APPLICATION OF QUEUING THEORY TO COMMERCIAL BANKING (A CASE STUDY OF STANDARD TRUST BANK P.L.C MINNA BRANCH)

BY

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PGD / MCS/2001/1100

DEPARTMENT OF MATHEMATICS / COMPUTER SCIENCE, FEDERAL UNIVERSITY OF TECHNOLOGY MINNA

NOVEMBER, 2003

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A PROJECT SUBMITTED TO THE DEPARTMENT OF MATHEMATICS / COMPUTER SCIENCE, FEDERAL UNIVERSITY OF TECHNOLOGY MINNA IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE AWARD OF THE POST GRADUATE DIPLOMA IN COMPUTER SCIENCE

NOVEMBER, 2003

DEDICATION

This research work is dedicated unto the ***"Most High God".***

CERTIFICATION

This project has been read and certified by the undersigned as meeting the requirements of the Department of Mathematics / Computer Science, Federal University of Technology, Minna.

MR. L.N. EZEAKO	***DATE***
SUPERVISOR	
MR. L.N. EZEAKO	***DATE***
HEAD OF DEPARTMENT	
EXTERNAL EXAMINER	***DATE***

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May the good Lord reward you all accordingly.

Akinlolu, Sunday Olawale

NOVEMBER, 2003

ABSTRACT

A queuing system is being examined because it is seen to be out of balance in some respect. There may be long queues and hence long waiting times for an arrival, or alternatively there might be greater capacity to serve the customers than required, thereby resulting in under utilization of the service facility. In any case, one is interested in the economic balance in the system. This is a balance between the cost of providing service and the cost incurred by the customer or the time loss by the customer waiting for service.

Based on the above-mentioned problems, the need for automation cannot be over-emphasized. This was carried out by using Visual Basic language of achieve the desired results.

CHAPTER THREE

SYSTEMS ANALYSIS AND DESIGN

CHAPTER FOUR

SYSTEMS IMPLEMENTATION

CHAPTER FIVE

1.5 VALUE ADDING PRODUCT

Creating and sustaining top – of – the – market financial and electronic products in the Nigeria banking industry has always been the priority of the bank. These products, customs – made to meet the special needs of her customers, are of premium quality and compete favourably with similar banking products anyway in the World. These high quality products has made the bank the toast of the industry and they drive her steady earnings and growth. These products have been conceptualized from several months of intensive research and the experience the bank shares with her customers, which have been consistently well received. The value adding products includes the following;

1.5.1 Saving Account

This is a regular savings account with interest pegged at 6% per annum and a minimum opening balance of #2,000 that entitles the account holder to several benefits including the right to make lodgments and draw down on the account at any of the bank's business offices nationwide. The minimum opening balance is a further indication of the bank's flexibility in the crusade to satisfy her customers. It is this ability to bend to the customers wish without compromising standards that has contributed the most to the strength of the bank.

1.5.8 Current Account

Current account holders enjoy the flexibility of issuing Cheques to third parties for encashment or lodgment into their account in a bank of their choice. Cheques drawn on other banks can also be lodged into the account. Customers with huge turnover enjoy some concessions from the bank. A monthly statement of account is rendered to each account holder.

1.5.9 Franchise Services

In line with the banks mission of being a partner with her clients through the provision of a complete range of banking services, Standard Trust Bank identifies with the Federal and State Governments by serving as a designated bank for their internal revenue generation schemes. The bank also identifies with strategic parastatals in the Nigerian economy such as the Nigerian Customs Services, Nigerian Telecommunications Limited, Mobile Telecommunications Limited, Nigerian Ports Authority and the National Maritime Authority by ensuring easy payment of levies and taxes nationwide. Payments for examinations by ***WAEC, NECO and JAMB*** are also effected across all her Business offices nationwide.

1.5.10 Trust Pay

This is a product specially designed to ease the logistical problems associated with salary administration for employers of large workforces, in both the public and private sectors. The Card works in conjunction with an electronic card account to offer workers access to their salaries everybody of the week using the bank's ATM network. The accounts are credited with the salaries electronically from the

employers' offices. The ATM may be deployed to the same location to reduce wasted man – hours resulting from workers going to the bank en-masse on payday.

1.5.11 Cash Fast LMT

Cash fast Local Money Transfer is a fast, safe and convenient way by which customers and non-customers of the bank can send money to their business partners, relatives, Friends anywhere in the country. With Standard Trust Bank's network of 80 Business Offices strategically located in all the state capitals and major energy and commercial centers nationwide and superior information technology, transferred funds are ready for collection by the beneficiaries as soon as the sender makes payment from any of the bank's business offices. The high point of the service is that only the sender knows the code with which the funds can be collected thereby making it fraud proof.

1.5.12 Cash Fast IMT

Cash fast International Money Transfer is another variation of the cash fast product, which makes use of recent advancements in Internet technology to satisfy the needs of Nigerians living abroad who wish to transfer money to friends and relatives living in Nigeria. Presently, the bank is in partnership with two international money transfer orgnisations namely: Transcheque Services Incorporation, London with more than 2,000 agents World Wide and eUScash dot com, an international money transfer company with head office in Atlanta, USA and branches all over U.S and Canada.

