tool for designing and evaluating the performance of queuing systems (Bank, C. et al, 2001) A queuing model of a system is an abstract representation whose purpose is to isolate those factors that relate to the system's ability to meet service demands whose occurrences and durations are random (J. Sztrik, 2010).

## **2.2 Queuing Characteristics**

In designing a good queuing system, it is necessary to have good information about the model. The characteristics listed below would provide sufficient information:

- (i) The Arrival Pattern
- (ii) The Service Pattern
- (iii) The Number of Customers Allowed in the system

- (iv) The Queuing Discipline
- (v) The Number of Service Channels

### **2.2.1 The Arrival Pattern**

The arrival pattern defines the way customers enter the system. Mostly the arrivals are random with random intervals between two adjacent arrivals. Typically, the arrival is described by a random distribution of intervals also called Arrival Pattern. It expresses the mode of arrival of customers at the service facility governed by some probability law. The number of customers emanate from finite or infinite sources. Also, the customers may arrive at the service facility in batches of fixed size or of variable size or one by one. In the case when more than one arrival is allowed to enter the system simultaneously, (entering the system does not necessarily mean entering into service), the input is said to occur in bulk or batches.

It is also necessary to know the reaction of a customer upon entering the system. A customer may decide to wait no matter how long the queue becomes, or if the queue is too long to suit him, may decide not to enter it. If a customer decides not to enter the queue because of its huge length, he is said to have balked. On the other hand, a customer may enter the queue, but after some time loses patience and decides to leave. In this case he is said to have reneged. In the case when there are two or more parallel queues, the customer may move from one queue to another for his personal economic gains, that is jockey for position. The final factor to be considered regarding the input process is the manner in which the arrival pattern changes with time. The input process which does not change with time is called a stationary input process. If it is time dependent, then the process is termed as transient.

The simple arrival process is one which have completely regular arrivals (i.e. the same constant time interval between successive arrivals). A Poisson stream of arrivals corresponds to arrivals at random. In a Poisson stream successive customers arrive after intervals which independently are exponential distributed. The Poisson stream is important as it is a convenient mathematical

model of many real life queuing system and is described by a single parameter – the average arrival rate. Other important arrival processes are scheduled arrivals, batch arrival and time dependent arrival rate (i.e. the arrival rate varies according to the time of day).

### **2.2.2 The Service Pattern**

The service pattern represents some activity that takes time and that the customers are waiting for again take it very generally. It may be a real service carried on persons or machines, but it may be a CPU time slice, connection created for a telephone call, being shot down for an enemy plane, etc. Typically, a service takes random time. Theoretical models are based on random distribution of service duration also called Service Pattern. Another important parameter is the number of servers. Systems with one server only are called Single Channel Systems, systems with more servers are called Multi Channel Systems.

Assuming that the service times for customers are independent and do not depend upon the arrival process is common. Another common assumption about service times is that they are exponentially distributed. This means the arrangement of server-s facility to serve the customers. If there are infinite numbers of servers then all the customers are served instantaneously on arrival and there will be no queue. If the number of servers is finite, then the customers are served according to a specific order.

Further, the customers may be served in batches of fixed size or of variable size rather than individually by the same server, such as a computer with parallel processing or people boarding a bus. The service system in this case is termed as bulk service system. Sometimes, the service rate may also depend on the number of customers, waiting for service. For example, when the queue becomes longer, a server may work faster or, conversely, may become less efficient. The situation in which service depends upon the number of waiting customers is referred to as state dependent-system.

Some of the queuing processes admit the physical limitation to the amount of waiting room, so that when the waiting line reaches a certain length, no further

customers are allowed to enter until space becomes available by a service completion. Such types of situation are referred to as finite source queues, that is, there is a finite limit to the maximum queue size. The queue can also be viewed as one with forced balking. Where a customer is forced to balk if he arrives at a time when queue size is at its limit.

### **2.2.3 The Number of Customers Allowed in the system**

The number of customers can be considered either limited (closed systems) or unlimited (open systems). Unlimited population represents a theoretical model of systems with a large number of possible customers (a bank on a busy street, a motorway petrol station). Example of a limited population may be a number of processes to be run (served) by a computer or a certain number of machines to be repaired by a service man. It is necessary to take the term "customer" very generally. Customers may be people, machines of various nature, computer processes, telephone calls, etc.

In certain cases, a service system is unable to accommodate more than the required number of customers at a time. No further customers are allowed to enter until space becomes available accommodate new customers. Such type of situations is referred as finite (or limited) source queue. Examples of finite source queue are cinema halls, restaurants, etc.

On the other hand, if the service system is able to accommodate any number of customers at the time, then it is referred to as infinite (or unlimited) source queue. For example, in a sales department, here the customer orders are received; there is no restriction on the number of orders that can come in, so that a queue of any size can form.

Patient customer is the customer arrives at the service system, stays in the queue until server on matter how much he has to wait for service. Impatient customer is the customer arrives at the service system, waits for a certain time in the queue and leaves the system without getting service due to some reasons like long queue before him. Balking means the customer decides not to join the queue by seeing the number of customers already in service system. Reneging means

the customer after join the queue, waits for some time and leaves the service system due to delay in service. Jockeying means the customer moves from one queue another thinking that he will get served faster doing so.

#### **2.2.4 The Queuing Discipline**

Queue represents a certain number of customers waiting for service (of course the queue may be empty). Typically, the customer being served is considered not to be in the queue. Sometimes the customers form a queue literally (people waiting in a line for a bank teller). Sometimes the queue is an abstraction (planes waiting for a runway to land). There are two important properties of a queue: Maximum Size and Queuing Discipline.

Maximum Queue Size (also called System capacity) is the maximum number of customers that may wait in the queue (plus the one(s) being served). Queue is always limited, but some theoretical models assume an unlimited queue length. If the queue length is limited, some customers are forced to renounce without being served.

Queuing Discipline represents the way the queue is organized (rules of inserting and removing customers to/from the queue). In the queue structure, the important thing to know is the queuing discipline. The queue discipline is the order or manner in which customers from the queue are selected for service. There are a number of ways in which customers in the queue are served. Some of these are:

(a) Static queue discipline are based on the individual customer's status in the queue. Few of such discipline are:

- (i) If the customer is served in the order of their arrival, then this is known as the first-come, first-served (FCFS) service discipline. Prepaid taxi queue at airports where a taxi is engaged on a first-come, first-served basis is an example of this discipline.
- (ii) Last-come-first-served (LCFS) : Sometimes, the customers are serviced in the reverse order of their entry so that the ones who join the

last are served first. For example, assume that letters to be typed, or order forms to be processed accumulate in a pile, each new addition being put on the top of them. The typist or the clerk might process these letters or orders by taking each new task from the top of the pile. Thus, a just arriving task would be the next to be serviced provided that no fresh task arrives before it is picked up. Similarly, the people who join an elevator last are the first ones to leave it.

- (b) Dynamic queue disciplines are based on the individual customer attributes in the queue. Few of such disciplines are:
  - (i) Service in Random Order (SIRO): Under these rule customers are selected for service at random, irrespective of the arrivals in the service system. In every customer in the queue is equally likely to be selected. The time of arrival of the customers is, therefore, of no relevance in such a case.
  - (ii) Priority Service: Under these rule customers are grouped in priority classes on the basis of some attributes such as service time or urgency or according to some identifiable characteristic, and FCFS rule is used within each class to provide service. Treatment of VIPs in preference to other patients in a hospital is an example of priority service.

