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# **West African Journal of Industrial & Academic Research**

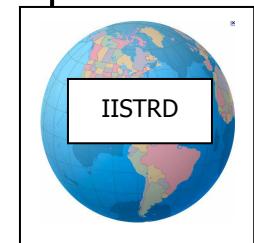
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## **Section A**

# **Industrial, Engineering Research and Production**

# Water Pipeline Network Analysis Using Simultaneous Loop Flow Correction Method

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## Abstract

A water pipeline network analysis with a case study of Owerri in Imo State, Nigeria municipal water reticulated system has been undertaken. What prompted this study is that the case study has a lot of fluctuations in its head loss. Also, the discharge is not proportional to the pipe diameter. The study therefore adopted simultaneous loop flow correction method because it computes simultaneous flows corrections for all loops, hence, the best since computational procedures takes into account the iterative influence of flow corrections between loops which have common pipes. After applying the simultaneous loop flow correction analyzer in a twenty-four sampled pipeline network, a drastic reduction in head loss and regular line along the axis was observed. Besides, the rate at which the water flows was observed to be proportional to the pipe diameter. Hence, the method is a useful aid in planning, designing and operating of reticulated pipeline network for higher efficiency and improved economy.

**KEYWORDS:** Water Reticulated System, Simultaneous Loop Flow, Iteration, Flow Rate, Pipeline Network, Head Loss

---

## 1.0 Introduction

Water is an essential natural resource for industrial and natural process, for example, it is used for oil refining, liquid extraction in hydrometallurgical process, cooling, scrubbing in the iron and steel industry and several operations in food processing facilities. Water is an essential input to achieve some desired outcomes, including health and income. Water affects sanitation and hygiene because lack of access to water leads to unhygienic behavior. Water supply is the provision of water by public utilities, commercial organizations, community endeavors or by individuals, usually via a system of pumps and pipes. Water supply systems get water from various locations, including ground water (aquifers) surface water (lakes and rivers) conservation and the sea through desalination. The water is then in most cases purified, disinfected through chlorination and sometimes fluoridated. Treated water then either flows by gravity or pumped reservoirs, which can be elevated such as water towers.

Analysis and design of pipe networks create a relatively complex problem, particularly if the network consists of a range of pipe as frequently occurs in water distribution systems. In the absence of significant fluid acceleration, the behavior of a network can be determined by a sequence of steady state conditions, which form a small but vital component for assessing the adequacy of a network.

In 2010, about 86% of the global population 96.74 billion people had access to piped water supply through house connections or to an improved water source through other means than house, including standpipes, water kiosks, protected springs and protected wells. However, about 14% (884 million people) did not have access to an improved water sources and had to use unprotected wells or springs, canals, lakes or rivers for their water needs [13].

Greater number of people having access to pipe water receive poor quality of service, especially in developing countries where about 80% of the world population lives, the United Nations (2006) revealed that total water availability per capita in Nigeria

decreased from 2514 m<sup>3</sup> per year in 2000 to 2250 m<sup>3</sup> per year in 2005. In Nigeria, only water as at 2010 as reported in *Thisday* News paper of August 19, 2010 under the heading, Nigeria, only 17.2 percent have access to potable water. In light of this, this year's world water day centers on water and food security as decline access to water affects agricultural produces. Therefore, there is a dire need for adequate planning, design and provision of reticulated water to every nook and cranny of this nation to ensure a healthy living standard for all, boost agricultural produces and provide enough water for industrial purposes.

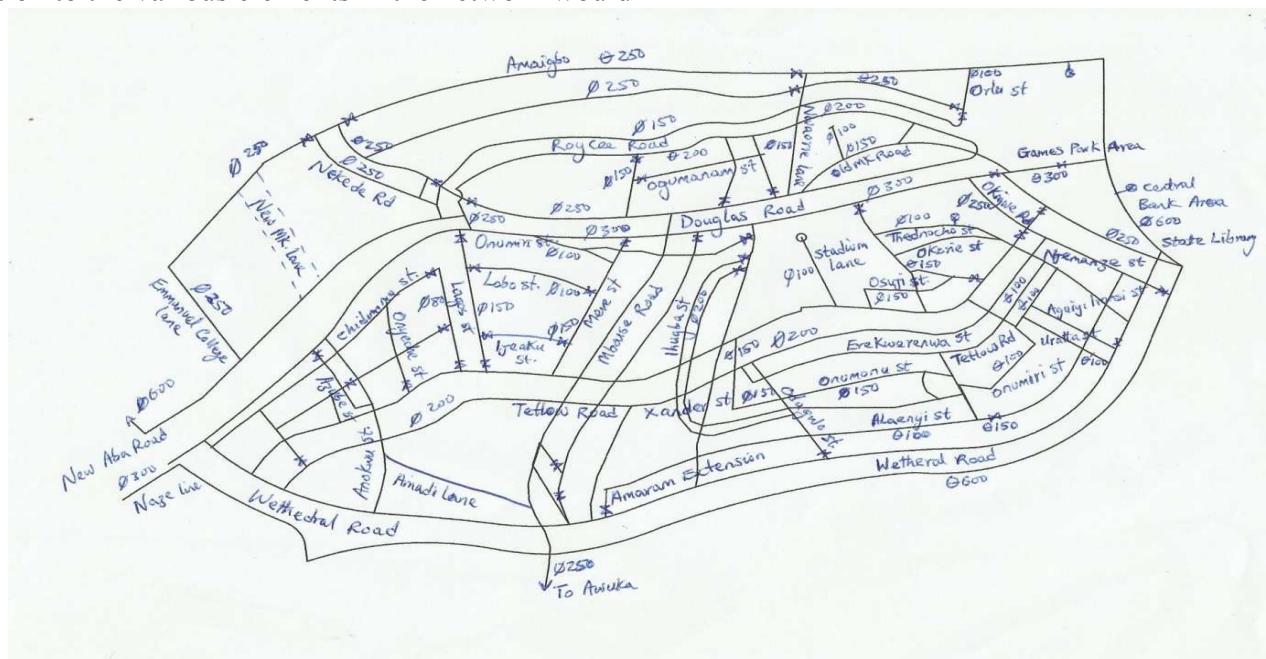
## Materials and Method

A pipe network is a set of pipes which are interconnected in such a way that flow from a given input get to a given outlet. An attempt to apply Bernoulli's equation and the continuity of flow equation to the various elements in the network would

lead to a very large number of simultaneous equations which would be cumbersome to solve.

In this work, simultaneous loop flow technique was used to determine the discharge (flow rate) connections in each pipe; head losses in each pipe and Node pressures. Minor losses due to pipe fittings such as valves; pipe bends, elbows, etc can be accounted for by using the equivalent length of pipe method.

The waterworks of Owerri Municipal Area was adopted as a case study. It covers some parts of Owerri Municipal council and Owerri West Local Government Area. The pipe lengths, various pipe diameters, volume flow rates, piping materials, types of joints, and other relevant information was collected from the water board. These values were used in this analytical work. The network diagram of ISWC distribution is shown in Figure 1.



**Figure 1 (the network diagram of ISWC)**

## Solution of Network Equations

Direct solution of systems of non-linear simultaneous equation is not feasible; hence, it is necessary to use iterative solution methods.

Generally, these methods start with an estimated solution which is interactively refined by repeated corrections until the deviation from the true solution is reduced to an acceptable tolerance value. Hardy Cross (HC) method is the most widely used technique for

solving for the unknown in water network analysis. It is based on a loop iterative computation.