CHAPTER ONE

HISTORICAL BACKGROUND OF THE BANK

The Bank was incorporated in Nigeria as a private limited liability company on 15th March, 1990. It obtained its license to operate as a Commercial Bank on the 5th March, 1990 and commenced business on the 4th June, 1990.

The bank was restructured on 30th July, 1997 and the name was changed from Crystal Bank of Africa Limited to Standard Trust Bank Limited.

Standard Trust Bank, Commenced operations in August 1997 as a commercial Bank with five Business offices driven by a Board of Directors, a management team and staff focused on revolutionizing the Nigerian Banking Industry. The Bank transformed into a full Universal Bank, after obtaining the necessary approvals of the Central Bank of Nigeria. Following the resolution of the Board of Directors at an Extra – ordinary General Meeting on 19th July, 2002, the bank became a Public Limited Company (PLC). By so doing, the bank affirms its position as a truly national institution by virtue of ownership and geographical spread.

The bank, from its humble beginning has been able to record modest achievements, which make her today, one of the leading banks in Nigeria. This has been made possible by her commitment to excellent service delivery anchored on all branch networking and sound professional values.

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Standard Virtual Customers Can:

- Transfer funds securely from their accounts to named beneficiaries who may not be customers of the bank
- Check balances, pay bills, Purchase GSM airtime, request for various banking services among others
- Conduct a range of enquiries and transactions over any touch – tone telephone
- Leverage on the Wireless Application Protocols features of their GSM telephone to conduct transactions on Internet.
- Withdraw cash from their account through any of the bank's ATM located nationwide, round- the – clock.

1.6 OBJECTIVES OF THE STUDY

The researcher has been motivated to study the activities of the bank with particular reference to how the bank contends with the problem of congestion in rendering quality service to her customers in a highly competitive banking environment. Taking into consideration the high expectation and demands from the customers and to offer useful suggestions.

The main objectives include the following:

(a) Is it worthwhile to invest effort in reducing the service time?

(b) How many servers should be employed

(c) Should priorities for certain types of customers be introduced?

(d) Is the waiting area for customers adequate?

1.7 DEFINITION OF TERMS

(1) ***ARRIVAL:*** This defines the way customers enter the system or the bank

(2) ***SERVICE:*** This represents some activity that takes time and the customers are waiting

(3) ***QUEUE:*** This represents a certain number of customers waiting for service

(4) ***OUTPUT:*** It represents the way customers leave the system

(5) ***ARRIVAL RATE:*** This is the mean number of arrivals per time period. It is represented with Lamda (λ).

(6) ***SERVICE RATE:*** This is the mean number of customers served per time period. It is represented with 'mu' (μ).

(7) ***DEPARTURE RATE:*** This is the number of departures per unit time

(8) ***TRAFFIC INTENSITY:*** This is a measure of the congestion of the system

(9) ***MAXIMUM QUEUE SIZE:*** This is the maximum number of customers that wait in the queue plus the one(s) being served

The corporate identity of the bank rests on four fundamental values, which goes with the acronym ***"H.E.I.R".***

1. Humility

The bank is meek and believe the "Customer is King" Her products and services cover every segment of the market. At Standard Trust, they do not despise small beginnings. The bank supports numerous pioneering efforts and new businesses.

2. Empathy

The bank seeks to know its customers and understand their businesses very well, with a view to developing mutually beneficial and enduring relationships. The banks communities are affected positively in several ways through well – planned and executed community relation projects.

3. Integrity

The bank upholds moral excellence, honesty, wholeness and sincerity in all its interactions with everyone - customers, service providers, staff and all other stakeholders. This value has been of tremendous help in building the Standard Trust Brand.

4. Resilience

The banks innate ability to bounce back from any setback in an even better shape is one virtue that sets her apart from the crowd. The customers have not only recognized this value, they reinforce it by their sophisticated service expectations.

1.5.2 *Standard Gold*

This is a unique savings account for the discerning clientele, the standard Gold Savings Account is highly exclusive with a minimum balance of N20,000. interest rates are graduated to reflect volumes and reward customers with very low frequency of withdrawals. Members of the Standard Gold Club are specially treated are issued special Chequebooks and cards.

1.5.3 *Personal Banking*

A Personal Banking Unit exists in the bank to cater for peculiar needs of high net-worth individuals who exhibit trait of affluence, busy lifestyles, sophisticated financial needs, a love for convenience, accumulation and preservation of wealth. Here the bank offers to the concerned customers a most complete and professional range of high quality banking, investment advisory as well as related services in the most personal confidential manner.

1.5.4 *Standard Flexi – Fixed Account*

This is a unique interest – bearing account that ensures that her customer's money is working for them all the time. Balance above a prefixed level from the customers current account are automatically swept to a Standard Flexi – Fixed Account and swept right back when the balance in the current accounts falls below the same imit. This feature ensures that there are no idle funds in her customers' current ıccounts and that optimal returns accrue to their funds at all times.

1.2 *OPERATING STRUCTURE*

The bank is very Unique, in that she maintains a flat operating structure built around three directorates and five marketing zones. These are:

The Directorates: Corporate Services

Operations and Control

Public Sector and Financial Services

The Zones: Lagos, Federal Capital Territory, North, South and West.