For the queuing models that the study shall consider, the assumption would be that the customers are serviced on the first-come-first-served basis.

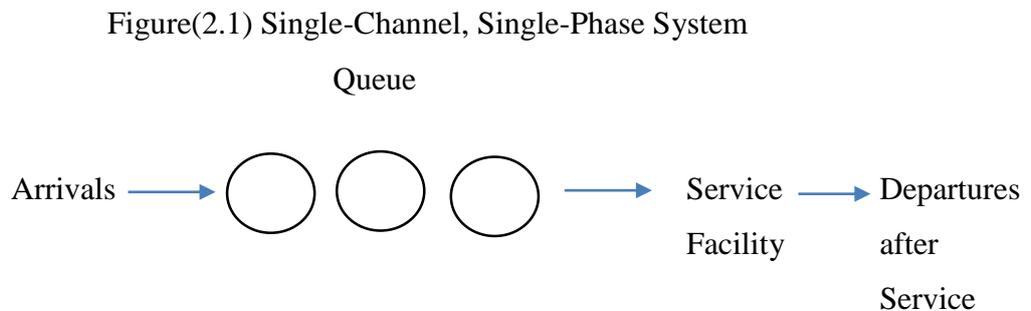
### **2.2.5 The Number of Service Channels**

The more the number of service channels in the service facility, the greater the overall service of the facility. The combination of arrival rates service rate is critical for determining the number of service channels. When there are a number of service channels available for service, then the arrangement of service depends upon the design of the system's service mechanism.

Parallel channels mean a number of channels providing identical service facilities so that several customers may be served simultaneously. Series channel means a customer go through successive ordered channels before service is completed. A queuing system is called a one-server model, i.e., when the system has only one server and a multi-server model i.e., when the system has a number of parallel channels, each with one server.

### 2.3 Type of Queuing System Design

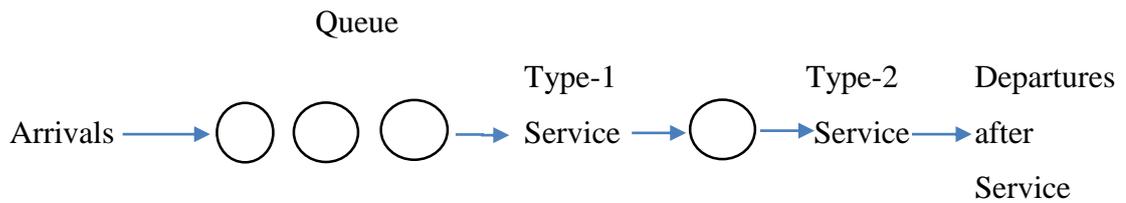
The single-channel, single-phase in queuing where there is a single channel with the customer going through only one phase. In a single-phase system, the customer receives service from only one station and then exists the system. A fast-food restaurant in which the person who takes the order also brings food and takes money is a single-phase system. The figure (2.1) shows the Single-Channel, Single-Phase system.



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The bank had several tellers on duty and each customer waited in one common line for the first available teller, then we would have a multiple-channel queuing system. Most banks today are multichannel service systems, as are most large barbershops, airline ticket counters, and post offices. The figure (2.2) shows the Single-Channel, Single-Phase system.

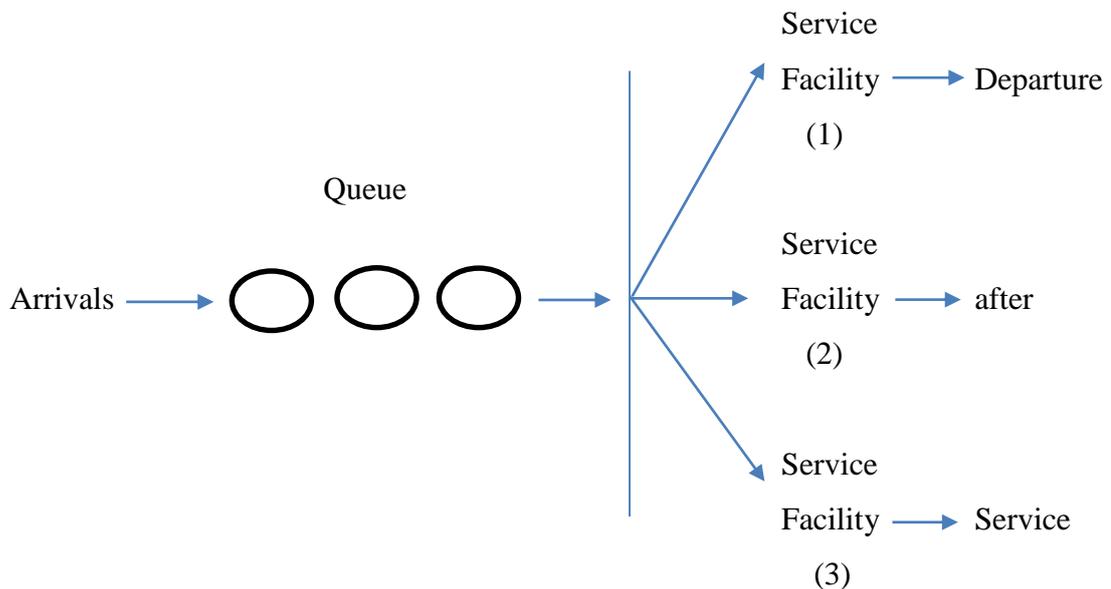
Figure (2.2) Single-Channel, Multiphase System



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Multichannel, single phase waiting lines are found in many banks today. Multichannel – single phase in queuing where there is more than one point at which to queue and where the customer has only one phase of activity. The figure (2.3) shows the Mingle-Channel, Single-Phase system.

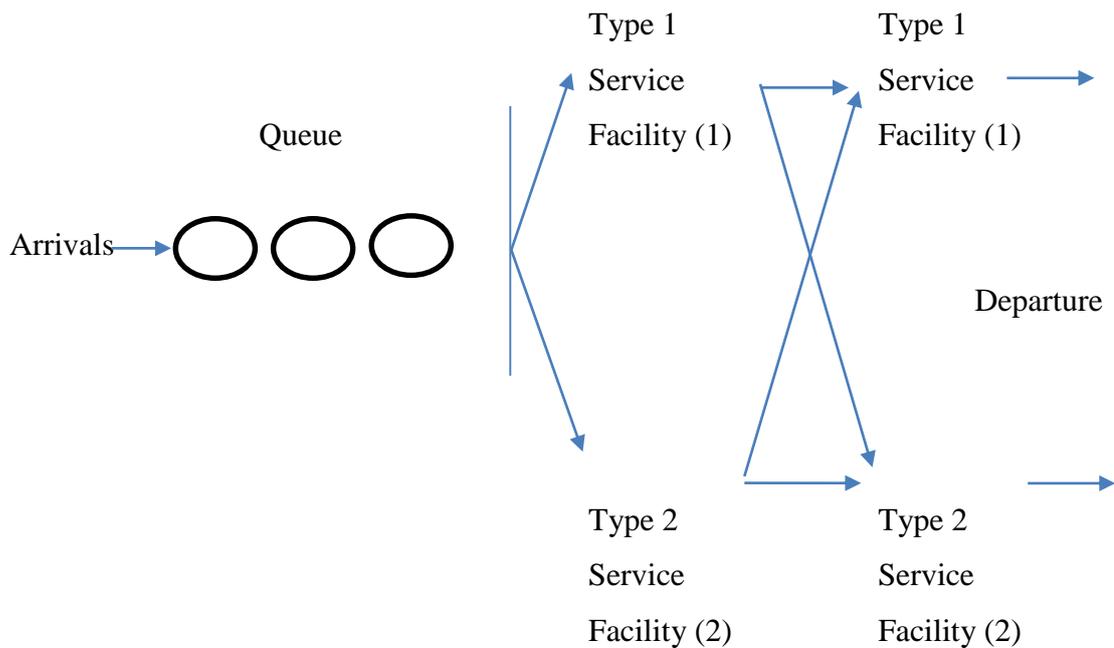
Figure(2.3) Multichannel, Single-Phase System



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The multiple-line configuration is appropriate when specialized servers are used or when space considerations make a single line inconvenient. The following figure is shown the multichannel, multiphase system.