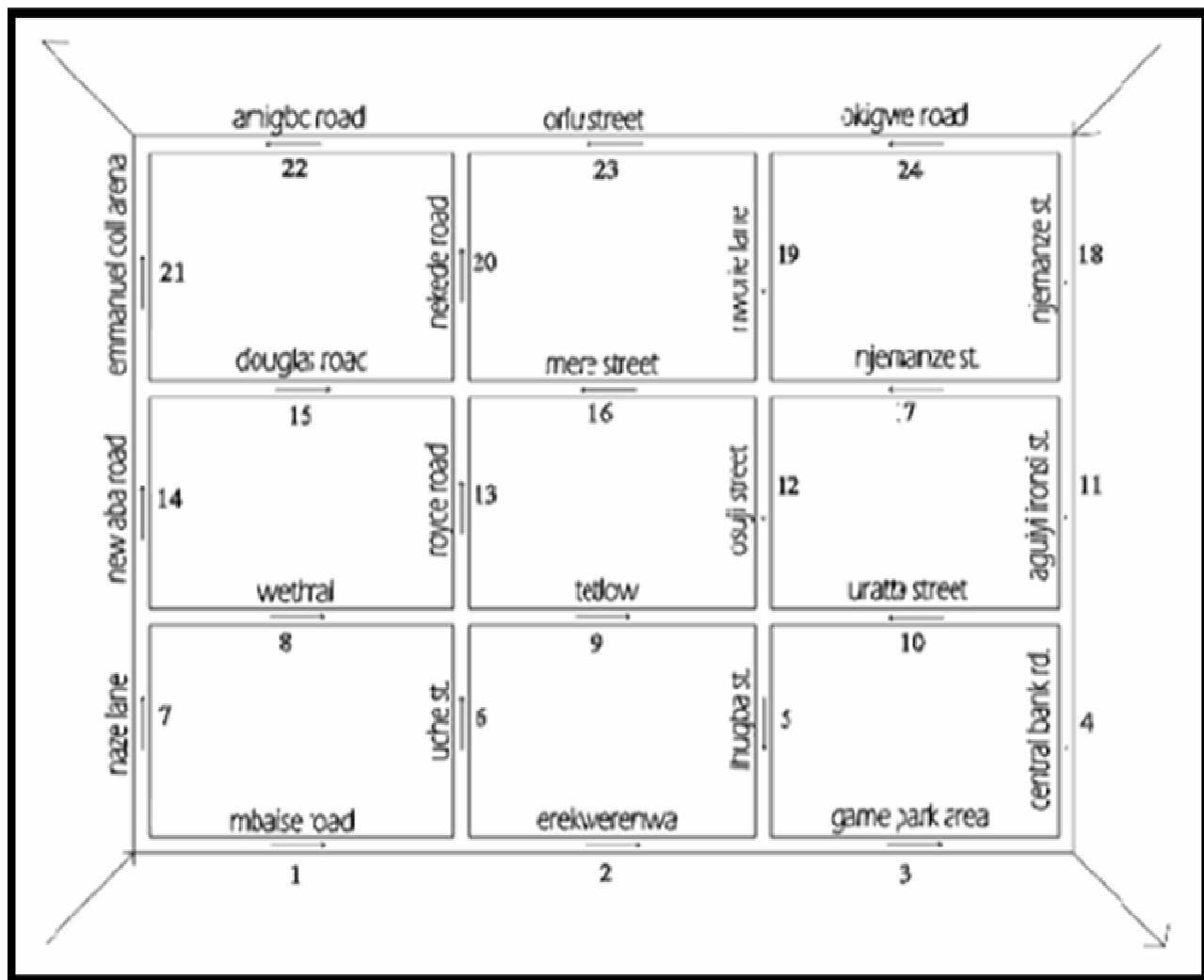
Newton-Raphson method is a better technique for solving the network problems; however, the method adopted here computes simultaneous flow corrections for all loops, hence, the best since the computational procedure takes into account the iterative influence of flow corrections between loops which have common pipes. In HC method, an initial flow distribution,

which satisfies flow continuity at nodes, is assumed. Nevertheless, the simultaneous loop flow correction method converges more rapidly to the true solution than the loop by loop Hardy Cross method.

The first order estimates of the loop flow corrections, which would reduce the loop out-of-balance heads to zero, are found from the following Newton – Raphson approximations.

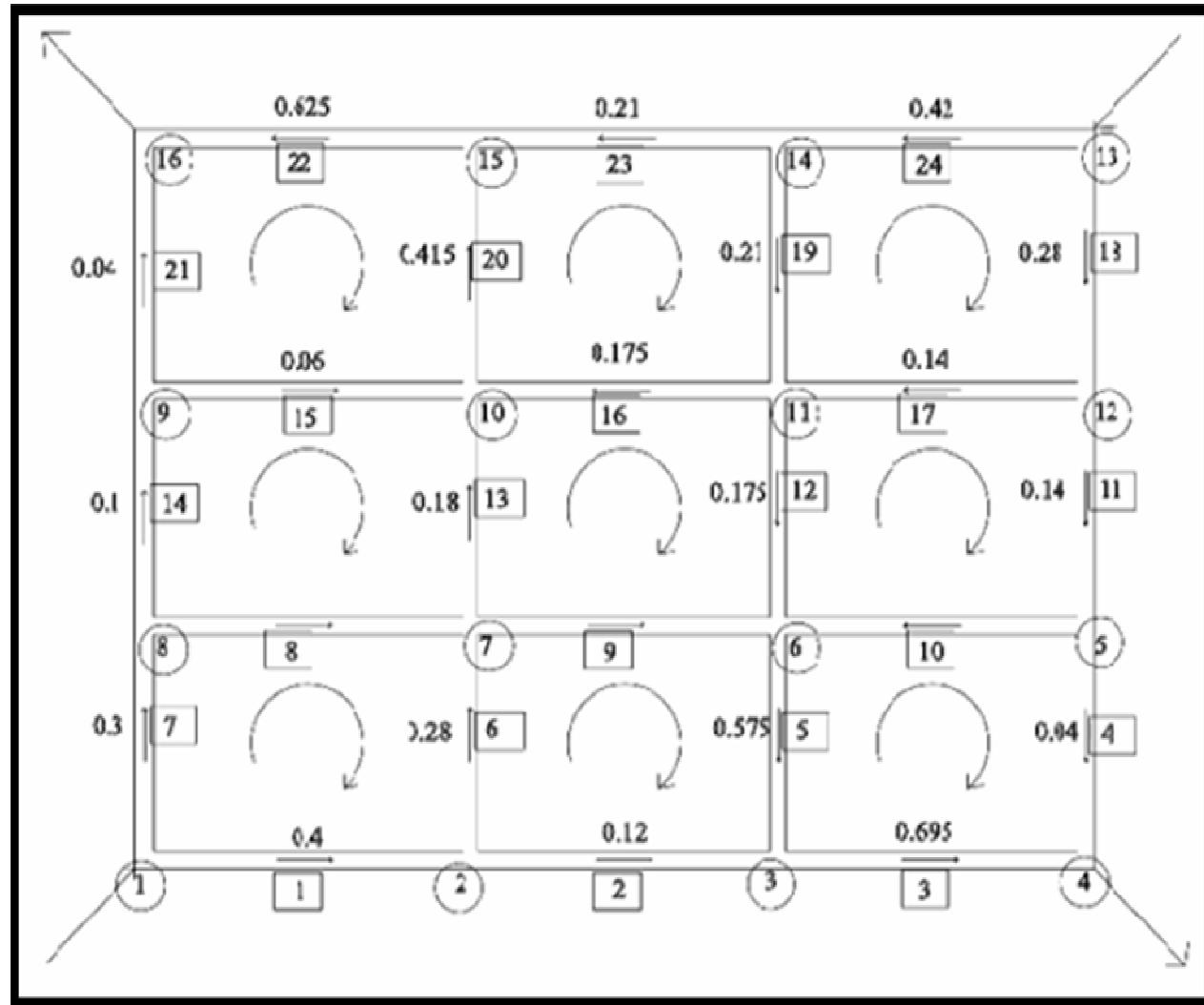
$$\begin{aligned}-h_1 &= \frac{\partial h_1}{\partial q_1} \Delta q_1 + \frac{\partial h_1}{\partial q_2} \Delta q_2 + \dots + \frac{\partial h_1}{\partial q_n} \Delta q_n \\ -h_2 &= \frac{\partial h_2}{\partial q_1} \Delta q_1 + \frac{\partial h_2}{\partial q_2} \Delta q_2 + \dots + \frac{\partial h_2}{\partial q_n} \Delta q_n \\ -h_n &= \frac{\partial h_n}{\partial q_1} \Delta q_1 + \frac{\partial h_n}{\partial q_2} \Delta q_2 + \dots + \frac{\partial h_n}{\partial q_n} \Delta q_n\end{aligned}$$

### Twenty Four (24) Pipeline Network Case Study



**Figure 2: (Network Diagram Of The Study Area)**

## The Network Diagram



**Figure 3: (Network Diagram With Pipe Length, Discharge, Nodes, And The Loops)**

The figure above show the network diagram of the study area, showing the nodes, the pipes, the loops, and the discharge in all the pipes involved. The network has sixteen fixed grade nodes ( $NF=16$ ), and twenty four pipes ( $NP=24$ ) which are connected to form nine loop ( $NL=9$ ) and nine path (or pseudo loop) ( $NF-l=9$ ). The geometric data for

the network is shown in Table 1. In order to simplify the network/demands at the nodes, pumps and pressure reducing valves were not included. This enabled an exact solution for flows in all pipes and heads at the nodes to be determined analytically. Results from simultaneous loop flow techniques can then be obtained.

**Table 1: (Table values)**

Pipe	1	2	3	4	5	6	7	8
D	0.30	0.15	0.30	0.30	0.20	0.20	0.30	0.60
L	700	300	400	350	350	200	300	500
K	576	7,901	329.22	288.06	2,187.5	1,250	246.91	38.58
$Q_0$	0.40	0.12	0.695	0.04	0.575	0.28	0.30	0.20
hL	92.18	113.77	159.02	0.46	723.24	98.00	22.22	1.54
Nh/Q	460.9	1,896	457	23	2,512	700	148	15

Pipe	9	10	11	12	13	14	15	16
D	0.15	0.15	0.15	0.15	0.15	0.30	0.30	0.15
L	200	200	200	200	200	350	800	200
K	5,267.5	5,267.5	5,267.5	5,267.5	5,267.5	288.06	658.43	5,267.49
$Q_0$	0.10	0.14	0.14	0.175	0.18	0.10	0.06	0.175
hL	253.12	52.67	103.24	161.32	170.67	2.88	2.37	161.32
Nh/Q	1,687	1,053	1,476	1,844	1,896	58	79	1,855

Pipe	17	18	19	20	21	22	23	24
D	0.15	0.15	0.15	0.30	0.30	0.30	0.15	0.30
L	200	300	200	350	500	600	300	600
K	5,267.4 9	7,901.23	5,267.49	288.06	411.52	493.83	7,901.2 3	493.83
$Q_0$	0.14	0.28	0.21	0.415	0.04	0.625	0.21	0.42
hL	103.24	619.45	232.30	49.61	0.66	192.90	348.44	87.11
Nh/Q	737	4,425	2,212	239	33	617	3,318	415

Here,  $h_L = KQ^2$  where K (Weisbach constant) =  $\frac{8 f L}{\pi^2 g D^5}$

$f$  is Weisbach friction factor which is approximately 0.0242 and  $g$  is gravitational constant taken to be 9.81.