A Chief marketing Officer ***(CMD)*** heads each of the Zones with responsibility for over – seeing the three strategic Business Units ***(SBUs)*** in their respective zones. The ***SBUs*** are personal Banking, Commercial Banking and Enterprise Banking; each adequately represented in the Area and Business Offices for easy access and convenience of her customers.

1.3 *SERVICE DELIVERY*

One major characteristics of the service industry is that the producer / supplier cannot often be separated from his / her products. A look at standard Trust bank ***Plc*** reveals good understandings of the need to design products, which offer the customers values and meet some identifiable needs. Without products yielding the services desired by customers, the best efforts at customer service will accomplish very little. Standard Trust Bank Plc has made tremendous impact in product development in the industry. A good product, which cannot reach its customers, may be perceived to be worse than a bad one. This calls for the creation and

1.5.13 *Standard Care Account*

This is the bank's solution to parent worries about meeting their children's need. It is an account that enables parents save all monetary gifts to their children while at the same time setting aside, on a regular basis, some money for their upkeep, education and any emergencies as they grow. The account offers other benefits such as:

- Free Career Counselling for children between ages 12 – 18 years
- University Scholarship in the first year for any beneficiary that scores all A's in SSCE.
- Account balance can be used as collateral for credit from the bank.
- 3 times account balance payable to the nominated Trustee of the child, in the event of accidental death or permanent disability of the parent.
- The account automatically converts to a current account on the Childs eighteenth birthday.

1.5.14 *Standard Virtual Account*

This is an Internet Banking application, which allows her customer to conduct routine banking enquiries and transactions on their accounts over the Internet, from any part of the World. The bank's customers can also pay bills and effect funds transfer to any account within Standard Trust Bank or pay a beneficiary over the counter at any of her 80 Business Offices nationwide, all from the convenience of their home or office, or even while abroad. Standard virtual is a critical component of the bank's 24 hours banking portfolio.

(10) ***QUEUING DISCIPLINE:*** This represents the way the queue is ordered or organised.

(11) ***SINGLE CHANNEL SYSTEM:*** This is where there is one server only

(12) ***MULTI-CHANNEL SYSTEM:*** This is a situation where there are more servers.

CHAPTER TWO

2.1 GENERAL INTRODUCTION

From the time of birth (usually involving an approximately 9 –month period from the moment of conception) until death (an entire life – time – whether brief, extensive or in between) and at many moments along the way human beings often find themselves waiting for things, events, conditions etc. A major topic of Applied Mathematics that deals with this phenomenon of waiting is called Queuing Theory. Using the word "Queue", which is more common in British than American English and means "a line up" "to form a line", a closely reasoned body of mathematical theory has been developed to describe this common human activity. Theory applicable to normal economic activity. Realistic applications can be made to the phenomena of customers awaiting the delivery of goods / services, as well as goods – in – process coming to be finished goods.

The first queuing theory problem was considered by a Danish Engineer, Erlang in 1908 who worked for the Copenhagen, telephone exchange. He looked at how large a telephone exchange needed to be in order to keep to a reasonable value the number of telephone calls not connected because the exchange was busy (lost calls). Within ten years he developed a complex formula to solve the problem.

Furthermore, there are various contributions to the definition of queuing which ncludes Saaty (1961)."A queue or waiting line, involves arriving items that wait to e served at the facility which provides the service they seek" Cooper (1981): "The

term Queuing Theory is often used to describe the more specialized mathematical Theory of waiting lines " Kashyap and Chaudhry (1988)"In queuing theory we study situations where units of some kind arrive at a service facility for receiving service of some description, some of the units have to wait for service, and depart after service."

As mentioned above, queuing theory examine the progress of customers (people) pursuing offered services, as well as goods - in – process (things) achieving the status of completed goods (whether capital or consumer goods). There are 3 areas of focus; namely; Arrivals, Queue and Service Facility – each of which is further subdivided by a variety of analytical detail. A single process may consist of more than one server / station, if the person / product passes through a series of service facilities, and it may also have more than one actual queue / channel / waiting line leading to the subsequent service facility (ies).

The first area of focus considers arrivals, which deals with entries into a productive system, it may however be noted that the theory applies equally to customers and goods – in – process. The number of arrivals is significant (limited – few / many; or unlimited – possibly infinite). The pattern of arrival may admit of a tight / loose schedule (so many per time period) or completely at – random arrivals. The behaviour of the arrivals may consist of quiet, patient people, stable / unstable objects, querulous children / adults etc. thus the first area of concern is the nature and number of the object(s) entering the process.

Secondly, attention is drawn to the queue or the waiting line itself, which once established could have a limited or unlimited population. Common examples of queues includes; customers awaiting to collect money in the bank, people waiting for phoning, cars waiting for fuel in petrol stations, employees waiting for a lift in a modern high rise office block to mention but a few. Of greater importance is the queue discipline, which is the method by which a new arrival advances to actually begin receiving service. The most common method is ***F.I.F.O*** (first in, first out). But there are other methods like ***L.I.F.O*** (last in, first out); pre – assigned priority (advance to service individually determined before arrival); priority by types (categories established before arrival for various reasons) e.g. length of service time; here shorter required service time advances earlier. The size of economic cost for waiting, greater cost advances earlier and finally preemptive (new arrival displaces another person / object in the service facility and the former returns to the queue before continuing to receive the service).