Figure (2.4) Multichannel, Multiphase System



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## 2.4 Queuing Model Formula equations and notation

Queuing theory has its origins in research by Agner Krarup Erlang when created models to describe the Copenhagen telephone exchange. The ideas have since seen applications including telecommunication, traffic engineering, computing and particularly in industrial engineering in the design of shops, offices, banks and hospitals as well as in project management. M/M/K queue (or Erlang-C model) is a multiserver queuing model.

### 2.4.1 Equations for Multi-channel queuing Model

Utilization factor:

$$P = \frac{\lambda}{k\mu}$$

The probability that there are zero customers in the system:

$$P_0 = \left[ \sum_{n=0}^{k-1} \frac{1}{n} \left( \frac{\lambda}{n!} \right)^k + \frac{1}{n} \left( \frac{\lambda}{\mu} \right)^k \frac{k\mu}{k\mu - \lambda} \right]^{-1}$$

The probability that a customer has to wait:

$$P_w = \frac{1}{k!} \left(\frac{\lambda}{\mu}\right)^k \frac{k\mu}{k\mu - \lambda} P_0$$

The average number of customers in the system:

$$L_s = \frac{\lambda\mu(\lambda/\mu)^k}{(k-1)!(k\mu-1)^2} P_0 + \frac{\lambda}{\mu}$$

The average number of customers in the queue:

$$L_q = \frac{\lambda\mu(\lambda/\mu)^k}{(k-1)!(k\mu-1)^2} P_0 \text{ Or } L_q = L_s - p$$

The average time a customer spends in the system:

$$W_s = \frac{\lambda\mu(\lambda/\mu)^k}{(k-1)!(k\mu-1)^2} P_0 + \frac{1}{\mu} = \frac{L_s}{\lambda}$$

The average time a customer spends in the queue:

$$W_q = \frac{\mu(\lambda/\mu)^k}{(k-1)!(k\mu-1)^2} P_0 \text{ Or } W_q = W_s - \frac{1}{\mu} = \frac{L_q}{\lambda}$$

#### 2.4.1 Queuing model notation:

$\lambda$  = Arrival rate

$\mu$  = Service rate

$k$  = Number of service channels

$n$  = Number of customers

$L_s$  = The average number of customers in the service system

$L_q$  = The average number of customers waiting in the queue

$W_s$  = The average time customers spend in the system

$W_q$ = Average time customers wait in the queue

$\rho$ = System of utilization factor

$P_0$ = The probability that there are zero customers in the system

$P_w$ = The probability that a customer has to wait

$P_n$ = The probability that there are n customers in the system

## 2.5 Previous Study in Waiting line model

Queuing theory had its beginning in the research work of a Danish engineer named Erlang around 1909 (Winsotn, 1991). He conducted an experiment and had observed that the demand in telephone traffic is fluctuating. Latter he published a report addressing the delays in automatic dialing equipment. Soon after his published work and during the end of World War II, Erlang's early work was extended to more general problems and to business applications of waiting lines and to various service industries. Modeling some service industries as a queue system has many advantages such as diagnosing problems, identifying constraints so as to understanding the real systems rather than indicating individual prediction about the system (Bank, 1999)

Several studies present various queuing model to analyses the performances of service industries. For example, a queue system optimization model is used for the bank system is but used at different scenario (Tian & Tong, 2011; Wang et.al. 2010). Others such as Ullah et.al (2014) model a bank system as a queue model with M/M/s queue structure to improve the utilization of the staff. Generally, a queue model is constructed by several key parameters as an input: arrival rate " $\lambda$ ", service rate " $\mu$ ", along with one or more servers with different queue discipline or implementation approaches.

In the literatures different queue models are used to standardize a server configuration. For example, M/M/1 represents a single server that has unlimited queue capacity with both service and arrival rate follow a poison distribution (Bhavin and Bhathawala, 2012, Charan, 2012, Famule, 2010). It is the most commonly used queue model representation (Boxma & Cohen, 1997). Moreover, Ahmed (2011) implemented different queuing algorithms that are used in banks to serve the customers, and to improve average waiting time. Others such as Chowdhury (2013) describe several common queuing situations and present mathematical models for

analyzing waiting lines. He illustrated using a bank system to measure customers' satisfaction level on the service using multiple-channel queuing model with Poisson Arrival and Exponential Service Times (M/M/K).

Charan (2012) also investigate single server queuing system wherein the arrival of the units follow Poisson process with varying arrival rates in different states and the service time of the units is arbitrary (general) distributed. In this paper Poisson probability distribution for the arrival and exponential probability distribution for the service rate are assumed to fit in the model where several servers involved in the service provision of a bank system using first come first (FCFS) served queue discipline. It is represented as M/M/K where "K" stands the number of servers.

The study has suggested that any information on the waiting duration can reduce the uncertainty of the wait and lower the overall level of stress experienced by consumers (Maister, 1985). Previous research highlights the impact of queuing information and waiting duration information on the cognitive and affective aspect of the wait when the wait is long (Hui & Tse, 1996). Providing information on accurate wait times, which are more tolerable than vague ones, and providing frequent updates (Russle & Taylor, 2011) are important in making the waiting more pleasant.

According to Russle & Taylor (2011) indicated that when it is not possible to reduce waiting times the problem of providing quality service often depends more on psychological solutions. In other words, the organization will try to make waiting more Pleasant. The attractiveness of the waiting environment is related to its physical design in terms of comfort, space and decor. Service environment influences the affective aspects of waiting time (Baker & Cameron, 1996).

The queue discipline is another variable for waiting lines management that influences customer satisfaction. Jhala and Bhathawala (2016) in their study in which they introduced a new queue management system with SMS notification which eliminated the need to stand in line while waiting and help to provide comfort as well as fairness to customers, by allowing them to maintain their position in the queue while they are seated comfortably or engaged in constructive activity resulted in reduced queue length and actual waiting times, thus improving customer satisfaction. The waiting line structure also affects the level of satisfaction of the customer specifically in terms of waiting line and service facility. Customers want a structure that will facilitate fast and a convenient order taking and picking (Austria, 2015).

## **CHAPTER III**

### **HISTORY BACKGROUND OF GLOBAL TREASUE BANK**

This chapter presents the profile of the Global Treasure Bank. This chapter describes foundation of the bank, organization structure of the bank, it's vision, mission, objectives, core values and motto, expansion of branches and financial services rendered by the bank within (23) years of its business life. Therefore, waiting line management considers analysis on the actual arrival rates of clients, waiting times and services rate delivered by Global Treasure Bank.

#### **3.1 Profile of Global Treasure Bank**

Global Treasure Bank was founded as a public company limited by shares on 15-2-1996 under License Number Mababa/P-15 (2) 96 of the Central Bank of Myanmar by the initial name of Myanma Livestock and Fisheries Development Bank (MLFDB), pursuant to the law of the Financial Institutions of Myanmar. The new name Global Treasure Bank(GTB) was changed from MLFDB on 1-7-2013, permission of the Directorate of Investment and Company Administration with its letter No. Yaka-8 (Ga Nga) 001/2013(010995) dated 27-8-2013.