This set of linear simultaneous equation in  $\Delta$  can be written in matrix form as follows:-

$$\left( \begin{array}{cc|c} \frac{\partial h_1}{\partial q_1} & \frac{\partial h_1}{\partial q_2} & \\ \frac{\partial q_1}{\partial h_1} & \frac{\partial q_2}{\partial h_1} & \\ \hline \frac{\partial h_2}{\partial q_1} & \frac{\partial h_2}{\partial q_2} & \\ \frac{\partial q_1}{\partial h_2} & \frac{\partial q_2}{\partial h_2} & \end{array} \right) \dots \left( \begin{array}{cc|c} \frac{\partial h_1}{\partial q_n} & & \Delta q_1 \\ \frac{\partial q_n}{\partial h_1} & & \Delta q_2 \\ \hline \frac{\partial h_n}{\partial q_1} & \frac{\partial h_n}{\partial q_2} & \\ \frac{\partial q_1}{\partial h_n} & \frac{\partial q_2}{\partial h_n} & \end{array} \right) = \left( \begin{array}{c} -h_1 \\ -h_2 \\ \vdots \\ -h_n \end{array} \right)$$

LOOP 1

From the Network diagram in figure 3, the Head Loss in each loop can be determined thus;

$$K_7 Q_7^2 + K_8 Q_8^2 - K_6 Q_6^2 - K_1 Q_1^2 = H_1 - H_1 \\ = 0$$

LOOP 2

$$K_6 Q_6^2 + K_9 Q_9^2 + K_5 Q_5^2 - K_2 Q_2^2 = H_2 - H_2 \\ = 0$$

LOOP 3

$$-K_5 Q_5^2 - K_{10} Q_{10}^2 + K_4 Q_4^2 - K_3 Q_3^2 = H_3 - H_3 \\ = 0$$

LOOP 4

$$K_{10} Q_{10}^2 - K_{12} Q_{12}^2 - K_{17} Q_{17}^2 + K_{11} Q_{11}^2 = H_5 - H_5 \\ = 0$$

LOOP 5

$$-K_9 Q_9^2 + K_{13} Q_{13}^2 - K_{16} Q_{16}^2 + K_{12} Q_{12}^2 = H_6 - H_6 \\ = 0$$

LOOP 6

$$-K_8 Q_8^2 + K_{14} Q_{14}^2 + K_{15} Q_{15}^2 - K_{13} Q_{13}^2 = H_7 - H_7 \\ = 0$$

$J\Delta Q = -H$

$$\text{LOOP 7} \\ K_{21} Q_{21}^2 - K_{22} Q_{22}^2 - K_{20} Q_{20}^2 - K_{15} Q_{15}^2 = H_9 - H_9 \\ = 0$$

$$\text{LOOP 8} \\ K_{20} Q_{20}^2 - K_{23} Q_{23}^2 + K_{19}^2 + K_{16} Q_{16}^2 = H_{10} - H_{10} \\ = 0$$

$$\text{LOOP 9} \\ -K_{19} Q_{19}^2 - K_{24} Q_{24}^2 + K_{18} Q_{18}^2 + K_{17} Q_{17}^2 = H_{11} - H_{11} \\ = 0$$

**This gives the first computation for the head loss in loops.**

$$\begin{aligned} 22.22 + 1.54 - 98 - 92.18 &= -166.42 \\ 98 + 253.12 + 723.24 - 113.77 &= 960.59 \\ -723.24 - 52.67 + 0.46 - 159.02 &= -934.47 \\ 52.67 - 161.32 - 103.24 + 103.24 &= -108.65 \\ -253.12 + 170.67 - 161.32 + 161.32 &= -82.45 \\ -1.54 + 2.88 + 2.88 + 2.37 - 170.67 &= -166.96 \\ 0.66 - 192.90 - 49.61 - 2.37 &= -244.22 \\ 49.61 - 348.44 + 232.30 + 161.32 &= 94.79 \\ -232.30 - 87.11 + 619.45 + 103.24 &= 403.28 \end{aligned}$$

$$\left( \begin{array}{cccccccccc}
 \frac{\partial h_1}{\partial q_1} & \frac{\partial h_1}{\partial q_2} & \frac{\partial h_1}{\partial q_3} & \frac{\partial h_1}{\partial q_4} & \frac{\partial h_1}{\partial q_5} & \frac{\partial h_1}{\partial q_6} & \frac{\partial h_1}{\partial q_7} & \frac{\partial h_1}{\partial q_8} & \frac{\partial h_1}{\partial q_9} \\
 \frac{\partial h_2}{\partial q_1} & \frac{\partial h_2}{\partial q_2} & \frac{\partial h_2}{\partial q_3} & \frac{\partial h_2}{\partial q_4} & \frac{\partial h_2}{\partial q_5} & \frac{\partial h_2}{\partial q_6} & \frac{\partial h_2}{\partial q_7} & \frac{\partial h_2}{\partial q_8} & \frac{\partial h_2}{\partial q_9} \\
 \frac{\partial h_3}{\partial q_1} & \frac{\partial h_3}{\partial q_2} & \frac{\partial h_3}{\partial q_3} & \frac{\partial h_3}{\partial q_4} & \frac{\partial h_3}{\partial q_5} & \frac{\partial h_3}{\partial q_6} & \frac{\partial h_3}{\partial q_7} & \frac{\partial h_3}{\partial q_8} & \frac{\partial h_3}{\partial q_9} \\
 \frac{\partial h_4}{\partial q_1} & \frac{\partial h_4}{\partial q_2} & \frac{\partial h_4}{\partial q_3} & \frac{\partial h_4}{\partial q_4} & \frac{\partial h_4}{\partial q_5} & \frac{\partial h_4}{\partial q_6} & \frac{\partial h_4}{\partial q_7} & \frac{\partial h_4}{\partial q_8} & \frac{\partial h_4}{\partial q_9} \\
 \frac{\partial h_5}{\partial q_1} & \frac{\partial h_5}{\partial q_2} & \frac{\partial h_5}{\partial q_3} & \frac{\partial h_5}{\partial q_4} & \frac{\partial h_5}{\partial q_5} & \frac{\partial h_5}{\partial q_6} & \frac{\partial h_5}{\partial q_7} & \frac{\partial h_5}{\partial q_8} & \frac{\partial h_5}{\partial q_9} \\
 \frac{\partial h_6}{\partial q_1} & \frac{\partial h_6}{\partial q_2} & \frac{\partial h_6}{\partial q_3} & \frac{\partial h_6}{\partial q_4} & \frac{\partial h_6}{\partial q_5} & \frac{\partial h_6}{\partial q_6} & \frac{\partial h_6}{\partial q_7} & \frac{\partial h_6}{\partial q_8} & \frac{\partial h_6}{\partial q_9} \\
 \frac{\partial h_7}{\partial q_1} & \frac{\partial h_7}{\partial q_2} & \frac{\partial h_7}{\partial q_3} & \frac{\partial h_7}{\partial q_4} & \frac{\partial h_7}{\partial q_5} & \frac{\partial h_7}{\partial q_6} & \frac{\partial h_7}{\partial q_7} & \frac{\partial h_7}{\partial q_8} & \frac{\partial h_7}{\partial q_9} \\
 \frac{\partial h_8}{\partial q_1} & \frac{\partial h_8}{\partial q_2} & \frac{\partial h_8}{\partial q_3} & \frac{\partial h_8}{\partial q_4} & \frac{\partial h_8}{\partial q_5} & \frac{\partial h_8}{\partial q_6} & \frac{\partial h_8}{\partial q_7} & \frac{\partial h_8}{\partial q_8} & \frac{\partial h_8}{\partial q_9} \\
 \frac{\partial h_9}{\partial q_1} & \frac{\partial h_9}{\partial q_2} & \frac{\partial h_9}{\partial q_3} & \frac{\partial h_9}{\partial q_4} & \frac{\partial h_9}{\partial q_5} & \frac{\partial h_9}{\partial q_6} & \frac{\partial h_9}{\partial q_7} & \frac{\partial h_9}{\partial q_8} & \frac{\partial h_9}{\partial q_9}
 \end{array} \right) = \left( \begin{array}{c}
 \Delta q_1 \\
 \Delta q_2 \\
 \Delta q_3 \\
 \Delta q_4 \\
 \Delta q_5 \\
 \Delta q_6 \\
 \Delta q_7 \\
 \Delta q_8 \\
 \Delta q_9
 \end{array} \right) = \left( \begin{array}{c}
 -h_1 \\
 -h_2 \\
 -h_3 \\
 -h_4 \\
 -h_5 \\
 -h_6 \\
 -h_7 \\
 -h_8 \\
 -h_9
 \end{array} \right)$$

The first matrix formation that is drawn from the table above (table 1) is shown in matrix 1.

