CHAPTER ONE

**INTRODUCTION**

* 1. **Background to the Study**

The queuing ugly scenario is a quest to strike a balance between the average waiting time for motorists, vehicles, etc. and the idle time of the attendants in the filling station. The problems of queues are very popular in the day to day activities. Queues are often seen at the bus stop, ticket booths, petrol pump, bank counter, traffic lights and so on. Queuing theory deals with the mathematical description of the behaviour of queues and can apply to a variety of operational situations where it is not possible to predict the arrival rate of customers and service rate of service facilities accurately. Queuing theory has all the required tools for the analysis of queue system. It can be used to determine the level of service (either the service rate or the number of service facilities).

A queuing system consists of one or more servers that provide service of some sort to arriving customers. Customers who arrive to find all servers busy generally join one or more queues (waiting lines) in front of the servers, hence the name queuing systems. Waiting phenomenon is not an experience limited to human beings only: jobs wait to be processed in a machine, planes circles in a stack before given permission to land at an airport, trucks at central market wait for loading and offloading, in warehouse, items wait to be used, incoming calls wait to mature in the telephone exchange.

Delays and queuing problems are most common features not only in our daily-life situations such as at a bank or post office, at a ticketing office, in public transportation or in a traffic jam but also in more technical environments, such as in manufacturing, computer networking and telecommunications. They play an essential role for business process re-engineering purposes in administrative tasks. “Queuing models provide the analyst with a powerful tool for designing and evaluating the performance of queuing systems.”

Whenever customers arrive at a service facility, some of them have to wait before they receive the desired service. It means that the customer has to wait for his/her turn, may be in a line. Customers arrive at a service facility with several queues, each with one server. The customers choose a queue of a server according to some mechanism (e.g., shortest queue or shortest workload).

In some queuing systems customers arrive according to some stochastic process (e.g., a Poisson process) and immediately upon arrival must join one of the queues, thereafter to be served on a first-come first-served basis, with no jockeying or defections allowed. The service times are independent and identically distributed with a known distribution. Moreover, the service times are independent of the arrival process and the customer decisions.

Queuing analysis helps to provide better services and achieves higher efficiency. In marketing, distribution and retailing of petroleum products in Nigeria, queuing allows the system to queue their customers request until free servers become available.

To design an effective congestion control structure, a good knowledge of the relationship between the congestion and delay is needed. Queuing is due to the randomness in service time, and the principal actors are the customer and the server. The causes of congestion in petrol station may include;

1. Faulty fuel pump dispensary (meter).
2. Inaccurate metering and high cost of fuel at other filling station.
3. Location of the filling station,
4. Inadequate service space and channels in the retail outlets.
5. Scarcity of petroleum products from the supply source, which results in;
6. Creating chaotic situations at the service facility.
7. Customers having to wait for too long without being served.
8. Impatient customers are leaving thereby affecting their goodwill.

Queues or queuing theory was first analyzed by A.K Erlang in 1913 in the context of telephone facilities. It is extensively practiced or utilized in industrial setting or retail sector-operations management, and falls under the purview of decision sciences.

Queuing theory is the mathematical study of waiting lines, or queues. The theory enables mathematical analysis of several related processes, including arriving at the (back of the) queue, waiting in the queue (essentially a storage process), and being served at the front of the queue. The theory permits the derivation and calculation of several performance measures including the average waiting time in the queue or the system, the expected number waiting or receiving service, and the probability of encountering the system in certain states, such as empty, full, having an available server or having to wait a certain time to be served.

Queuing theory has applications in diverse fields including telecommunications, traffic engineering, computing and the design of factories, shops, offices and hospitals. Queue theory has also been found useful in real-world healthcare situations. McClain conducted a research on models for evaluating the impact of bed assignment policies on utilization, waiting time, and the probability of turning away patients. Queue theory was also applied in pharmacy with particular attention to the improvement of customer satisfaction and it was stated that customer satisfaction is improved by predicting and reducing waiting times and adjusting staffing according. Nosek, Jr., R.A. and Wilson, J.P. “Queuing theory and customer satisfaction: a review of terminology, trends, and applications to pharmacy practice”. The theory of queuing as applied in healthcare was presented by Green in Queueing analysis in healthcare, in Patient Flow: Reducing Delay in Healthcare Delivery, who discussed the relationship amongst delays, utilization and the number of servers. The use of queuing theory to get approximate results in any queuing system as well as the application of simulation models to refine the obtained results was also studied by Fiems et al.