In conducting banking business services smoothly and efficiently, Global Treasure Bank(GTB) deposit amount has increased with public interest and trust. The Bank expanded concrete loans by integrating cash deposit management to Livestock and Fisheries, Industrial, Trade, Construction, Services Sectors which support the comprehensive economic development and also provided assistance to agriculture, rural electrification and industrial projects to support National Development.

In order to the upgrading of Bank employee's working capacity, the Bank has given training courses for professionals on financial services to the bank staff at Head Office and our staff also attended competency trainings and workshops organized by the Central Bank of Myanmar. To Provide good banking services to customers' satisfaction and convenience, GTB Bank has also expended domestic banking network to as many as (169) Branches including (161) full branch banks and ( 8 ) minibranch banks .

Global Treasure Bank (Public Company Limited) is a Commercial Bank, licensed by Central Bank of Myanmar (CBM) to operate the following business;

- (a) Receiving various kind of deposits business;
- (b) Business of paying and collecting cash for cheques drawn by paid in person;
- (c) Providing credit facilities such as term loans, overdrafts, letter of credits, bank guarantees, trade financing and
- (d) Such other banking business as prescribed and approved by CBM under section 52 of Financial Institutions Law 2016.

### **Vision**

To be the one of the leading banking services provider in Myanmar, partnering with our customers for long term growth by providing superior services and enhanced financial products.

### **Mission**

As one of the leading banks in Myanmar, Global Treasure Bank is dedicated to providing efficient banking services and establishing a trustworthy, reliable and successful relationship with all stakeholders. Global Treasure Bank is committed to generating value for our customers.

### **Objective**

The main objective of Global Treasure Bank is to provide sound financial assistance to entrepreneurs for development of all business sectors.

### **Motto**

The motto of the Global Treasure Bank is “Your Dream, Your Success, Global Treasure Bank”.

## **Our Values**

The standards and principles which determine our behavior and the way we interact with our customers and staff

- (i) CUSTOMER FOCUS, Customer First
- (ii) INTEGRITY, Do what is right
- (iii) RESPECT, Value every one
- (iv) TEAMWORK AND OPERATIONAL EXCELLENCE, Provide best of services as a team.
- (v) INNOVATION, Embrace Technology and Be Creative

In 2017-2018 financial year, Global Treasure Bank taking part in philanthropic activities enthusiastically under the “Treasure Heart Social Support Association” to expend and support CSR activities, GTB donated over 103.8 million Kyats for CSR programs. GTB donation supports well-being of communities in the field of healthcare, natural disaster rehabilitation and community development such as rural power supply and water supply. GTB Bank helps children who attend schools for the disabled, nutrition programs for hospitalize people, home for the aged, the cancer foundations etc.

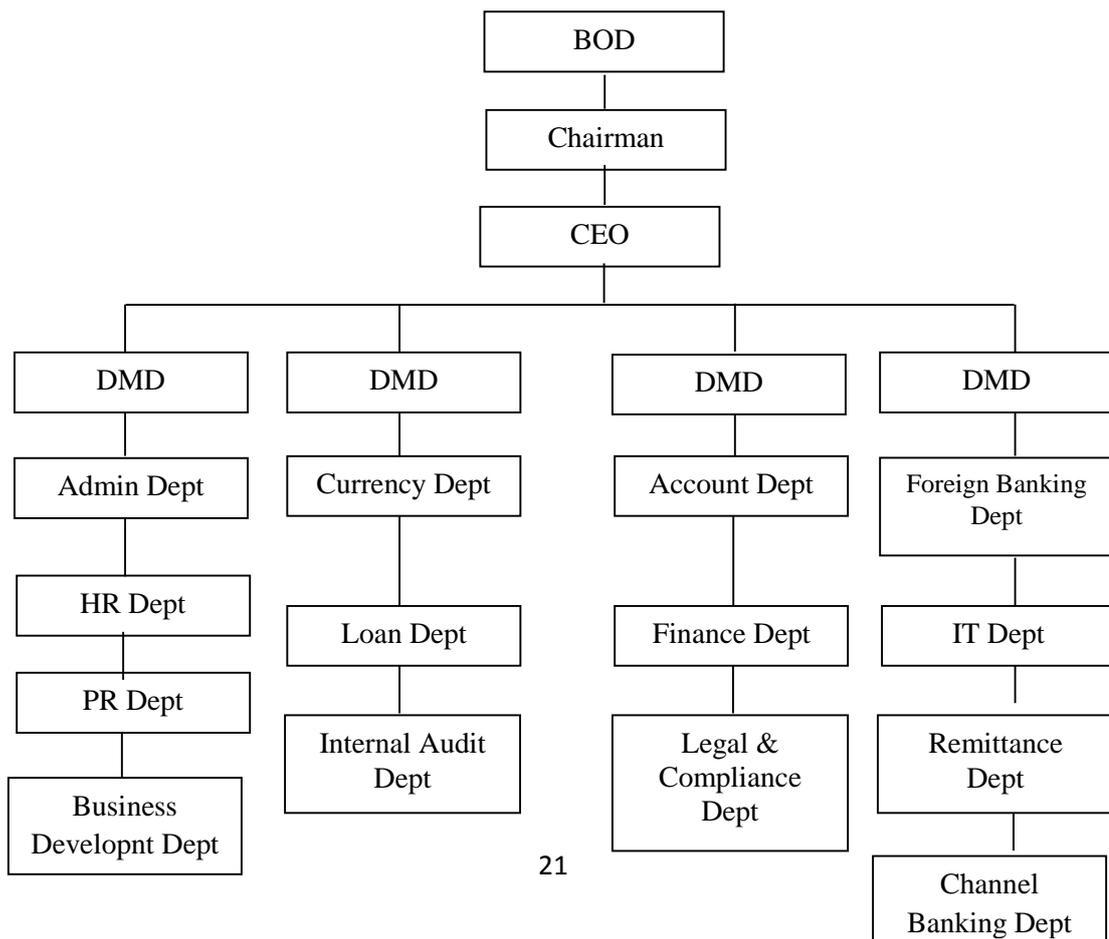
Global Treasure Bank, in cooperation with 15 private banking institutions namely the Co-operative Bank, Myanmar Oriental Bank, Small and Medium Industrial Development Bank, Myawaddy Bank, Rural Development bank, Asia Green Development Bank, Yangon City Bank, United Amara Bank, Nay Pyi Taw Sibin Bank, Construction & Housing Development Bank, Myanmar Micro Finance Bank, Shwe (Rural and Urban Development) Bank, Ayeyarwaddy Farmers Development Bank, Myanmar Citizens Bank and Innwa Bank to provide domestic money transactions services. The cooperation can facilitate banking operations and jointly offer in remittance services. Global Treasure Bank has established correspondent banking relationships with ten international banks from China, Germany, Hong Kong, India, Malaysia, Singapore, South Korea, Taiwan, Thailand & Vietnam, which are Myanmar's major trading partners, to fulfill the needs of our customers in international banking and trade finance services. Global Treasure Bank is a reliable and secured partner for the country's growing business. The bank is

committed to developing and maintaining a long term partnership with other financial institutions to grow trade finance transactions, money transfer services and international banking services.