### The matrix values

$$J_{1 \times 9} = \left( \begin{array}{cccccccccc}
 5,472 & -700 & 0 & 0 & 0 & -15 & 0 & 0 & 0 \\
 -700 & 6,798 & -2,515 & 0 & -1,687 & 0 & 0 & 0 & 0 \\
 0 & -2,515 & 4,048 & -1,052 & 0 & 0 & 0 & 0 & 0 \\
 0 & 0 & -1,053 & 5,110 & -1,844 & 0 & 0 & 0 & -737 \\
 0 & -1,687 & 0 & -1,844 & 7,271 & -1,896 & 0 & -1,844 & 0 \\
 -15 & 0 & 0 & 0 & -1,896 & 2,048 & -79 & 0 & 0 \\
 0 & 0 & 0 & 0 & 0 & -79 & 968 & -239 & 0 \\
 0 & 0 & 0 & 0 & -1,844 & 0 & -239 & 7,613 & -2,212 \\
 0 & 0 & 0 & -737 & 0 & 0 & 0 & -2,212 & 7,789
 \end{array} \right) = \left( \begin{array}{c}
 \Delta q_1 \\
 \Delta q_2 \\
 \Delta q_3 \\
 \Delta q_4 \\
 \Delta q_5 \\
 \Delta q_6 \\
 \Delta q_7 \\
 \Delta q_8 \\
 \Delta q_9
 \end{array} \right) = \left( \begin{array}{c}
 166.42 \\
 -960.59 \\
 934.47 \\
 108.65 \\
 82.45 \\
 166.96 \\
 244.22 \\
 -94.79 \\
 -403.28
 \end{array} \right)$$

$$\begin{aligned}
 \Delta q_1 &= 0.0259, \quad \Delta q_2 = -0.0384, \quad \Delta q_3 = 0.2290, \quad \Delta q_4 = 0.0846 \\
 \Delta q_5 &= 0.0624, \quad \Delta q_6 = 0.1497, \quad \Delta q_7 = 0.2640, \quad \Delta q_8 = -0.0019, \quad \Delta q_9 = -1.0443
 \end{aligned}$$

Matrix 1

**First iteration tables – Table 2**

Pipe	1	2	3	4	5	6	7	8
$Q_0$	0.3741	0.1584	0.466	0.269	0.3076	0.2157	0.3259	0.0762
$h_L$	80.63	198.25	71.49	20.84	206.98	58.16	26.22	0.224
$nh/Q$	431.06	2503.16	306.82	154.94	1,345.77	539.27	160.91	5.88

Pipe	9	10	11	12	13	14	15	16
$Q_0$	0.1992	– 0.0444	0.2246	0.1528	0.0927	0.2597	– 0.054	0.1107
$h_L$	111.60	–10.38	265.72	122.98	45.27	17.96	–1.94	64.55
$nh/Q$	1,120.48	467.57	2,366.16	1,609.69	976.70	143.85	71.45	1,166.21

Pipe	17	18	19	20	21	22	23	24
$Q_0$	0.0111	0.2357	0.2524	0.1491	0.3040	0.3610	0.2119	0.4643
$h_L$	0.649	438.95	335.57	6.40	38.03	64.36	354.78	106.46
$nh/Q$	116.94	3,724.65	2,659.03	85.85	250.20	356.57	3,348.56	458.58

**Computation of  $Q^{(i)}$  ( from the 1st iteration)**

$$\begin{aligned}
 Q_1 &= Q_1^{(0)} - \Delta QL_1 = 0.40 - 0.0258 = 0.3741 \\
 Q_2 &= Q_2^{(0)} - \Delta QL_2 = 0.12 - (-0.0384) = 0.1584 \\
 Q_3 &= Q_3^{(0)} - \Delta QL_3 = 0.695 - 0.2290 = 0.4660 \\
 Q_4 &= Q_4^{(0)} - \Delta QL_3 = 0.04 + 0.2290 = 0.2690 \\
 Q_5 &= Q_5^{(0)} - \Delta QL_2 - \Delta QL_3 = 0.575 - 0.0384 - 0.2290 \\
 &= 0.3076 \\
 Q_6 &= Q_6^{(0)} - \Delta QL_1 - \Delta QL_2 = 0.28 - 0.0259 - 0.0384 = \\
 &0.2157 \\
 Q_7 &= Q_7^{(0)} + \Delta QL_1 = 0.3 + 0.0259 = 0.3259 \\
 Q_8 &= Q_8^{(0)} + \Delta QL_1 - \Delta QL_6 = 0.2 + 0.0259 - 0.1497 = \\
 &0.0762 \\
 Q_9 &= Q_9^{(0)} + \Delta QL_2 - \Delta QL_5 = 0.3 - 0.0384 - 0.0624 = \\
 &0.1992 \\
 Q_{10} &= Q_{10}^{(0)} - \Delta QL_{10} + \Delta QL_4 = 0.10 - 0.2290 + \\
 &0.0846 = -0.0444 \\
 Q_{11} &= Q_{11}^{(0)} + \Delta QL_3 + \Delta QL_4 = 0.14 + 0.0846 = \\
 &0.2246
 \end{aligned}$$

$$\begin{aligned}
 Q_{12} &= Q_{12}^{(0)} - \Delta QL_4 + \Delta QL_5 = 0.175 - 0.0846 + \\
 &0.0624 = 0.1528 \\
 Q_{13} &= Q_{13}^{(0)} + \Delta QL_5 - \Delta QL_6 = 0.18 + 0.0624 - \\
 &0.1497 = 0.0927 \\
 Q_{14} &= Q_{14}^{(0)} + \Delta QL_6 = 0.1 + 0.1497 = 0.2497 \\
 Q_{15} &= Q_{15}^{(0)} + \Delta QL_6 - \Delta QL_7 = 0.06 + 0.1497 - \\
 &0.2640 = 0.0543 \\
 Q_{16} &= Q_{16}^{(0)} - \Delta QL_5 - \Delta QL_8 = 0.175 - 0.0624 - \\
 &0.0019 = 0.1107 \\
 Q_{17} &= Q_{17}^{(0)} - \Delta QL_4 + \Delta QL_9 = 0.14 - 0.0846 - \\
 &0.0443 = 0.0111 \\
 Q_{18} &= Q_{18}^{(0)} + \Delta QL_9 = 0.28 - 0.0443 = 0.2357 \\
 Q_{19} &= Q_{19}^{(0)} - \Delta QL_8 + \Delta QL_9 = 0.21 - 0.0019 + 0.0443 \\
 &= 0.2524 \\
 Q_{20} &= Q_{20}^{(0)} - \Delta QL_7 + \Delta QL_8 = 0.415 - 0.2640 - \\
 &0.0019 = 0.1491 \\
 Q_{21} &= Q_{21}^{(0)} + \Delta QL_7 = 0.04 + 0.2640 = 0.3040 \\
 Q_{22} &= Q_{22}^{(0)} - \Delta QL_7 = 0.625 - 0.2640 = 0.3610 \\
 Q_{23} &= Q_{23}^{(0)} - \Delta QL_8 = 0.21 + 0.0019 = 0.2119 \\
 Q_{24} &= Q_{24}^{(0)} - \Delta QL_9 = 0.42 + 0.21 + 0.0443 = 0.4643
 \end{aligned}$$

**The second computations for the head loss in loops.**

$$h_3 = -206.98 + 10.38 + 20.84 - 71.49 = -247.25$$

$$\begin{aligned}
 h_1 &= 26.22 + 0.224 - 58.16 - 265.72 = -297.43 \\
 h_2 &= 58.16 + 111.60 + 206.98 - 198.25 = 178.49 \\
 h_4 &= -10.38 - 122.98 - 0.649 + 265.72 = 131.71 \\
 h_5 &= -111.60 + 45.27 - 64.55 + 122.98 = -7.90
 \end{aligned}$$

$$\begin{aligned}
h_6 &= -0.224 + 17.96 - 1.94 - 45.27 & = h_8 &= 6.40 - 354.78 + 335.57 + 64.55 & = \\
-29.47 & & 51.74 & & \\
h_7 &= 38.03 - 64.36 - 6.40 + 1.94 & = h_9 &= -335.57 - 106.46 + 438.95 + 0.649 & = \\
-30.79 & & -2.43 & &
\end{aligned}$$

The second matrix formation that is drawn from the first iteration table (table 2) is shown in matrix 2 below.

$$J_2 = \left[ \begin{array}{cccccccccc} 1,137.12 & -539.27 & 0 & 0 & -5.88 & 0 & 0 & 0 & 0 \\ -539.27 & 5,508.68 & -1345.77 & 0 & -1,120.48 & 0 & 0 & 0 & 0 \\ 0 & -1345.72 & 2,275.11 & -467.57 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & -467.57 & 4,560.36 & -1,609.69 & 0 & 0 & 0 & -116.97 \\ 0 & -1,120.48 & 0 & -1,609.69 & 4,873.08 & -976.70 & 0 & -1,166.21 & 0 \\ -5.88 & 0 & 0 & 0 & -976.70 & 1,197.88 & -71.45 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & -71.45 & 64.07 & -85.85 & 0 \\ 0 & 0 & 0 & 0 & -1,166.21 & 0 & -85.85 & 7,259.65 & -2,659.03 \\ 0 & 0 & 0 & -116.94 & 0 & 0 & 0 & -2,659.03 & 6,959.2 \end{array} \right] \begin{array}{l} \Delta q_1 \\ \Delta q_2 \\ \Delta q_3 \\ \Delta q_4 \\ \Delta q_5 \\ \Delta q_6 \\ \Delta q_7 \\ \Delta q_8 \\ \Delta q_9 \end{array} = \begin{array}{l} 297.436 \\ -178.49 \\ 247.25 \\ -13.711 \\ 7.90 \\ 29.474 \\ 30.79 \\ -51.74 \\ 2.431 \end{array}$$

$$\begin{aligned}
\Delta q_1 &= 0.2740, \quad \Delta q_2 = 0.0258; \quad \Delta q_3 = 0.1212, \quad \Delta q_4 = -0.0134 \\
\Delta q_5 &= 0.0089, \quad \Delta q_6 = 0.0358 \quad \Delta q_7 = 0.0430 \quad \Delta q_8 = -0.0060 \quad \Delta q_9 = -0.0022.
\end{aligned}$$