Thirdly, is the service facility, availability, whether, the facility is free or already – in service, is of prime concern. The service time is another critical issue, recognizing that this can vary – as – a single server or several may provide the same service to individual needs of particular customers / goods – in – service or as the individual needs of particular customers / goods in – service differ as they come to the server. This could be the most unstable variable in non – production line processes as applicable in the bank being researched. Capacity of the service facility, whether of one or more servers / stations (number of customers / goods – in – process that can be serviced simultaneously), is another dimension of the analysis.

Conclusively, it is worthy of note to mention that there are various acceptable schools of thought regarding queuing models, while this research is constrained to the 4 specific models advanced by Heizer, Jay and Barry Render (1996). The models are:

(i) SINGLE CHANNEL QUEUING MODEL: This consists of a single queue and single service facility and assumes that arrivals are unlimited and can be formally treated in a Poisson distribution. Service times are assumed to take on the form of an exponential distribution (reflecting the normal randomness of service times).

(ii) MULTIPLE – CHANNEL QUEUING MODEL: This is adds a second queue directed toward a second service facility.

(iii) CONSTANT SERVICE TIME MODEL: This represents a single queue leading to single service facility which, in turn handles each customer in the exact same amount of time. Here the exponential distribution does not apply to service.

(iv) LIMITED POPULATION MODEL: This deals with a limited number of arrivals and a single server and applies to situations where a single operator (the service facility) deals with a limited number of machines (the queue).

2.2 *CHARACTERISTICS OF QUEUING SYSTEM*

Suffice to state here before proceeding further that some of the main characteristics of all queuing systems in which customers require just one service point have been adequately taken care of in the general introduction. However, other major characteristics include.

(i) ***POPULATION OF CUSTOMERS:*** This can be considered either limited (closed system) or unlimited (open system) Unlimited population represents a theoretical model of systems with a large number of possible customers (a bank on a busy street, a motor way petrol station). Example of a limited population may be a number of processes to be run (served) 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 e.t.c. Most works in queuing theory are based on the assumption that the maximum number of customers allowed in the system is infinite; because this provides convenient simplification of the analysis. This assumption is reasonably accurate provided that the rate of arrival of future customers is not affected by the number of customers already in the queue.

(ii) **ARRIVAL PATTERN:** This refers to the way in which customers arrive in a queue. Customers to a queuing system can arrive in a variety of *patterns.* Some useful factors for specifying an arrival pattern are; type of arrivals, that is customers may arrive in singly or in group / batch and inter-arrival times which is the time interval between two successive arrivals, the arrival may be at regular intervals or irregular intervals or random. An arrival

commonly found in practise is for customers to arrive at queues individually and in random. When this occurs the number of arrivals per unit time generally follows a Poisson probability distribution.

(i) ***SERVICE PATTERN***: This is the length of time taken to serve an individual customer. The service pattern may also vary with customers served in "bulk" on one a time. However, when customers arrive individually and at random, it is usually for the service pattern also to be random. It is assumed mathematically that the service time forms a negative exponential probability distribution.

(ii) ***SERVICE CHANNEL:*** This refer to the number of service point or queues. If there is one queue, but several service counters, the customers at the head of the queue will move to the first free counter when it becomes available. (This system is practiced in some commercial banks) e.g. Standard Trust Bank PLC Minna Branch, where this system operates. There can also be several service counters with its own queue (e.g. in post office, supermarket and some commercial bank).

(iii) ***STEADY STATE:*** A queuing systems is said to be in steady state when the behaviour of the system is independent of time. Steady state systems are the ones commonly considered in queuing theory

(iv) ***TRANSIENT STATE:*** This is said to occur when the behaviour of the system depends on time. A system may be in transient state for a short time (e.g when a service counter opens, there might be an initial rush of customers) but then it may settle down into a steady state (until it closes for the day). This is very common in commercial banks especially when the time is getting close to the end of the business hours of the day and on Fridays due to preparations for the weekend. However, the Friday rush has been drastically reduced with the introduction of Saturday banking.

(v) ***TRAFFIC INTENSITY:*** This is the ratio of the average arrival rate to the average service rate. It should be apparent, however, that unless the average service rate is faster than the average rate of new customers arriving in the queue, the queue will get longer indefinitely. An important assumption in queuing theory is that the traffic intensity must be less than one. Traffic intensity (System utilisation) is represented by "rho". Furthermore, if a queuing system is to work, arrival rate intensity must be less than service rate and the traffic intensity must be less than one. If arrival rates is approaching service rate in size, the queue length and the average time spent in the system will grow, and the service personnels find it increasingly difficult to keep up with demand. The system becomes uncontrollable (stochastic) if traffic intensity is greater or equal to one. Moreover, the average time spent by each customer in the system would theoretically be infinite.