### 3.2 Organization Structure of Global Treasure Bank

Global Treasure Bank’s head office is formed with (13) department. The bank is managed by the Board of Directors which comprise of 15 members. One of them is elected as Chairman of the Board. Furthermore, two Independent Non-Executive Directors are appointed at the Annual General Assembly Meeting to provide appropriate advice from neutral standpoint, independent of management. BOD Meetings are convening at least once a month to decide on important matters stipulated in Laws and Article of Association, as well as to make important decisions related to management policy and management strategy. The Managing Director serves as Chief of Executive Officer of the bank and senior management. GTB is running the bank by employing over (1000) employees at financial year (2018-19 ). Organization structure of Bank is as follows:

**Figure (3.1) Organization Structure of GTB**



### 3.3 Services Provided by GTB

Global Treasure Bank limited is methodically performing with the Financial Institutions of Myanmar Law, bye laws, regulations and Institutions of the Central Bank of Myanmar.

#### 3.3.1 Deposit Products

This product includes Saving Deposit, Current Deposit, Fixed Deposit, Minor Deposit, Certified Cheque, Payment Order and Performance Guarantee.

(a) **Saving Deposit:** The saving customers who are already 18 can open saving deposit account by themselves. The customers must bring NRC card to open account. Our bank opens the saving account with the initial deposit 10,000 kyats. But the customers cannot open the account with P. O (or) Cheque. Individual (or) Company (or) Associations can also open the account. To deposit (or) withdraw the money, the customers need to bring the book. They can deposit the money with the cheque (or) cash. GTB let the customers to withdraw the money once a week and the minimum balance must be 10,000 KS. Customers can withdraw the money by themselves (or) their representatives. We calculate the interest with 8.5 %. Customers can close the account after 3 months. If wants to close the account, the account holder must come to the bank. The saving interest rates are 8.25%.

(b) **Current Deposit:** Current deposit account can be opened with initial amount of 1,000 Kyats and more of thousand Kyats can be put up frequently. Current accounts can be opened individually, joint account with two or more persons, company account, organization account etc. Withdraws and deposits are not limited by using cheque book.

(c) **Fixed Deposit:** Fixed Deposit is the kind of deposit that customers can deposit/withdraw within fixed durations such as 3 months, 6 months, 9 months and 12 months according to their wish. If the customers want to deposit after maturity withdrawal, they don't need to register again. Also customers can keep the registered book in hand if they do not want to make further operations. Can continue the previous book if customers want to deposit/withdraw again. And then the customers

can deposit again after maturity which the duration is the same (or) different, they can use the previous book. The current interest rates are 3months' interest rate is 9.25%, 6 months' interest rate is 9.50%, 9 months' interest rate is 9.75% and 12 months' interest rate is 10.0% respectively.

**(d) Call Deposit:** Call Deposit can be opened by companies, associations, individual, joint (or) more than two. Call Deposit can be opened with initial amount 10000 KS and the minimum balance must be 10000 KS. And then one-time deposit must be at least 10000 KS. The current interest rate is 2%.

But our bank doesn't give the interest below 10000 KS. The customers can withdraw money by themselves (or) their representatives. However, today deposit money can be withdrawn next day. If the customers want to deposit/withdraw with online, they must pay commission charges and fees like remittance charges.

**(e) Minor Deposit:** The customers who want to open Minor Deposit Account can be opened with their parents (or) guardians. Bring your NRC card when account opens. When the customers turn (18) years old, the bank takes back the minor's signature and open Individual Account.

**(f) Certified Cheque :** Bank fee will be charged 5 pyas per 100 Kyats up to 1,000 Kyats (minimum) and 5,000 Kyats (maximum).

**(g) Payment Order:** Bank fee will be charged 5 pyas per 100 Kyats up to 1,000 Kyats (minimum) and 5,000 Kyats (maximum).

**(h) Performance Guarantee:** Commission fees will be charged on guarantee amount.

### **3.3.2 International Banking**

Global Treasure Bank operates 22 Money Changer Counters in strategic areas such as Yangon head office, Mandalay-Yadanabon Diamond Plaza, Mandalay z6 Street, Mandalay Sai Tan bank, Thandwe (Rakhine), Naypyitaw, Shwe Bo (Sagaing Region), Kalay ( Sagaing Region), Mawlamyaing - t, Mawlamyaing Zay Kyo,

Kawthaung, Dawei, Monywa, Sawbwargyigon, Pyay, ShweBonTha, Katha, Myawaddy, Muse, Maung Taw, Tamu and Maungmakan Township. The bank provides a range of services including foreign exchange, foreign currency accounts, money transfer, SWIFT remittance, bank guarantee and trade finance such as letters of credit, bills for collection, trust receipts and ' import & export trade financing in major foreign currencies such as USD, Euro, Singapore Dollars, Malaysia Ringgit and Thai Baht.

An inward money transfer service has been operating from zoo countries through Western Union Company of USA. In 2017-2018 financial year, clients from Africa, America, Asia & Middle East, Europe and Oceania countries conducted 50,643 transactions amounting to USD 31.6 million to various part of Myanmar through Global Treasure Bank branches. Money transfers could be made in cash or by using payment instruments such as cheques and authorized payments. In June 2016, outward remittances through Western Union Money Transfer services are being provided at GTB branches. Customers who do not possess bank account can also send money to all over the world through GTB branches.

### **3.3.3 Loan & Overdraft of Global Treasure Bank**

For loans services, Loans interest 13%. Interest will be collected by every 3 months. Type of loans and collaterals are Loan, Overdraft, Government Staff Loan. Global Treasure Bank is lending money to the public service personnel. As part of issuing government staff loan, GTB has been offering door to door service to the teachers from the Basic Education Department under the Ministry of Education to ensure their social welfare and to enable them to perform their duties happily, free from worry. A total of (149) bank branches across the country have already granted loans to government staff numbering (90,777) amount to Kyats 68,740,171,800 ' until today. Loans & overdraft need to pay collaterals are lands & building and guarantee.

### **3.3.4 Hire Purchase of Global Treasure Bank**

For hired purchase, borrower shall pay down payment of 30 % of value and one-year interest amount at the beginning of borrowing to the bank. Remaining 70%

are divided 12 months to 60 months and pay by installment on the latest on fifth of every month. Interest rate for hire purchase are Rental fees for 1 year 13% & service charges 1% , 2 year 13% & service charges 2% and 3 year 13% & service charges 3%.

### **3.3.5 Remittance**

Global Treasure Bank can transfer money from not only GTB's branch to branch but also other banks' branches such as MOB Bank, CB Bank, SMIDB Bank, MWD Bank, NSB Bank, CHDB Bank, RDB Bank, AGD Bank, UAB Bank and YCB Bank. Our Bank transfers the money within a few minutes.

**(a) Internal Remittance:** Domestic remittance services can be done not only areas of the GTB branches but also remittance benefit sharing partnership banks such as MOB Bank, CB Bank, SMIDB Bank, MWD Bank, RDB Bank, AGD Bank, UAB Bank, YCB Bank accordingly. Overseas remittance services is providing with 200 countries through Western Union. Inwards remittance can be withdrawn at nearby GTB branches in a minute. The bank is recognized as one of the leading banks in domestic banking services with a current network of 156 branches which is a great opportunity for remittance.

**(b) Foreign Remittance:** As Foreign Remittance, the customers can easily take the remittance money from the nearest GTB's branches by using "Western Union" which gives the service of remittance to over 200 foreign countries.

### **(c) Foreign Exchange of Global Treasure Bank**

Foreign Exchange is one of the function of Foreign Banking System. The customers can exchange three foreign currencies such as American Dollar, Euro Dollar and Singapore Dollar.