## Matrix 2

**2<sup>nd</sup> Iteration Tables – Table 3**

Pipe	1	2	3	4	5	6	7	8
Q( <sup>2</sup> )	0.1001	0.1326	0.3448	0.3902	0.2122	-0.032	0.5999	0.3144
hL	5.77	138.93	39.14	43.86	98.50	-1.32	88.86	3.81
Nhl/Q	115.28	2,095.48	227.03	225.61	928.37	81.23	296.25	24.24

Pipe	9	10	11	12	13	14	15	16
Q( <sup>2</sup> )	0.2161	-0.1790	0.2112	0.1751	0.0658	0.2855	-0.062	0.0958
hL	131.34	-168.78	234.96	161.50	22.81	23.48	-2.49	48.34
Nhl/Q	1,215.55	1,885.81	2,2251	1844.66	693.31	164.48	80.98	1,009.19

pipe	7	8	9	20	1	2	3	4
( <sup>2</sup> )	.0223	.2335	.2486	0. 1001	.3470	.3180	.2179	.4665
L	.62	30.79	25.54	2. 89	9.55	9.94	75.15	07.47
hl/Q	34.98	,689.85	,618.99	.74 57	85.59	14.09	.443.32	60.75

## Computation of Q<sup>(2)</sup> (from 2<sup>nd</sup> iteration)

$$\begin{aligned}
 Q_1 &= Q_1^{(1)} - \Delta QL_1 = 0.3741 - 0.02740 = 0.1001 \\
 Q_2 &= Q_2^{(1)} - \Delta QL_2 = 0.1584 - 0.0258 = 0.1326 \\
 Q_3 &= Q_3^{(1)} - \Delta QL_3 = 0.4660 - 0.1212 = 0.3448 \\
 Q_4 &= Q_4^{(1)} - \Delta QL_3 = 0.2690 + 0.1212 = 0.3902 \\
 Q_5 &= Q_5^{(1)} - \Delta QL_2 - \Delta QL_3 = 0.3076 + 0.0258 - 0.1212 \\
 &= 0.2122 \\
 Q_6 &= Q_6^{(1)} - \Delta QL_1 - \Delta QL_2 = 0.2157 - 0.2740 + 0.0258 \\
 &= -0.0325 \\
 Q_7 &= Q_7^{(1)} + \Delta QL_1 = 0.3259 + 0.2740 = 0.5999 \\
 Q_8 &= Q_8^{(1)} + \Delta QL_1 - \Delta QL_6 = 0.0762 + 0.2740 - \\
 &0.0358 = 0.3144 \\
 Q_9 &= Q_9^{(1)} + \Delta QL_2 - \Delta QL_5 = 0.1992 + 0.0258 - \\
 &0.0089 = 0.2161 \\
 Q_{10} &= Q_{10(1)} - \Delta QL_3 + \Delta QL_4 = 0.0444 - 0.1212 - \\
 &0.0134 = -0.1790 \\
 Q_{11} &= Q_{11}^{(1)} + \Delta QL_4 = 0.2246 - 0.0134 = 0.2112 \\
 Q_{12} &= Q_{12}^{(1)} - \Delta QL_4 + \Delta QL_5 = 0.1528 + 0.0134 + \\
 &0.0089 = 0.1751
 \end{aligned}$$

$$\begin{aligned}
 Q_{13} &= Q_{13}^{(1)} + \Delta QL_5 - \Delta QL_6 = 0.0927 + 0.0089 - \\
 &0.0358 = 0.0658 \\
 Q_{14} &= Q_{14}^{(1)} + \Delta QL_6 = 0.2497 + 0.0358 = 0.2855 \\
 Q_{15} &= Q_{15}^{(1)} + \Delta QL_6 - \Delta QL_7 = -0.0543 + 0.0358 - \\
 &0.0430 = -0.06150 \\
 Q_{16} &= Q_{16}^{(1)} - \Delta QL_5 - \Delta QL_8 = 0.1107 - 0.0089 - \\
 &0.0060 = 0.0958 \\
 Q_{17} &= Q_{17}^{(1)} - \Delta QL_4 + \Delta QL_9 = 0.0111 + 0.0134 - \\
 &0.0022 = 0.0223 \\
 Q_{18} &= Q_{18}^{(1)} + \Delta QL_9 = 0.2357 - 0.0022 = 0.2335 \\
 Q_{19} &= Q_{19}^{(1)} - \Delta QL_8 + \Delta QL_9 = 0.2524 - 0.0060 + \\
 &0.0022 = 0.2486 \\
 Q_{20} &= Q_{20}^{(1)} - \Delta QL_7 + \Delta QL_8 = 0.1491 - 0.0430 - \\
 &0.0060 = 0.1001 \\
 Q_{21} &= Q_{21}^{(1)} + \Delta QL_7 = 0.3040 + 0.0430 = 0.3470 \\
 Q_{22} &= Q_{22}^{(1)} - \Delta QL_7 = 0.3610 - 0.0430 = 0.3180 \\
 Q_{23} &= Q_{23}^{(1)} - \Delta QL_8 = 0.2119 + 0.0060 = 0.2179 \\
 Q_{24} &= Q_{24}^{(1)} - \Delta QL_9 = 0.4643 + 0.0022 = 0.4665
 \end{aligned}$$

## The third computation of the head loss in each loop.

$$\begin{aligned}
 h_1 &= 88.86 + 3.81 + 1.3 - 5.77 = 88.22 \\
 h_2 &= -1.32 + 131.34 + 98.50 - 138.93 = \\
 89.59 & \\
 h_3 &= -98.50 + 168.78 + 43.86 - 39.14 = \\
 75.00 & \\
 h_4 &= -168.78 - 161.50 - 2.62 + 234.96 = \\
 97.94 &
 \end{aligned}$$

$$\begin{aligned}
 h_5 &= -131.34 + 22.81 - 48.34 + 161.50 = \\
 4.63 & \\
 h_6 &= -3.81 + 23.48 - 2.49 - 22.81 = -5.63 \\
 h_7 &= 49.55 - 49.94 - 2.89 + 2.49 = - \\
 0.08 & \\
 h_8 &= 2.89 - 375.15 + 325.54 + 48.34 = 1.62 \\
 h_9 &= -325.54 - 107.47 + 430.79 + 2.62 \\
 &= 0.40
 \end{aligned}$$

The third matrix formation that is drawn from the second iteration table (table 3) is shown in matrix 3

$$J_3 = \begin{pmatrix} 517 & -81.23 & 0 & 0 & 0 & -24.24 & 0 & 0 & 0 \\ -81.23 & 4,320.63 & -928.37 & 0 & -1,215.55 & 0 & 0 & 0 & 0 \\ 0 & -928.37 & 3,266.02 & -1,885.81 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & -1,885.81 & 6,190.45 & -1,844.66 & 0 & 0 & 0 & -234.98 \\ 0 & -1,215.55 & 0 & -1,844.66 & 4,762.71 & -693.31 & 0 & -1,009.19 & 0 \\ -24.24 & 0 & 0 & 0 & -693.31 & 963.01 & -80.98 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & -80.98 & 738.40 & -57.74 & 0 \\ 0 & 0 & 0 & 0 & -1,009.19 & 0 & -57.74 & 7,129.2 & -2,618.99 \\ 0 & 0 & 0 & -234.98 & 0 & 0 & 0 & -2,618.99 & 7,004.57 \end{pmatrix} \begin{pmatrix} \Delta q_1 \\ \Delta q_2 \\ \Delta q_3 \\ \Delta q_4 \\ \Delta q_5 \\ \Delta q_6 \\ \Delta q_7 \\ \Delta q_8 \\ \Delta q_9 \end{pmatrix} = \begin{pmatrix} -88.22 \\ -89.59 \\ -75.00 \\ 97.94 \\ -4.63 \\ 5.63 \\ 0.79 \\ -1.62 \\ -0.40 \end{pmatrix}$$

$$\begin{aligned} q_1 &= -0.1761, & q_2 &= -0.0330, & q_3 &= -0.0301, & q_4 &= 0.0040, \\ q_5 &= -0.0089, & q_6 &= -0.0050, & q_7 &= 0.0004, & q_8 &= -0.0017, & q_9 &= -0.0006 \end{aligned}$$

### Matrix 3

3<sup>rd</sup> Iteration Tables – Table 4

Pipe	1	2	3	4	5	6	7	8
$Q(^2)$	0.2762	0.1656	0.3749	0.3601	0.2093	0.1106	0.4238	0.1433
hL	43.95	216.68	46.27	37.35	95.83	15.29	44.35	0.79
Nhl/Q	318.25	2,616.91	246.84	207.44	915.72	276.49	209.30	11.03