Examples:

M / M / I	=	Poisson input, one exponential server
D / M / I	=	Deterministic (known) input, one exponential server, one unlimited FIFO or unspecified queue, unlimited customer population
M / G / 3 / 20	=	Poisson input, three servers with any distribution, maximum number of customers 20, unlimited customer population.
D / M / I / LIFO / 10 / 50	=	Deterministic arrivals, one exponential server, queue is a stack of the maximum size 9, total number of customers 50.
M /M / 5	=	Poisson input, five exponential servers one unlimited customer population. This model is what operates in standard Trust Bank PLC Minna Branch, which is the case study of this research.

CHAPTER THREE

SYSTEM ANALYSIS DESIGN

3.1 INTRODUCTION

The system analysis and design stage involves analyzing the existing system in order to aid the designing of the proposed system. The analysis is considered important because the design of the new system is dependent on whatever information gathered during the analysis stages.

In recognition of the above, the problems associated with the existing system as well as the objectives guiding this investigation are also outlined so that the new system that will be designed will be able to meet the expected benefits.

3.2 PROBLEM DEFINITION AND IDENTIFICATION

Queuing theory arises from the use of powerful mathematical analysis to theoretically describe service facility along with statistical / probabilistic techniques to account for varying dynamic patterns within the stages of the service facilities due to uncertainty in inter - arrival times and service times. The problem to be met that occasioned the development of such theory is simply entitled "Congestion" what happens when a system does not operate smoothly or efficiently.

The demand for solutions to congestion problems arises all across the board of the international economy, well as in the course of daily living, which is the basis of this research. Issues identified borders around.

(i) How long does a customer expect to wait in the queue before they are served, and how long will they have to wait before the service is completed.

(ii) What is the probability of a customer having to wait longer than a given time interval before they are served.

(iii) What is the average length of the queue?

(iv) What is the expected utilization of the servers and the expected time period, which they will be fully occupied, since the servers cost the bank money, as such they need to be kept busy.

3.3 ANALYSIS OF THE PROPOSED SYSTEM

The practical purpose of this research is to provide examination tools for system composed of queuing like the bank been researched leading to service facilities, so that the system may be made more efficient. Queuing Theory deals mathematically with both the regularities and irregularities of such systems – ultimately identifying occurrences of congestion (resulting from irregularities) and offering avenues for improving efficiency, as well as producing specific numerical data for further application.

The measurement of congestion offered are the following:

(a) The mean and distribution of time spent in a queue

(b) The mean and distribution of customers in both the queue itself and the entire system

(c) The mean and distribution of the service facilities "busy period"

3.4 PROBLEMS OF THE EXISTING SYSTEM

(1) ***BALKING:*** This is where customers decide not to join the queue if it is too long and resort to cut corners through some known staffs of the bank for priority service.

(2) ***JOCKEYING:*** This is where customers switch between queues if they will get served faster by so doing.

(3) ***RENEGING:*** This is where customers leave the queue if they have waited too long for service. Here the bank must be extra careful as it may lead to outright customer loss if the situation persists unabated.

(4) ***NATURE OF THE BANKING BUSINESS ITSELF:*** By its nature, few hands or servers are around the counters to service a large number of customers. As such there is bound to be some measure of delay regardless of computer aids as some of the services are manually based.

3.5 COST – BENEFIT ANALYSIS

During the last financial year, the bank reviewed her human capital requirements in a right sizing bid, which was adduced to her huge investments in the technologies which she requires to further consolidation her leading position in electronic banking in the country.

From the Annual Report and Accounts 2002 the managerial employees increased from 243 in year 2001 to 269 in year 2002 while other employees decreased from

1,790 in year 2001 to 1,339 in year 2002 in which case the total number of employees decreased from 2,033 in year 2001 to 1,606 in the year 2002. Ironically despite this sharp reduction in the total number of staffs there is an increase in related staff cost from #1,397,414,000 in the year 2001 to #1,685,343,000 in the year 2002. It is assumed that all the staffs are servers as all the service units are dependent on one another. Nevertheless, queuing systems are practically important because of the typical trade – off between the various cost of providing service and the costs associated with waiting for the service (or leaving the service 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 as some members may leave because of the long queues and if this situation persist there is the tendency of the bank losing such customers to other banks that will be ready to render quick and quality service.

In designing queuing systems we need to aim for a balanced between service to customers (short queue implying many servers) and economic considerations (not too many servers).

3.6 CHOICE OF LANGUAUGE

In developing this system, Visual Basic Programming Language was used. It is a software which is accessible to authorized managers and other personnel for various purposes and in decision making process. The power of the language allows professional to accomplish anything that can be accomplished using any other Windows Programming Language.

3.7 WHY VISUAL BASIC ?

It is the fastest and easiest way to create applications for Microsoft Windows. Whether one is an experienced professional or brand new to windows programming. Visual Basic provides one with a complete set of tools to simplify rapid application development.

3.8 WHAT IS VISUAL BASIC ?

The "Visual" part refers to the method used to create the graphical user interface (GUI). Rather than writing numerous lines of codes to describe the appearance and location of interface elements, one will simply add pre-built objects into place on screen.

The "Basic" part refers to the BASIC (Beginners All – Purpose Symbolic Instruction Code) language, a language used by more programmers than any other language in the history of computing.