**(i) Western Union:** Bank provides western union over 200 countries & start operating international remittance from 3.1.2013. Customer can withdraw money within a few minutes which send from international any branches including HO.

- (ii) **Saving with foreign currency:** Bank provides saving with foreign currency which is dollar, Singapore dollar, euro. The account can be opened by individual, corporate & joint. Bank provides Telegraphic Transfer (TT), Letter of credit for trading.

### **3.4 Management of Waiting Line in GTB**

GTB has many of banking services such as day to day transactions are saving, current, remittance. Other transaction such as loan, overdraft and hire purchase services are minimum one month and maximum two or three months. So, this study is observed day to day transactions.

#### **3.4.1 Saving Transaction of Waiting Line**

Saving transactions are bank accounts available to customers, usually over 18 years of age. It's used for everyday transactions and expenses, as well as payments to other accounts. Most customers have their salary paid into this saving account. At the month of begin 1 to 5 days, most customers make deposit and withdrawal transaction because saving interest be relieved. For every saving transaction, generally waiting time is between minimum 5 minutes and maximum 15 minutes.

#### **3.4.2 Current Transaction of Waiting Line**

Transaction accounts are known by a variety of descriptions, including a current account, cheque account when held by a bank. They are commonly called current or cheque accounts. Current accounts are operated by both businesses and personal users. The bank maintains the account may charge the account holder maintenance or transaction fees or offer the service free to the holder. For current transaction, generally waiting time is minimum 5 minutes and maximum 20 minutes.

#### **3.4.3 Remittance Transaction of Waiting Line**

A remittance refers to money that is sent or transferred to another party. The most common way to making a remittance is by using an electronic payment system through a bank of money transfer service such as Western Union. If the customers

make remittance (encashment) transaction, the customers must take his/her NRC. The bank staff checks this card and then withdrawal the money. If the customers make remittance (Drawing) transaction, the customers must give relevant information of other party (such as NRC and phone no.) and then deposit the money. For, remittance customers, generally waiting time is minimum 5 minutes and maximum 15 minutes.

## **CHAPTER IV**

### **ANALYSIS OF QUEUING SYSTEM IN GTB**

This chapter obtains from primary sources. The method of data collection is through direct observation. The recording of relevant information such as; number of customers the arrival times of customers, waiting time, and service time. The observation was made during the working hours (9:00 am – 3:00 pm). The recorded information was used to calculate average waiting time, average service time and the utilization factor.

#### **4.1 Multiple-Server Queuing Model with Poisson Arrivals and Exponential Service Times (M/M/k)**

The model adopted two or more servers or channels are available to handle arriving customers. Let still assume that customers waiting service form one single line and then proceed to the first available server. For this queuing system, it is assumed that the arrivals follow a Poisson probability distribution with rate  $\lambda$ . Each of these channels has an independent and identical exponential time distribution.

The total service rate must be greater than the arrival rate, that is,  $k\mu > \lambda$ . If  $k\mu < \lambda$ , the waiting line would eventually grow infinitely large. Before using the formulas, check to be sure that  $k\mu > \lambda$

#### **4.2 Analysis of Saving Transaction Results and Explanations**

The multiple channel queuing system applied in Global Treasure Bank. According to actual condition, saving counter has (2) tellers and saving transaction's observed data presented in the table (4.1). The relevant transaction calculation results and as assuming condition saving counter has (3) tellers and then shown in the table (4.2).

**Table 4.1. Actual observed data on saving transactions (2 Tellers)**

<b>Sr No.</b>	<b>Date</b>	<b>Number of Customers</b>	<b>Average Service Time</b>
1.	2.10.2019	85	6
2.	3.10.2019	89	6
3.	4.10.2019	83	7
4.	7.10.2019	77	6
5.	8.10.2019	86	7
6.	9.10.2019	74	6
7.	10.10.2019	70	7
8.	16.10.2019	64	5
9.	17.10.2019	67	7
10.	18.10.2019	65	6
11.	21.10.2019	61	5
12.	22.10.2019	69	6
13.	23.10.2019	63	6
14.	24.10.2019	69	6
15.	25.10.2019	69	5
16.	29.10.2019	63	5
17.	30.10.2019	70	8
18.	31.10.2019	72	8
	<b>Total</b>	<b>1296 persons</b>	<b>112 minutes</b>

Source: Survey data 2019

According to the actual relevant of saving data observation, the whole of October has the operation days 18. This day has operated customers are 1296 persons and the average service time is 112 minutes.

**Table 4.2 Summary of Analysis of Saving transaction at Multiple-Server Queuing Model**

<b>Performance Measure</b>	<b>Actual condition ( 2 ) Tellers</b>	<b>Assuming condition ( 3 ) Tellers</b>
Arrival rate ( $\lambda$ )	12 Persons	12 Persons
Service rate ( $\mu$ )	10 Persons	10 Persons
System Utilization ( $\rho$ )	60 %	40 %
$L_s$ (persons)	1.875	1.293
$L_q$ (persons)	1.275	0.893
$W_s$ (hours)	0.156	0.074
$W_q$ (hours)	0.056	0.026
$P_o$	25 %	29 %
$P_w$	45 %	14 %

Source: Survey data 2019

According to table (4.1), actual saving transaction has (2) tellers which make cash deposit and withdrawal. The customer arrival rate per hour is 12 persons, service rate is 10 persons per hour. According to actual condition, at least (2) persons of customers are waited at saving counter between per hour. System utilization is 60 %, the average number of customer in the system is (1.875) and the average number of customer waiting in the system is (1.275). The average time customers spend in the system is (0.156) hr. and the average time customers wait in the queue. The probability of having no customer in the system is (25%) and the probability of customer is wait in the system is (45%).

According to table (4.2), saving teller has (3) tellers which make cash deposit and withdrawal. The customer arrival rate per hour is 12 persons, service rate is 10 persons per hour. According to actual condition, at least (2) persons of customers wait at saving counter between per hour. System utilization is (40%), the average number of customer in the system is (1.293) and the average number of customer waiting in

the system is (0.893). The average time customers spend in the system is (0.074) hr. and the average time customers wait in the queue is (0.026). The probability of having no customer in the system is (29%) and the probability of customer is wait in the system is (14%).

### 4.3 Analysis of Current Transaction Results and Explanations

The multiple channel queuing system applied in Global Treasure Bank. According to actual condition, current counter has (2) tellers and current transaction's observed data presented in the table (4.3). The relevant transaction calculation results and as assuming condition saving counter has (3) tellers and then shown in the table (4.4).

**Table 4.3 Actual observed data on current transactions (2 Tellers)**

<b>Sr No.</b>	<b>Date</b>	<b>Number of Customers</b>	<b>Average Service Time</b>
1.	2.10.2019	92	7
2.	3.10.2019	103	6
3.	4.10.2019	98	5
4.	7.10.2019	104	6
5.	8.10.2019	101	7
6.	9.10.2019	96	6
7.	10.10.2019	92	5
8.	16.10.2019	96	6
9.	17.10.2019	102	5
10.	18.10.2019	96	5
11.	21.10.2019	87	5
12.	22.10.2019	92	6
13.	23.10.2019	101	5

<b>Sr No.</b>	<b>Date</b>	<b>Number of Customers</b>	<b>Average Service Time</b>
14.	24.10.2019	96	6
15.	25.10.2019	95	5
16.	29.10.2019	92	6
17.	30.10.2019	94	5
18.	31.10.2019	93	5
	<b>Total</b>	<b>1730 persons</b>	<b>101 minutes</b>

Source: Survey data 2019

According to the actual relevant of current data observation, the whole of October has the operation days 18. This day has operated customers are 1730 persons and the average service time is 101 minutes.