Pipe	9	10	11	12	13	14	15	16
$Q(^2)$	0.1920	-0.1449	0.2152	0.1622	0.0619	0.2805	-0.0669	0.1030
hL	103.68	-110.60	243.94	138.58	20.18	22.66	-2.95	55.88
Nhl/Q	1,080.00	1,526.57	2,267.10	1,708.75	652.02	161.57	88.19	1,085.05

Pipe	17	18	19	20	21	22	23	24
$Q_0$	0.0177	0.2329	0.2475	0.0980	0.3474	0.3176	0.2196	0.4971
hL	1.65	428.58	322.67	2.77	49.67	49.81	381.03	122.03
nh/Q	186.44	3,680.38	2.60.43	56.53	285.95	313.66	3,470.22	490.97

### Computation of Q3 (from 3<sup>rd</sup> iteration)

$$\begin{aligned} Q_1 &= Q_1(^2) - \Delta Q L_1 = 0.1001 + 0.1761 = 0.2762 \\ Q_2 &= Q_2(^2) - \Delta Q L_2 = 0.1326 + 0.0330 = 0.1656 \\ Q_3 &= Q_3(^2) - \Delta Q L_3 = 0.3448 + 0.0301 = 0.3749 \\ Q_4 &= Q_4(^2) - \Delta Q L_3 = 0.3902 - 0.0301 = 0.3601 \\ Q_5 &= Q_5(^2) - \Delta Q L_2 - \Delta Q L_3 = 0.2122 - 0.0330 + 0.0301 = 0.2093 \\ Q_6 &= Q_6(^2) - \Delta Q L_1 - \Delta Q L_2 = 0.0325 + 0.1761 - 0.0330 = 0.1106 \end{aligned}$$

$$\begin{aligned} Q_7 &= Q_7(^2) + \Delta Q L_1 = 0.5999 - 0.1761 = 0.4238 \\ Q_8 &= Q_8(^2) + \Delta Q L_1 - \Delta Q L_6 = 0.3144 - 0.1761 + 0.0050 = 0.1433 \\ Q_9 &= Q_9(^2) + \Delta Q L_2 - \Delta Q L_5 = 0.2161 - 0.0330 + 0.0089 = 0.1920 \\ Q_{10} &= Q_{10}(^2) - \Delta Q L_3 + \Delta Q L_4 = -0.1790 + 0.0301 + 0.0040 = -0.1449 \\ Q_{11} &= Q_{11}(^2) + \Delta Q L_4 = 0.2112 + 0.0040 = 0.2152 \end{aligned}$$

$$\begin{aligned}
Q_{12} = Q_{12}(^2) - \Delta QL_4 + \Delta QL_5 &= 0.1751 - 0.0040 - 0.0089 = 0.1622 \\
Q_{13} = Q_{13}(^2) + \Delta QL_5 - \Delta QL_6 &= 0.0658 - 0.0089 + 0.0050 = 0.0619 \\
Q_{14} = Q_{14}(^2) + \Delta QL_6 &= 0.2855 - 0.0050 = 0.2805 \\
Q_{15} = Q_{15}(^2) + \Delta QL_6 - \Delta QL_7 &= -0.0615 - 0.0050 - 0.0004 = -0.0669 \\
Q_{16} = Q_{16}(^2) - \Delta QL_5 - \Delta QL_8 &= 0.0958 + 0.0089 - 0.0017 = 0.1030 \\
Q_{17} = Q_{17}(^2) - \Delta QL_4 + \Delta QL_9 &= 0.0223 - 0.0040 - 0.0006 = 0.0177
\end{aligned}$$

$$\begin{aligned}
Q_{18} = Q_{18}(^2) + \Delta QL_9 &= 0.2335 - 0.0006 = 0.2329 \\
Q_{19} = Q_{19}(^2) - \Delta QL_8 + \Delta QL_9 &= 0.2486 - 0.0017 + 0.0006 = 0.2475 \\
Q_{20} = Q_{20}(^2) - \Delta QL_7 + \Delta QL_8 &= 0.1001 - 0.0004 - 0.0017 = 0.0980 \\
Q_{21} = Q_{21}(^2) + \Delta QL_7 &= 0.3470 + 0.0004 = 0.3474 \\
Q_{22} = Q_{22}(^2) - \Delta QL_7 &= 0.3180 - 0.0004 = 0.3176 \\
Q_{23} = Q_{23}(^2) - \Delta QL_8 &= 0.2179 + 0.0017 = 0.2196 \\
Q_{24} = Q_{24}(^2) - \Delta QL_9 &= 0.4665 + 0.0006 = 0.4671
\end{aligned}$$

#### The fourth head loss determination in each loop.

$$\begin{aligned}
h_1 &= 44.35 + 0.79 - 15.29 - 43.95 \\
&= -14.1 \\
h_2 &= 15.29 + 103.68 + 95.83 - 216.68 \\
&= -1.88 \\
h_3 &= -95.83 + 110.60 + 37.35 - 46.27 \\
&= 5.85 \\
h_4 &= -110.60 - 138.58 - 1.65 + 243.94 \\
&= -6.89
\end{aligned}$$

$$\begin{aligned}
h_5 &= -103.68 + 20.18 - 55.88 + 138.58 \\
&= -0.80 \\
h_6 &= -0.79 + 22.6 - 2.95 - 20.18 \\
&= -1.26 \\
h_7 &= 49.67 - 49.81 - 2.77 + 2.95 \\
&= 0.04 \\
h_8 &= 2.77 - 281.03 + 322.67 + 55.88 \\
&= 0.29 \\
h_9 &= -322.67 - 122.03 + 428.58 + 1.65 \\
&= -14.47
\end{aligned}$$

The fourth matrix formation that is drawn from the third iteration table (table 4) is shown in matrix 4

$$J_4 = \left( \begin{array}{ccccccccc} 815.07 & -276.49 & 0 & 0 & 0 & -11.03 & 0 & 0 & 0 \\ -276.49 & 4,889.12 & -915.72 & 0 & -1,080 & 0 & 0 & 0 & 0 \\ 0 & -915.72 & 2,896.57 & -1,526.57 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & -1,526.57 & 5,688.86 & -1,708.75 & 0 & 0 & 0 & -186.44 \\ 0 & -1080 & 0 & -1,708.75 & 4,525.82 & -652.02 & 0 & -1,085.05 & 0 \\ -11.03 & 0 & 0 & 0 & -652.02 & 912.81 & -88.19 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & -88.19 & 744.33 & -56.53 & 0 \\ 0 & 0 & 0 & 0 & -1,085.05 & 0 & -56.53 & 7,219.23 & -2,607.43 \\ 0 & 0 & 0 & -186.44 & 0 & 0 & 0 & -2,607.43 & 6,965.22 \end{array} \right) \begin{pmatrix} \Delta q_1 \\ \Delta q_2 \\ \Delta q_3 \\ \Delta q_4 \\ \Delta q_5 \\ \Delta q_6 \\ \Delta q_7 \\ \Delta q_8 \\ \Delta q_9 \end{pmatrix} = \begin{pmatrix} 14.10 \\ 1.88 \\ -5.85 \\ 6.89 \\ 0.80 \\ 1.26 \\ -0.04 \\ -0.29 \\ 14.47 \end{pmatrix}$$

$$\begin{aligned}
q_1 &= 0.0179, & q_2 &= 0.0017, & q_3 &= -0.0006, & q_4 &= 0.0017, & q_5 &= 0.0020 \\
q_6 &= 0.0030, & q_7 &= 0.0004, & q_8 &= 0.0012, & q_9 &= 0.0026
\end{aligned}$$

#### Matrix 4

#### 4<sup>th</sup> Iteration Tables – Table 5

Pipe	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>	<b>7</b>	<b>8</b>
$Q(^4)$	0.2583	0.1639	0.3755	0.3595	0.2116	0.0944	0.4417	0.1582
hL	38.44	212.25	46.42	37.23	97.94	11.14	48.17	0.97
Nhl/Q	297.64	2,589.99	247.24	207.12	925.71	236.02	218.11	12.26

Pipe	<b>9</b>	<b>10</b>	<b>11</b>	<b>12</b>	<b>13</b>	<b>14</b>	<b>15</b>	<b>16</b>
$Q(4)$	0.1917	-0.1426	0.2169	0.1625	0.0609	0.2835	-0.064	0.1022
$hL$	103.36	-107.11	247.81	139.09	19.54	23.15	-2.72	55.02
Nhl/Q	1,078.3 5	1,502.24	2,285.02	1,711.88	641.71	163.32	84.60	1,076.71

Pipe	<b>17</b>	<b>18</b>	<b>19</b>	<b>20</b>	<b>21</b>	<b>22</b>	<b>23</b>	<b>24</b>
$Q(4)$	0.0186	0.2355	0.2461	0.0988	0.3478	0.3172	0.2184	0.4945
$hL$	1.82	438.20	319.03	2.81	49.78	49.69	376.88	120.76
Nhl/Q	195.70	372.44	2592.69	56.88	286.26	313.30	3,451.2 8	488.41