Visual Basic has evolved from the original 'BASIC' language and now contains several hundred statements, functions, and keywords, many of which relate directly to the Windows GUI. Beginners can create useful application by learning just a few keywords.

the Learn VB now CD plus the Microsoft Developer Network (MSDN™) Library CDs containing full online documentation.

2. The professional edition provides computer professionals with a full – featured set of tools for developing solutions for others. it includes all features of the Learning edition, plus additional Active X controls, the Internet Information Server Application Designer, Integrated Visual Database Tools and Data Environment, Active Data Objects, and the Dynamic HTML page Designer. Documentation provided with the professional edition includes the Visual Studio Professional Features book plus Microsoft Developer Network CDs containing full online documentation.

3. The Enterprise edition allows professionals to create robust distributed applications in a team setting. It includes all the features of the professional edition, plus Back Office tools such as SQL Server, Microsoft Transaction Server, Internet Information Server, Visual SourceSafe, SNA Server, and more. Printed documentation provided with the Enterprise edition includes the Visual Studio Enterprise Features book plus Microsoft. Developer Network CDs containing full online documentation.

CHAPTER FOUR

4.1 INTRODUCTION

This chapter focuses more at providing the users with the necessary information needed on how to install and run the system effectively and efficiently. Indeed, all aspect of the system were operationally tested prior to their use. This, thereby allow the software designed to be accepted.

4.2 SYSTEM INSTALLATION

HARDWARE REQUIREMENTS

1. IBM PC OR COMPACTIBLE
2. 32 MB RAM
3. 2.33 MB HARD DISK
4. SVGA COLOUR MONITOR
5. FLOPPY DISK DRIVE (3.5 OR 5.25)
6. PRINTER
7. CD ROM DRIVE
8. STABILIZER OR U.P.S

SOFTWARE REQUIREMENTS

1. VISUAL BASIC MS - DOS
2. WORD PERFECT 6.1 FOR WINDOWS
3. WINDOWS 98-OPERATING SYSTEM

Install software on system with the appropriate command.

4.3 SYSTEM TESTING

System testing is a key stage in system implementation. It involves the use of test data on the new system in order to ensure that the system work accurately and efficiently before live operation commences. At this stage, the logical design and the physical design are thoroughly examined to ensure its workability. Therefore, the system testing stage serves as a confirmation that all is correct and an opportunity to show the users that the system works as required.

4.4 STAFF TRAINING

Training is very essential for the users of the system and software. The amount of training required for various categories of personnel will depend upon the complexity of the system and software and the skills presently available.

The software package is easy to understand and as such the period of training should not be more than four (4) weeks. Within the specified period of training the staff should be given proper access to the new system. Possible problems that are likely to arise should be resolved within this period. Training should involve the use of test data.

4.4 *SYSTEM IMPLEMENTATION REVIEW*

Implementation follows on from the detailed design stage. This involves the coordination of the effort of the user department and in getting the system into operation, the system analyst is an important member in participation due to his thorough knowledge of the system.

Indeed, the main aims of the system implementation are as follows:

(a) To check whether the system goal and objectives have been achieved or not.

(b) Determining whether user service requirement have been met while simultaneously reducing errors and costs

(c) Determine whether personal procedures, operating activities and other control have been confirmed.

(d) To check whether known and unexpected limitations of the system need attention.