**Table 4.4 Summary of Analysis of current transaction at Multiple-Server Queuing Model**

<b>Performance Measure</b>	<b>Actual condition ( 2 ) Tellers</b>	<b>Assuming condition ( 3 ) Tellers</b>
Arrival rate ( $\lambda$ )	16 Persons	16 Persons
Service rate ( $\mu$ )	11 Persons	11 Persons
System Utilization ( $\rho$ )	72 %	48 %
$L_s$	3.078	1.663
$L_q$	2.358	1.183
$W_s$ (hours)	0.192	0.103
$W_q$ (hours)	0.101	0.012
$P_o$	16 %	22 %
$P_w$	61 %	22 %

Source: Survey data 2019

According to table (4.3), actual current transaction has (2) tellers which make cash deposit and withdrawal. The customer arrival rate per hour is 16 persons, service rate is 11 persons per hour. According to actual condition, at least (5) persons of customers are waited at current counter between per hour. System utilization is 72 %, the average number of customer in the system is (3.08) and the average number of customer waiting in the system is (2.36). The average time customers spend in the system is (0.192) hr. and the average time customers wait in the queue is (0.101). The probability of having no customer in the system is (16%) and the probability of customer is wait in the system is (61%).

According to table (4.4), current teller has (3) tellers which make cash deposit and withdrawal. The customer arrival rate per hour is 16 persons, service rate is 11 persons per hour. According to actual condition, at least (5) persons of customers wait at current counter between per hour. System utilization is (48%), the average number of customer in the system is (1.663) and the average number of customer waiting in the system is (1.183). The average time customers spend in the system is (0.103) hr. and the average time customers wait in the queue is (0.012) hr. The probability of having no customer in the system is (22%) and the probability of customer is wait in the system is (22%).

#### **4.4 Analysis of Remittance Transaction Results and Explanations**

The multiple channel queuing system applied in Global Treasure Bank. According to actual condition, current counter has (2) tellers and current transaction's observed data presented in the table (4.5). The relevant transaction calculation results and as assuming condition saving counter has (3) tellers and then shown in the table (4.6).

**Table 4.5 Actual observed data on remittance transactions (2 Tellers)**

<b>Sr No.</b>	<b>Date</b>	<b>Number of Customers</b>	<b>Average Service Time</b>
1.	2.10.2019	91	8
2.	3.10.2019	88	6
3.	4.10.2019	82	8

<b>Sr No.</b>	<b>Date</b>	<b>Number of Customers</b>	<b>Average Service Time</b>
4.	7.10.2019	91	6
5.	8.10.2019	76	8
6.	9.10.2019	72	6
7.	10.10.2019	80	7
8.	16.10.2019	74	6
9.	17.10.2019	75	9
10.	18.10.2019	82	7
11.	21.10.2019	79	6
12.	22.10.2019	73	5
13.	23.10.2019	81	5
14.	24.10.2019	76	7
15.	25.10.2019	81	6
16.	29.10.2019	74	8
17.	30.10.2019	72	8
18.	31.10.2019	83	5
	<b>Total</b>	<b>1430 persons</b>	<b>121 minutes</b>

Source: Survey data 2019

According to the actual relevant of remittance data observation, the whole of October has the operation days 18. This day has operated customers are 1430 persons and the average service time is 121 minutes.

**Table 4.6 Summary of Analysis of remittance transaction at Multiple-Server Queuing Model**

<b>Performance Measure</b>	<b>Actual condition ( 2 ) Tellers</b>	<b>Assuming condition ( 3 ) Tellers</b>
Arrival rate ( $\lambda$ )	13 Persons	13 Persons
Service rate ( $\mu$ )	9 Persons	9 Persons
System Utilization ( $\rho$ )	72 %	48 %
$L_s$	2.271	1.646
$L_q$	1.551	1.166
$W_s$ (hours)	0.175	0.127
$W_q$ (hours)	0.064	0.016
$P_o$	16 %	22 %
$P_w$	60 %	22 %

Source: Survey data 2019

According to table (4.5), actual remittance transaction has (2) tellers which make cash deposit and withdrawal. The customer arrival rate per hour is (13) persons, service rate is (9) persons per hour. According to actual condition, at least (4) persons of customers are waited at remittance counter between per hour. System utilization is 72 %, the average number of customer in the system is (2.271) and the average number of customer waiting in the system is (1.551). The average time customers spend in the system is (0.175) hr. and the average time customers wait in the queue is (0.064). The probability of having no customer in the system is (16%) and the probability of customer is wait in the system is (60%).

According to table (4.6), remittance teller has (3) tellers which make cash deposit and withdrawal. The customer arrival rate per hour is (13) persons, service rate is (9) persons per hour. According to actual condition, at least (4) persons of customers wait at saving counter between per hour. System utilization is (0.48), the average number of customer in the system is (1.646) and the average number of

customer waiting in the system is (1.166). The average time customers spend in the system is (0.127) hr. and the average time customers wait in the queue is (0.016) hr. The probability of having no customer in the system is (22%) and the probability of customer is wait in the system is (22%).

## **CHAPTER V**

### **CONCLUSION**

This chapter includes three parts. Firstly, finding and discussion of operation process for waiting line system, sometimes need to increase one counter each transaction that is including saving, current and remittance transaction at Global Treasure Bank. The second part includes suggestion and recommendation of the study. The last part of chapter present needs for further studies.

#### **5.1 Finding and Discussion**

According saving operations results shown the arrival rate and service rate are same at the 2 tellers and 3 tellers service. System utilization results is (2) tellers service is 20 % more than (3) tellers service. Both of average number of customer in the system and average number of customers waiting to be served in operations are reduced quality (3) tellers service less than (2) tellers service. So, the average time a customer spends in the system and average time a customer queue in the system at (3) tellers service are less than (2) tellers service. The probability of having no customer in the system at (3) tellers' operation is more than (2) tellers' operation and the probability of customer has to wait is less than (2) teller service operation. So, this study wants to find out if increasing the number of tellers can help to reduce the amount of time spent on queue.

According current operations results shown the arrival rate and service rate are same at the 2 tellers and 3 tellers service. System utilization results is (2) tellers service is 24 % more than (3) tellers service. Both of average number of customer in the system and average number of customers waiting to be served in operations are reduced quality (3) tellers service less than (2) tellers service. So, the average time a customer spends in the system and average time a customer queue in the system at (3) tellers service is less than (2) tellers service. The probability of having no customer in the system at (3) tellers' operation is more than (2) tellers' operation and the probability of customer has to wait is less than (2) teller service operation. So, this study want to find out if increasing the number of tellers can help to reduce the amount of time spent on queue.

According to remittance operations results, the arrival rate and service rate are the same for 2 tellers and 3 tellers service. System utilization results for 2 tellers service is 24% more than for 3 tellers service. Both the average number of customers in the system and the average number of customers waiting to be served in operations are reduced for 3 tellers service compared to 2 tellers service. So, the average time a customer spends in the system and the average time a customer queue in the system for 3 tellers service is less than for 2 tellers service. The probability of having no customer in the system for 3 tellers' operation is more than for 2 tellers' operation, and the probability of a customer having to wait is less than for 2 teller service operation. So, this study wants to find out if increasing the number of tellers can help to reduce the amount of time spent on queue.