Ani, C. I. “Resource Allocation Methodology for Internet Heterogeneous Traffic, Nigerian Journal of Technology”, studied a resource allocation methodology for internet traffic system and explained that the most important quality of service parameters associated with the buffer queuing process at each node (service point) are traffic frame loss rate, traffic frame delay and frame delay variation (jitter). It was also explained that the quality of service parameters relating to specific traffic load and transmission rates are obtained by evaluating the performance of the queuing process at a node for a given buffer size. Queuing theory was employed to address practical questions of sizing and availability assessments, important issues for airspace control systems, indicating useful techniques for the management of critical mission control centres, where many aspects related to human operation, fault tolerance, degraded operation, and demand of service maintenance are basic concerns. A path-combiner was employed in simulation modelling in the study of the effect of data traffic patterns on quality of service parameters order to ensure that the arriving traffic has equal probability of being served in the queue in a random manner. The queue was serviced by a server working at a fixed service rate for all the distributions and using a queue service discipline of first-in-first-out (FIFO).

Application of queuing theory is an attempt to minimize cost through minimization of inefficiencies and delays in a system and there are many problems in health care system which can be solved using queuing theory in operational research. The effectiveness of a queuing model in identifying provider staffing patterns to reduce the fraction of patients who leave without being seen was examined and it was concluded that queuing models can be extremely useful in most effective allocation of staff. The application of queuing theory may be of particular benefit in pharmacies with high volume outpatient workloads and/or those that provide multiple points of service. By better understanding queuing theory, service managers can make decisions that increase the satisfaction of all relevant groups: customers, employees and management. A queuing model was also used by Gorunescu et al. and Siddharthan et al. to determine the main characteristics of the access of patients to hospital, such as mean bed occupancy and the probability that a demand for hospital care is lost because all beds are occupied.

**1.2** **Statement of the Problem**

A queuing process is said to be operative and we consequently face a queuing problem when either customers requiring service have to wait because the service facility is busy or the service facility are to wait for customers (remain idled).

Many previous studies have been conducted to investigate how waiting in line in a service system affect customer's goodwill. Queues occur when there is too much demand on service facilities or an inadequate number of service facilities. That is, when the request for a service facility exceeds the capacity of that facility, the servers spend much time in serving just some of customers. It is on this note that many customers are not able to receive adequate services on time so that we say that there is an excess of waiting time.

Also, there is a queue problem when there is less demand on service facilities leading to too much idle facility time or too many facilities. This warrant the customers to wait before service or the service facilities stand idle and wait for customers. Queues or waiting lines are regular happenings that occur in our everyday life and different organizations or different settings like fuel stations and varieties of business situations. Observing the fact that one major problem customers encounter in a fuel station are waiting time, it becomes relevant that a study of this process is conducted to find a solution to the long waiting time in the station.

This project is based on the perceptive that most of these challenges can be managed by using queuing model to determine the waiting line performance such as: average arrival rate of customers, average service rate of customers, system utilization factor and the probability of a specific number of customers in the system. The resulting performance variables can be used by the policy makers to increase competence, improve the quality of service and reduce cost in managing the filling station as well.

**1.3 Aims and Objectives of the Study**

The aim of this study is to determine the amount of average time customers spend on a queue and actual time of service delivery. That is, to examine the possible delay at the BOVAS filling station, Opopogboro, Ado Ekiti.

Therefore the objectives of this study are as follows:-

(1) To determine the optimal service level for the facility.

(2) Determine the arrival and service rate distributions of customers purchasing FUEL from the petrol station.

(3) Use the existing model to obtain the values for the queuing parameters.

**1.4 Research Questions**

1. What is the mean number of arrivals per hour (λ)?

2. What is the mean number of customers served per hour (µ)?

3. What is the relationship between the mean number of arrivals and the mean number of customers served per hour (λ and µ)?

4. What is the average time a patient spends waiting in the queue before being attended to by the attendant?

5. What resources needed to reduce the length of queues at the filling station and increase customers’ satisfaction?

**1.5 Significance of the Study**

The importance of this study cannot be overemphasized as it will highlights the relationship between congestion and delay and its relevance to designing an effective congestion control for any system.

The study will help BOVAS filling station, Opopogboro Ado Ekiti to improve their quality of service by anticipating if there are many customers in the queue, determine the average time a customer spends in queue, determine the average time a customer is to be served, and the utilization rate.

This study will be a reference to analyse the current system at the filling station and improve the next system.

Generally, this study will further enriched management literature on queuing theory. This work will be of practical significance to scholars, managers, businessmen and students alike.

**1.6 Research hypothesis**

The following hypotheses will be tested.

**Hypothesis 1**

Ho: The arrival pattern of applicants follows a poison distribution.

H1: The arrival pattern of applicants does not follow a poison distribution.

**Hypothesis 2**

H0: The distribution of service time fits an exponential distribution.

H1: The distribution of service time does not fit an exponential distribution