4.5 *SYSTEM CONVERSION / CHANGEOVER*

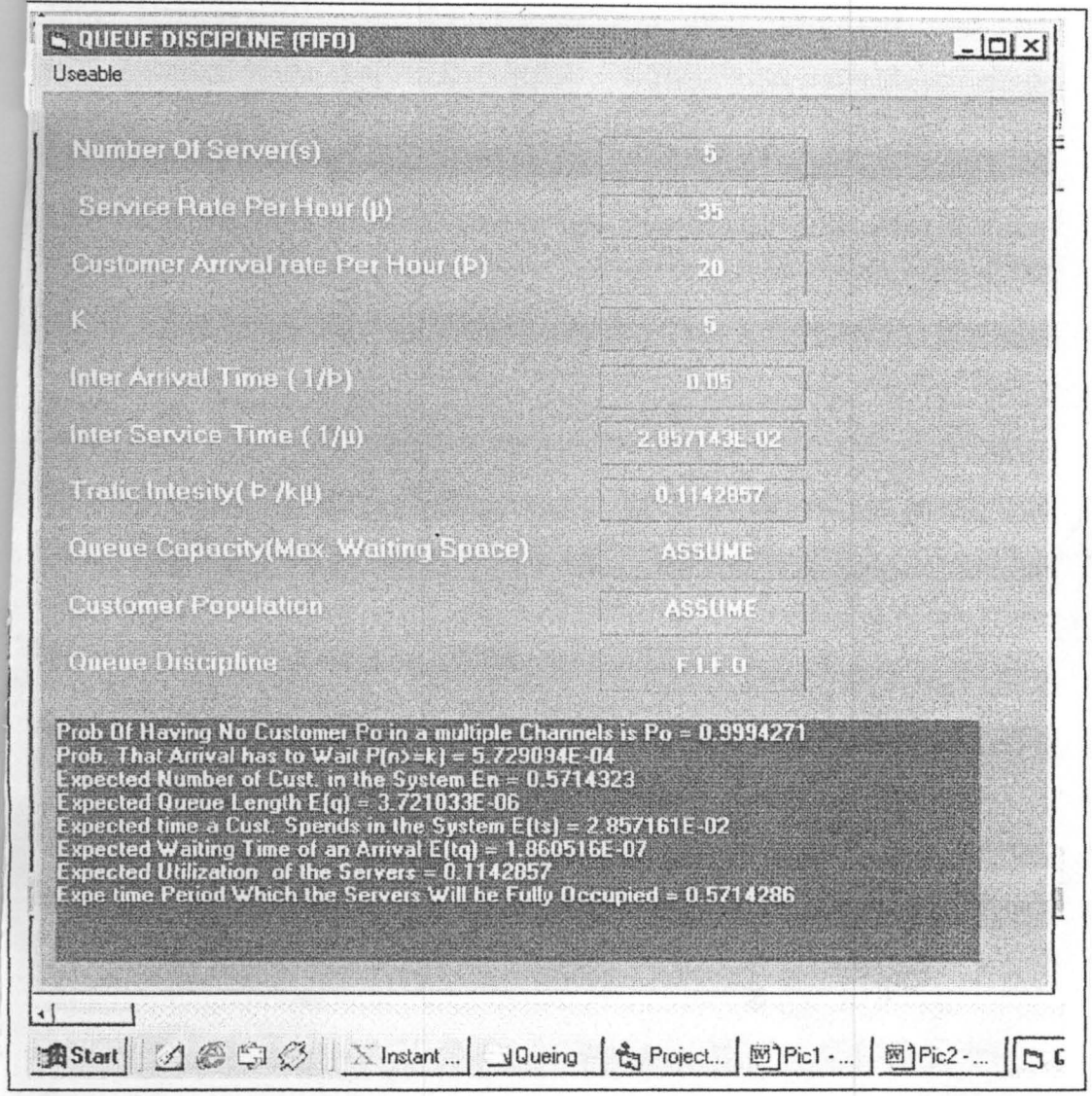
File conversion is a vital activity which is sometimes under estimated. It involves the conversion of the old file data into the form required by the new system and is usually a very expensive stage in the whole project. The changeover may be achieved in a number of ways. The most common methods are – ***DIRECT, PARALLEL and PILOT.***

1. Direct Changeover:: This method is the complete replacement of the old system by the new, in one move. For security reasons, the old system may be held in abeyance, including people and equipment. In the event of a major failure of the new system the Organisation would revert to the old system.

2. Parallel Method: This means processing current data by the old and new systems to cross- check the result. Here the old system is kept alive and operational until the new system has been proved for at least one system cycle, using full live data.

3. Pilot Method: This is in a piece – meal like. Until results are obtained and satisfactory, nothing much would be done to other section of the Organisation.

Generally, the parallel method is recommendation for the Organisation. This method allows the results of the new system to be compared with the old system before acceptance by the user, thereby promoting users confidence.


QUEUE DISCIPLINE (FIFO)
Useable
Number Of Server(s)
5
Service Rate Per Hour (μ)
35
Customer Arrival rate Per Hour (Þ)
20
K
5
Inter Arrival Time (1/Þ)
0.05
Inter Service Time (1/μ)
2.857143E-02
Tratic Intesity(Þ /kμ)
0.1142857
Queue Capacity(Max. Waiting Space)
ASSUME
Customer Population
ASSUME
Queue Discipline
F I F O
Prob Of Having No Customer Po in a multiple Channels is Po = 0.9994271
Prob. That Arrival has to Wait P(n>=k) = 5.729094E-04
Expected Number of Cust. in the System En = 0.5714323
Expected Queue Length E(q) = 3.721033E-06
Expected time a Cust. Spends in the System E(ts) = 2.857161E-02
Expected Waiting Time of an Arrival E(tq) = 1.860516E-07
Expected Utilization of the Servers = 0.1142857
Expe time Period Which the Servers Will be Fully Occupied = 0.5714286
Start
Instant ...
Queing
Project...
Pic1 - ...
Pic2 - ...

CHAPTER FIVE

SUMMARY OF FINDINGS, RECOMMENDATION AND CONCLUSION

SUMMARY OF FINDING

After close observation for some period, some findings were made from the research, which includes the following:

(i) That during the early banking hours of the day, particularly between 8.am – 9am, arrivals is very low as such there is idle service from some servers.

(ii) That during the business closings hours, the service is usually overstretched with more arrivals rushing in to be served which requires them (customers) to take a queue and wait until they are finally served.

(iii) That there are some other peak periods like Fridays and month ends when salaries of different establishments banking with Standard Trust Bank Plc are paid. These peak periods also overstretches the services as the number of servers cannot be commensurate with the customers arrivals which is a major problem associated with the nature of the business itself as earlier highlighted in Chapter Three as one of the problem of the existing system. However, it must be noted that the Friday peak period is gradually being checkmated with the Saturday banking at S.T.B.

RECOMMENDATION

From the first findings, idle servers during the early banking hours of the day could be withdrawn to do some other productive duties or functions to check idleness and its associated cost on the bank. The bank could also endeavour to increase the number of serves during the business closing hours of the day and during the peak periods already highlighted to meet with the demand of the customers. As it is not only the customers that can be pissed off if they have to wait for a long time before they are served. It must be understood that the servers are also human that have maximum / optimum strain / stress levels, since they are not robots.