### Computation of $Q(4)$ (from the 4<sup>th</sup> iteration )

$$Q_1 = Q_1(3) - \Delta QL_1 = 0.2762 - 0.0179 = 0.2583$$

$$Q_2 = Q_2(3) - \Delta QL_2 = 0.1656 - 0.0017 = 0.1639$$

$$Q_3 = Q_3(3) - \Delta QL_3 = 0.3749 + 0.0006 = 0.3755$$

$$Q_4 = Q_4(3) + \Delta QL_3 = 0.3601 - 0.0006 = 0.3595$$

$$Q_5 = Q_5(3) - \Delta QL_2 - \Delta QL_3 = 0.2093 + 0.0017 + 0.0006 = 0.2116$$

$$Q_6 = Q_6(3) - \Delta QL_1 - \Delta QL_2 = 0.1106 - 0.0179 + 0.0017 = 0.0944$$

$$Q_7 = Q_7(3) + \Delta QL_1 = 0.4238 + 0.0179 = 0.4417$$

$$Q_8 = Q_8(3) + \Delta QL_1 - \Delta QL_6 = 0.1433 + 0.0179 - 0.0030 = 0.1582$$

$$Q_9 = Q_9(3) + \Delta DQL_2 - \Delta QL_5 = 0.1920 + 0.0017 - 0.0020 = 0.1917$$

$$Q_{10} = Q_{10}(3) - \Delta QL_3 + \Delta QL_4 = -0.1449 + 0.0006 + 0.0617 = -0.1426$$

$$Q_{11} = Q_{11}(3) + \Delta QL_4 = 0.2152 + 0.0017 = 0.2169$$

$$Q_{12} = Q_{12}(2) - \Delta QL_4 + \Delta QL_5 = 0.1622 - 0.0017 + 0.0020 = 0.1625$$

$$Q_{13} = Q_{13}(3) + \Delta QL_5 - \Delta QL_6 = 0.0619 + 0.0020 - 0.0030 = 0.0609$$

$$Q_{14} = Q_{14}(3) + \Delta QL_6 = 0.2805 + 0.0030 = 0.2835$$

$$Q_{15} = Q_{15}(3) + \Delta QL_6 - \Delta QL_7 = -0.0669 + 0.0030 - 0.0004 = -0.0643$$

$$Q_{16} = Q_{16}(3) - \Delta QL_5 - \Delta QL_8 = 0.1030 - 0.0020 + 0.0012 = 0.1022$$

$$Q_{17} = Q_{17}(3) - \Delta QL_4 + \Delta QL_9 = 0.0177 - 0.0017 + 0.0026 = 0.0186$$

$$Q_{18} = Q_{18}(3) + \Delta QL_9 = 0.2329 + 0.0026 = 0.2355$$

$$Q_{19} = Q_{19}(3) + \Delta QL_8 + \Delta QL_9 = 0.2475 + 0.0012 - 0.0026 = 0.2461$$

$$Q_{20} = Q_{20}(3) - \Delta QL_7 + \Delta QL_8 = 0.0980 - 0.0004 + 0.0012 = 0.0988$$

$$Q_{21} = Q_{21}(3) + \Delta QL_7 = 0.3474 + 0.0004 = 0.3478$$

$$Q_{22} = Q_{22}(3) - \Delta QL_7 = 0.3176 - 0.0004 = 0.3172$$

$$Q_{23} = Q_{23}(3) - \Delta QL_8 = 0.2196 - 0.0012 = 0.2184$$

$$Q_{24} = Q_{24}(3) - \Delta QL_9 = 0.4971 - 0.0026 = 0.4945$$

### The fifth computation of the head loss in each loop.

$$h_1 = 48.17 + 0.97 - 11.14 - 38.44 = -0.44$$

$$h_2 = 11.14 + 103.36 + 97.94 - 212.25 = 0.19$$

$$h_3 = -97.94 - 107.11 + 37.23 - 46.42 = -0.02$$

$$h_4 = -107.11 - 139.09 - 1.82 + 247.81 = -0.21$$

$$h_5 = -103.36 + 19.54 - 55.02 + 139.09 = 0.25$$

$$h_6 = -97 + 23.15 - 2.72 - 19.54 = -0.08$$

$$h_7 = 49.78 - 49.69 - 2.81 + 2.72 = 0.00$$

$$h_8 = 2.81 - 376.88 + 319.03 + 55.02 = -0.02$$

$$h_9 = 319.03 - 120.76 + 438.20 + 1.82 = 0.23$$

The fifth matrix formation that is drawn from the fourth iteration table (table 5) is shown in matrix 5

$$J_5 = \left( \begin{array}{ccccccccc} 764.03 & -236.02 & 0 & 0 & 0 & -12.26 & 0 & 0 & 0 \\ -236.02 & 4,830.07 & -925.7 & 0 & -1078.35 & 0 & 0 & 0 & 0 \\ 0 & -925.71 & 2,882.31 & -1502.24 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & -1502.24 & 5,694.84 & -1,711.88 & 0 & 0 & 0 & -195.7 \\ 0 & -1,078.35 & 0 & -1711.88 & 4,508.65 & -641.71 & 0 & -1076.71 & 0 \\ -12.26 & 0 & 0 & 0 & -641.71 & 901.89 & -84.60 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & -84.60 & 741.04 & -56.88 & 0 \\ 0 & 0 & 0 & 0 & -1076.71 & 0 & -56.88 & 7,178.08 & -2592.69 \\ 0 & 0 & 0 & -195.70 & 0 & 0 & 0 & -2592.69 & 6,998.24 \end{array} \right) \left( \begin{array}{c} \Delta q_1 \\ \Delta q_2 \\ \Delta q_3 \\ \Delta q_4 \\ \Delta q_5 \\ \Delta q_6 \\ \Delta q_7 \\ \Delta q_8 \\ \Delta q_9 \end{array} \right) = \left( \begin{array}{c} 0.44 \\ -0.19 \\ 0.02 \\ 0.21 \\ -0.25 \\ 0.08 \\ -0.00 \\ 0.02 \\ -0.23 \end{array} \right)$$

$$\begin{aligned} q_1 &= 0.5711 & q_2 &= -0.0188 & q_3 &= 0.0143 & q_4 &= 0.0257 & q_5 &= -0.0452 & q_6 &= 0.0648 \\ q_7 &= 0.0060 & q_8 &= -0.0180 & q_9 &= -0.0388 \end{aligned}$$

5<sup>th</sup> iteration table – Table 6

Pipe	1	2	3	4	5	6	7	8
$Q(^4)$	-0.3128	0.1827	0.3612	0.3738	0.1785	-0.4955	1.0128	0.6645
hL	-1.52	263.69	42.94	40.24	69.69	-306.85	253.23	17.03
Nhl/Q	9.72	2886.69	215.3	215.30	780.84	1238.6	500.06	51.26

Pipe	9	10	11	12	13	14	15	16
$Q(^4)$	0.2249	-0.1312	0.2421	0.0916	-0.0491	0.3483	-0.0055	0.1294
hL	142.22	-90.66	3.090	44.19	-12.69	34.94	-1.99	88.19
Nhl/Q	1264.7	1382.01	25.53	564.45	516.90	200.63	723.64	1363.06

Pipe	17	18	19	20	21	22	23	24
$Q(^4)$	-0.0459	0.1967	0.2669	0.0868	0.3538	0.3112	0.2364	0.5333
hL	-11.10	305.66	375.17	2.17	51.50	47.82	441.49	140.43
Nhl/Q	483.66	3107.88	2811.32	50.00	291.12	307.33	3735.1	526.65

### Computation of Q (<sup>5</sup>) (from the 5<sup>th</sup> iteration )

$$Q_1 = Q_1(^4) - \Delta QL_1 = 0.2583 - 0.5711 = -0.3128$$

$$Q_6 = Q_6(^4) - \Delta QL_1 - \Delta QL_2 = 0.0944 - 0.5711 - 0.0188 = -0.4955$$

$$Q_7 = Q_7(^4) + \Delta QL_1 = 0.4417 + 0.05711 = 1.0128$$

$$Q_2 = Q_2(^4) - \Delta QL_2 = 0.1639 + 0.0188 = 0.1827$$

$$Q_8 = Q_8(^4) + \Delta QL_1 - \Delta QL_6 = 0.1582 + 0.5711 - 0.0648 = 0.6645$$

$$Q_3 = Q_3(^4) - \Delta QL_3 = 0.3755 - 0.0143 = 0.3612$$

$$Q_9 = Q_9(^4) + \Delta QL_2 - \Delta QL_5 = 0.1917 - 0.0188 + 0.0452 = 0.2181$$

$$Q_4 = Q_4(^4) + \Delta QL_3 = 0.3595 + 0.0143 = 0.3738$$

$$Q_5 = Q_5(^4) - \Delta QL_2 - \Delta QL_3 = 0.2116 - 0.0188 - 0.0143 = 0.1785$$

$$Q_{10} = Q_{10}(^4) - \Delta QL_3 + \Delta QL_4 = -0.1426 - 0.0143 + 0.0257 = -0.1312$$

$$Q_{11} = Q_{11}(^4) + \Delta QL_4 = 0.2169 + 0.0252 = 0.2421$$

$$Q_{12} = Q_{12}(^4) - \Delta QL_4 + \Delta QL_5 = 0.1625 - 0.0257 - 0.0452 = 0.0916$$

$$Q_{13} = Q_{13}(^4) + \Delta QL_5 - \Delta QL_6 = 0.0609 - 0.0452 - 0.0648 = -0.0491$$

