**CHAPTER 3**

**METHODOLOGY**

**3.1 Introduction**

According to the dictionary the Petit Larousse illustrated (2008), the methodology *is "The systematic study by observation of the scientific practice, the basic principles and methods of research that it uses".* The methodological framework of our work described all the methods and instruments used to collect the information we need as well as the procedure of the analysis and interpretation of the information gathered.

**3.2 Research Design**

A **research design** is a systematic plan to study a scientific problem. (Gorard, 2013)

In this study, the customers are coming from an infinite population and the system was enough to receive all the customers coming in to the filling station.

There were also six servers (6 servers) to receive customers.

From above conditions the model to be used is ***M* /*M* / *c*: FCFS/∞/∞**

Where;

M=Markovian (or Poisson) arrivals and exponential service time.

*c* Multi-server; where in our case *c* is equal to six fuel pump working in the filling station.

FCFS = First come, first served;

∞ = Infinite system limit;

∞ = Infinite source limit.

For the purpose of modeling, the arrivals (n) are the customers. As each reaches the filling station, he/she books for service. If service is rendered immediately he/she leaves the filling station or otherwise joins the queue. The fuel pumps are the servers (*c*).

The arrival rate, service time and number of servers were the data used for the study that have been collected using observation method. The data collection covered a period of 7 consecutive working days, between the hours of 7:00 am to 6:00 pm. The duration and time interval is to enable the researcher collect a representative data that considered traffic in weekdays and weekend (and also slacks/idle times and peak periods).

**3.3 Population of Inquiry**

Depelteau. F. (2000, p. 213) defines the population as being" *a set of all individuals who have precise characteristics in relationship with the objectives".* For our case, the population of inquiryconcerned the customers who are coming in to Bovas filling station, opopogboro Ado Ekiti to purchase fuel.

**3.4 Sampling Frame**

In statistics, a sampling frame is the source material or device from which a sample is drawn. It is a list of all those within a population who can be sampled, and may include individuals, households or institutions (Carl, 2003). For our case, the sampling frame concerned the customers who were coming to purchase fuel in Bovas filling station, Opopogboro Ado Ekiti every day.

However, given that the customers arrive randomly and we are most interested by the period between two successive customers, we have taken our sampling frame as number of hours in a year to collect arrival and service data.

**3.5 Sample and Sampling Technique**

**3.6 Instruments**

In my work, different documents have been used such as books, reports and electronic sources.

All these documents helped me to make the conceptual and theoretical framework of my work as well as to analyze the data and interpret the results. Also, I have used a register to record discrete time for customer arrival and service. So as t prevnt error, a stop clock and pen will be used to record the observation.

Also, formal and informal interviews at an individual level of discussions were conducted to obtain adequate clarification about other variables that can influence the development of the queuing model for customers’ congestion at the fueling terminal.

**3.7 Data Collection Procedure**

In this project the observation technique has been used where I registered the time when every customer enters the filling station and a time when he/she comes out from the filling station. This helped to draw a table used in estimating the average number of customer that entered in to the system and average number of customer served in one hour. From this I have estimated the remaining performance parameters of the system. These data have been collected for a period of 7 working days, from 07:00 A.M to 12:00 and from 01:00 P.M to 06:00 P.M. An oral interview has been used to collect staff opinions about causes and proposed solutions of queues.

**3.8 Data Processing and Analysis**

For analysis of our data and interpretation of the results, different computer tools have been used especially Microsoft Excel and SPSS. The data collected using observation technique has been entered in Excel spread sheet for cleaning and convert the recorded time in interval time and then imported in SPSS for analysis where descriptive statistics and significance test have been carried out as well as estimation of different performance parameters describing the behavior of the system.

The data from questionnaire has been directly entered in a designed SPSS sheet for cleaning and analysis. The figures and tables were interpreted in scope predefined objectives in order to make data meaningful and come out with conclusions and recommendations.

The system performance parameters used in this study were defined as follows:

**λ**: Arrival rate of customers at Bovas filling station per hour;

**μ**: Service rate ( Length of stay) of customers at Bovas filling station per hour;

**C**: Number of fuel pump (servers) working in Bovas filling station.

In this model, there are six parallel fuel pump

*ρ:*  Filling station utilization factor = λ/Cμ,

**Lq**: Average number of patients at outpatient department in the queue.

Lq

**L**: Average number of customers in the system = *Lq*

**Wq**: Waiting time of customers in the queue = Lq/ λ

**W**: Waiting time of customers in the system = L/ λ

**Pn** = probability of n customers existing in the system.

Pn =

Po = Possibility of 0 outpatients existing in the system.

P0 =