Furthermore, a money counter should be stationed per server, as a situation where a server would need to leave his service point to another service point to count money causes a lot of delay as the two service points concerned would be affected at the end of the day. The bank should also acquired more document readers even though it is capital intensive to speed up their clearing and verification processes which are predominantly done manually. Finally, the bank should expedite action on the installation of her Automated Teller Machine (ATM) to all her branch networks nationwide which will enable customers to make withdrawals and lodgments 24 hours a day, seven days a week without necessarily having any direct contact with the bank officials. This is new innovation that all her teeming customers are anxiously waiting for, that will transform the bank in its entirely to a complete universal bank.

CONCLUSION

It is common knowledge that by the nature of the banking system few hands or servers are around the counters to service a large number of customers. As such there is bound to be some measure of delay in the services. As any attempt by the bank to recruit more staffs will also increase the overhead cost of the bank as earlier mentioned under the cost benefit analysis.

However, the bank must be able to strike an economic balance in the system. This is a balance between the cost of providing service and the cost incurred by the customer or the time loss by the customer waiting for service to ensure that there is no under utilization of the service facility of the bank.

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```
Private Sub Form_Load()

 Label4.Caption = " Service Rate Per Hour (" & Chr(181) & ")"
 Label5.Caption = "Customer Arrival rate Per Hour (" & Chr(222) & ")"
 Label6.Caption = "Inter Arrival Time ( 1/" & Chr(222) & ")"
 Label11.Caption = "Inter Service Time ( 1/" & Chr(181) & ")"
Label7.Caption = "Trafic Intesity( " & Chr(222) & " /k" & Chr(181) & ")"

End Sub
```

```
Private Sub mnuClose_Click()
 Unload Me

End Sub
```

```
Private Sub mnuComp_Click()

Dim InteArTime As Single
Dim CusAriTme As Single
Dim SerRatePerHr As Single
Dim InteSerTime As Single, En As Single, Etq As Single
Dim TrafInte As Single, Pnk As Single, Eq As Single, ExPer As Single
Dim k As Integer, Po As Single, Fack As Integer, Ets As Single
' Computation
   Ns = Val(txNo.Text)
   Srt = Val(txSR.Text)
   Art = Val(txCa.Text)
   'ist=
   'inter arrival time
    CusAriTme = Val(txCa.Text)
       InteArTime = (1 / CusAriTme)
       txInt.Text = InteArTime
   'inter service Time
        SerRatePerHr = Val(txSR.Text)
        InteSerTime = (1 / SerRatePerHr)
        txISt.Text = InteSerTime
   'Trafic Intesity
        k = Val(txK.Text)
        'TrafInte = ((CusAriTme) / (k * InteSerTime))
        TrafInte = ((Val(txCa)) / (k * Val(txSR)))
        txTr.Text = TrafInte

   'Next Page major Computation
      'Prob of having no cust Po
        'compu Fact
```

```
        fac = 1
          For fac1 = k To 1 Step -1
            fac = fac * fac1
            Debug.Print fac
          Next fac1
        Po = 1 / (1 + ((1 / fac) * ((CusAriTme / SerRatePerHr) ^ k) * ((k * SerRatePerHr)
/ ((k * SerRatePerHr) - CusAriTme))))

    'prob that arrival must wait

        Fack = k - 1
        kg = 1
          For kmo = Fack To 1 Step -1
            kg = kg * kmo
            Debug.Print kg
          Next kmo

        Pnk = (SerRatePerHr * ((CusAriTme / SerRatePerHr) ^ k) * Po) / (kg * ((k *
SerRatePerHr - CusAriTme)))
        En = (SerRatePerHr * ((CusAriTme / SerRatePerHr) ^ k) * Po) / (kg * ((k *
SerRatePerHr - CusAriTme) ^ 2)) + (CusAriTme / SerRatePerHr)


    'Expec Queue Lng...
        Eq = En - (CusAriTme / SerRatePerHr)
    'Expected time a cust spends in the system
        Ets = En / CusAriTme
    'Expected Waiting Time of an arrival
        Etq = Eq / CusAriTme
    'Exp Utilisation of the serverss
        eus = CusAriTme / (k * SerRatePerHr)
    'Expe time Period which the servers will be fully occupied
        ExPer = (CusAriTme / (k * SerRatePerHr)) * Val(txNo.Text)
    'end of application
    Label1.Caption = "Prob Of Having No Customer Po in a multiple Channels is Po = "
& Po & vbCrLf & "Prob. That Arrival has to Wait P(n>=k) = " & Pnk & vbCrLf &
"Expected Number of Cust. in the System En = " & En & vbCrLf & "Expected Queue
Length E(q) = " & Eq & vbCrLf & "Expected time a Cust. Spends in the System E(ts) = "
& Ets & vbCrLf & "Expected Waiting Time of an Arrival E(tq) = " & Etq & vbCrLf &
"Expected Utilization  of the Servers = " & eus & vbCrLf & "Expe time Period Which
the Servers Will be Fully Occupied = " & ExPer

End Sub
```