## **5.2 Suggestions and Recommendations**

The first objective of this study can determine waiting line in GTB by the observation and calculation results. The second objective of this study can explore the shorter waiting time for the customers and quicker service rate by increasing the number of tellers. The service counters are not fully functional for the utility payments sometimes in the morning, during lunch hours, when traffic punishment payments are high and 1 or 2 servers are added for it, when a service counter is out of service and when some staffs are either late or absent from their work place. In queuing system, the balance between dealing with all customers fairly and the performance of the system is very important. Sometimes the performance of the system is more important than dealing with the customers fairly.

## **5.3 Needs for Future Studies**

The impact of waiting time on the system performance and how to improve the efficiency of the system operations. Based on this review, we will further design a model for the Queuing system for customer management in banks. The results of the findings gathered from the previous researches performed over Queuing systems. These findings will be used in the future research to analyze the system performance of the proposed Queuing model for banks. It will be more effective to add more factors in testing to take the right decision for choosing one of the available scheduling algorithms, such as throughput, utilization and response time.

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## APPENDIX (A)

For Actual Condition of Saving Transactions(2 Tellers),

Total number of customers for 18 days = 1296 persons

Average number of customers per day =  $1296/18 = 72$  persons

Arrival rate(  $\lambda$  ) =  $72/6 = 12$  persons

Total Service time for 18 persons = 112 min

Average service time for a person =  $112 / 18 = 6.22$  min

Service rate (  $\mu$  ) =  $60 / 6.22 = 9.65 \sim 10$  persons per hour

System of utilization factor :

$$\rho = \lambda / k\mu = 12 / 20 = 0.6 = 60 \%$$

The probability that there are zero customers in the system:

$$P_0 = \left[ \sum_{n=0}^{k-1} \frac{1}{n} \left( \frac{\lambda}{n!} \right)^k + \frac{1}{n} \left( \frac{\lambda}{\mu} \right)^k \frac{k\mu}{k\mu - \lambda} \right]^{-1}$$

$$P_0 = [1 + (12/10) + (12/10)^2/2 \times (20/8)]^{-1}$$

$$P_0 = 0.25 = 25 \%$$

The probability that a customer has to wait:

$$P_w = \frac{1}{k!} \left( \frac{\lambda}{\mu} \right)^k \frac{k\mu}{k\mu - \lambda} P_0$$

$$P_w = \frac{1}{2} (12/10)^2 \times (20/8) \times 0.25 = 0.45 = 45 \%$$

The average number of customers in the system:

$$L_s = \frac{\lambda\mu \left( \frac{\lambda}{\mu} \right)^k}{(k-1)!(k\mu-1)^2} P_0 + \frac{\lambda}{\mu}$$

$$L_s = \{ [(12 \times 10) (12/10)^2] / 64 \} \times 0.25 + 12/10 = 1.875$$

The average number of customers in the queue:

$$L_q = L_s - \rho$$

$$L_q = 1.875 - 0.6 = 1.275$$

The average time a customer spends in the system:

$$W_s = L_s / \lambda = 1.875 / 12 = 0.156 \text{ hour}$$

The average time a customer spends in the queue:

$$W_q = W_s - (1 / \mu) = 0.156 - (1/10) = 0.056 \text{ hour}$$

## APPENDIX (B)

For Actual Condition of Current Transactions (2 Tellers),

Total number of customers for 18 days = 1730 persons

Average number of customers per day =  $1730/18 = 96$  persons

Arrival rate ( $\lambda$ ) =  $96/6 = 16$  persons

Total Service time for 18 persons = 101 min

Average service time for a person =  $101 / 18 = 5.61$  min

Service rate ( $\mu$ ) =  $60 / 5.61 = 10.69 \sim 11$  persons per hour

System of utilization factor:

$$\rho = \lambda / k\mu = 16 / 22 = 0.72 = 72 \%$$

The probability that there are zero customers in the system:

$$P_0 = \left[ \sum_{n=0}^{k-1} \frac{1}{n} \left( \frac{\lambda}{n!} \right)^k + \frac{1}{n} \left( \frac{\lambda}{\mu} \right)^k \frac{k\mu}{k\mu - \lambda} \right]^{-1}$$

$$P_0 = [1 + (16/11) + (16/11)^2 / 2 \times (22/8)]^{-1}$$

$$P_0 = 0.157 \sim 16 \%$$

The probability that a customer has to wait:

$$P_w = \frac{1}{k!} \left( \frac{\lambda}{\mu} \right)^k \frac{k\mu}{k\mu - \lambda} P_0$$

$$P_w = \frac{1}{2} (16/11)^2 \times (22/6) \times 0.157 = 0.61 = 61 \%$$

The average number of customers in the system:

$$L_s = \frac{\lambda \mu (\lambda/\mu)^k}{(k-1)!(k\mu-1)^2} P_0 + \frac{\lambda}{\mu}$$

$$L_s = \{ [(16 \times 11) (16/11)^2] / 36 \} \times 0.157 + 16/11 = 3.078$$

The average number of customers in the queue:

$$L_q = L_s - \rho$$

$$L_q = 3.08 - 0.72 = 2.358$$

The average time a customer spends in the system:

$$W_s = L_s / \lambda = 3.08 / 16 = 0.192 \text{ hour}$$

The average time a customer spends in the queue:

$$W_q = W_s - (1 / \mu) = 0.192 - (1/10) = 0.101 \text{ hour}$$

## APPENDIX (C)

For Actual Condition of Remittance Transactions (2 Tellers),

Total number of customers for 18 days = 1730 persons

Average number of customers per day =  $1730/18 = 96$  persons

Arrival rate ( $\lambda$ ) =  $96/6 = 16$  persons

Total Service time for 18 persons = 101 min

Average service time for a person =  $101 / 18 = 5.61$  min

Service rate ( $\mu$ ) =  $60 / 5.61 = 10.69 \sim 11$  persons per hour

System of utilization factor:

$$\rho = \lambda / k\mu = 16 / 22 = 0.72 = 72 \%$$

The probability that there are zero customers in the system:

$$P_0 = \left[ \sum_{n=0}^{k-1} \frac{1}{n} \left( \frac{\lambda}{n!} \right)^k + \frac{1}{n} \left( \frac{\lambda}{\mu} \right)^k \frac{k\mu}{k\mu - \lambda} \right]^{-1}$$

$$P_0 = [1 + (16/11) + (16/11)^2 / 2 \times (22/8)]^{-1}$$

$$P_0 = 0.157 \sim 16 \%$$

The probability that a customer has to wait:

$$P_w = \frac{1}{k!} \left( \frac{\lambda}{\mu} \right)^k \frac{k\mu}{k\mu - \lambda} P_0$$

$$P_w = \frac{1}{2} (16/11)^2 \times (22/6) \times 0.157 = 0.61 = 61 \%$$

The average number of customers in the system:

$$L_s = \frac{\lambda \mu (\lambda/\mu)^k}{(k-1)!(k\mu-1)^2} P_0 + \frac{\lambda}{\mu}$$

$$L_s = \{ [(16 \times 11) (16/11)^2] / 36 \} \times 0.157 + 16/11 = 3.078$$

The average number of customers in the queue:

$$L_q = L_s - \rho$$

$$L_q = 3.08 - 0.72 = 2.358$$

The average time a customer spends in the system:

$$W_s = L_s / \lambda = 3.08 / 16 = 0.192 \text{ hour}$$

The average time a customer spends in the queue:

$$W_q = W_s - (1 / \mu) = 0.192 - (1/10) = 0.101 \text{ hour}$$