$$Q_{14} = Q_{14}(^4) + \Delta QL_6 = 0.2835 + 0.0648 = 0.3483$$

$$Q_{15} = Q_{15}(^4) + \Delta QL_6 - \Delta QL_7 = -0.0643 + 0.0648 - 0.0060 = -0.0055$$

$$Q_{16} = Q_{16}(^4) - \Delta QL_5 - \Delta QL_8 = 0.1022 + 0.0452 - 0.0180 = 0.1294$$

$$Q_{17} = Q_{17}(^4) - \Delta QL_4 + \Delta QL_9 = 0.0186 - 0.0257 - 0.0388 = -0.0459$$

$$Q_{18} = Q_{18}(^4) + \Delta QL_9 = 0.2355 - 0.0388 = 0.1967$$

$$Q_{19} = Q_{19}(^4) + \Delta QL_8 + \Delta QL_9 = 0.2461 - 0.0180 + 0.0388 = 0.2669$$

$$Q_{20} = Q_{20}(^4) - \Delta QL_7 + \Delta QL_8 = 0.0988 - 0.0060 - 0.0180 = 0.0868$$

$$Q_{21} = Q_{21}(^4) + \Delta QL_7 = 0.3478 + 0.0060 = 0.3538$$

$$Q_{22} = Q_{22}(^4) - \Delta QL_7 = 0.3172 - 0.0060 = 0.3112$$

$$Q_{23} = Q_{23}(^4) - \Delta QL_8 = 0.2184 + 0.0180 = 0.2364$$

$$Q_{24} = Q_{24}(^4) - \Delta QL_9 = 0.4945 + 0.0388 = 0.5330$$

## Results and Discussion

The simultaneous loop flow correction analyzer was applied to the water pipeline network in Owerri municipal area, a great reduction of the head loss was achieved in the system. This is pictured in the graphs below.

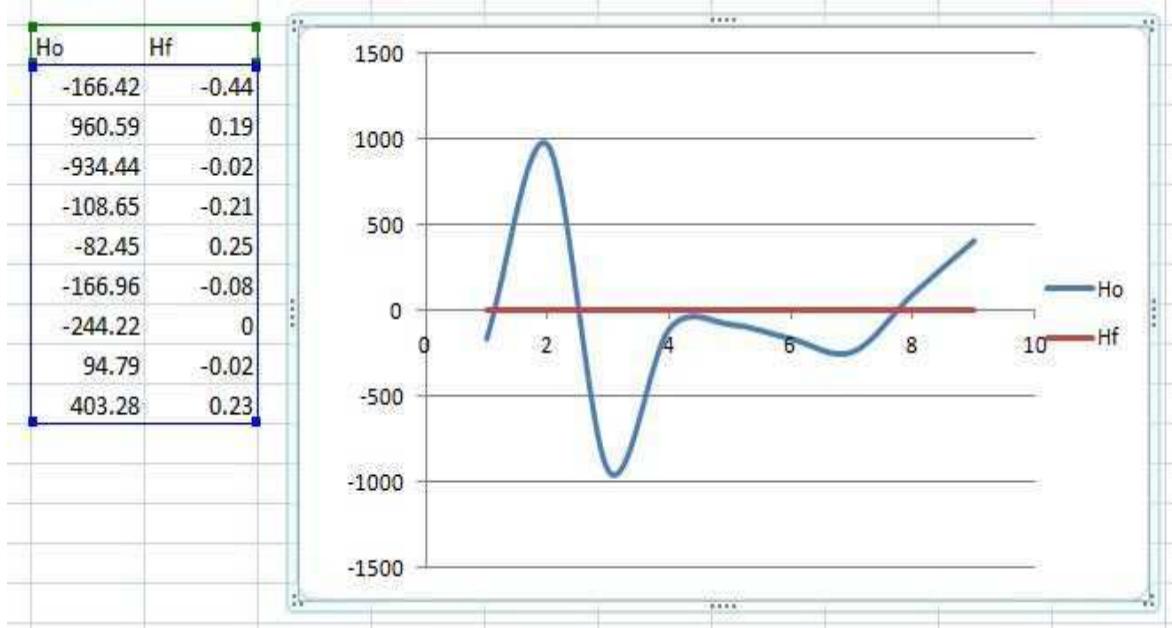
Graph 1 compares the original head loss( $H_o$ ) with the corrected one ( $H_f$ ), the original head loss (as calculated from the distribution network from the data collected) shows an irregular head loss across the wax (hops) from the graph, the blue line indicates the original while the red line indicates the corrected head loss. (as calculated after the fifth iteration). The result shows a drastic reduction in head loss which is approximately zero in all the loops involves and the line is regular along the axis ( $H_f$ ).

Graphs 2 and 3 compare the original and the corrected result using the discharge  $Q$  and the pipe diameter  $D$ . Practically, the rate of flow per minute is directly proportional to the pipe diameter (the longer the diameter, the greater the flow and *vise versa*). The original flow  $Q$  from the data collected shows proportionality with the pipe diameter which is fixed and this in contrary is an indication of bad network design that leads to losses as shown in graph 2. Furthermore, graph 3 pictures the corrected flow rate as it varies with the pipe diameter, thus, this graph indicates a direct proportionality of the flow rate,  $Q$  and the pipe diameter,  $D$ .

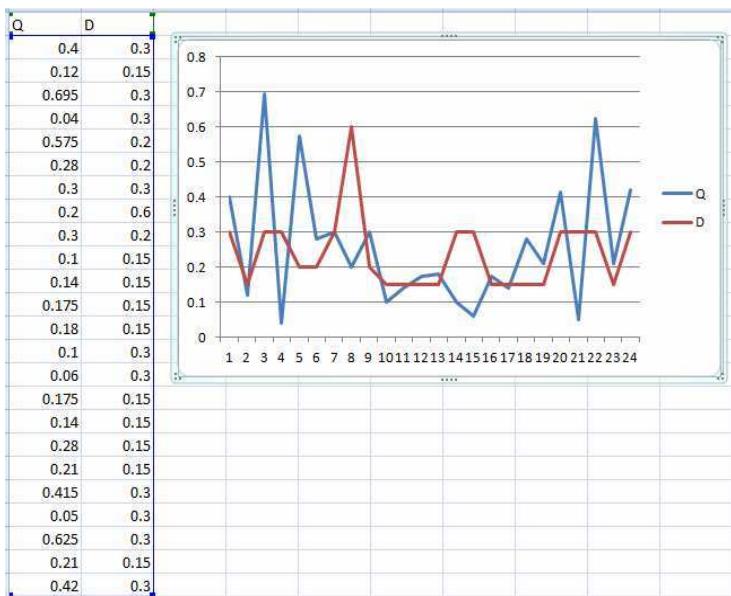
Graph 4 and 5 compares the pipe length and the head loss along the pipes. From definition, the loss is the energy per unit weight of fluid. In other words, it is the rate of the product of force and the length to the weight of fluid. This definition of head loss indicates that the head loss increases with increase in pipe length. Thus, Graph 4 pictures the original variation of the head loss with the pipe length. The graph lines counter each other, showing the level of non proportionality between the pipe length and head loss while the corrected result produced after the fifth iteration shows the level of proportionality between the two constraints since the line did not counter each other along the axis as shown in graph 5.

This method (simultaneous loop flow correction) produced an accurate result with a great reduction in the head losses in each loop after the fifth iteration. In addition to the above achievement, the rate at which the water flows ( $Q$ ) was observed to be proportional to the pipe diameter as shown in the graph 5. Here, the initial flow rates were compared with the corrected flow rates with respect to the pipe diameters. With the initial discharge, which is not proportional to the diameter, the deformation in pipes will be high. Hence, the simultaneous flow correction technique adopted in this work in analyzing pipeline network of water reticulation system has proven to be the best numerical technique.

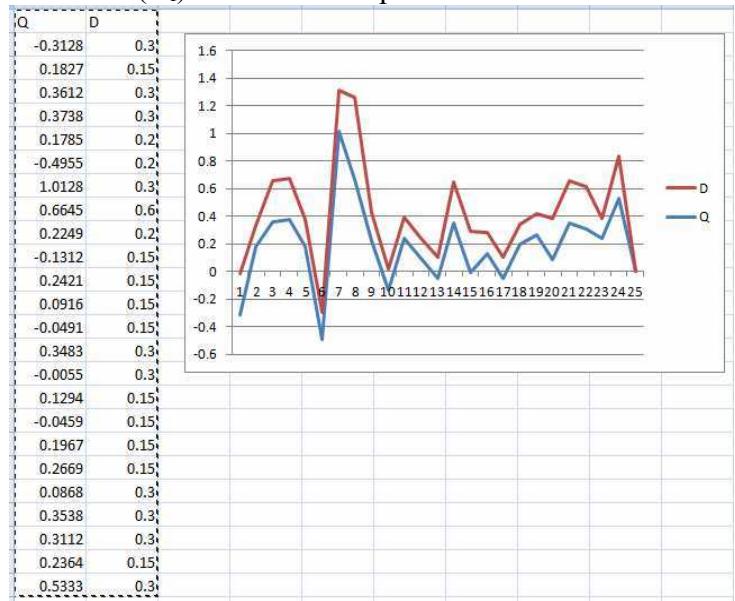
## Graphs and Result Curves



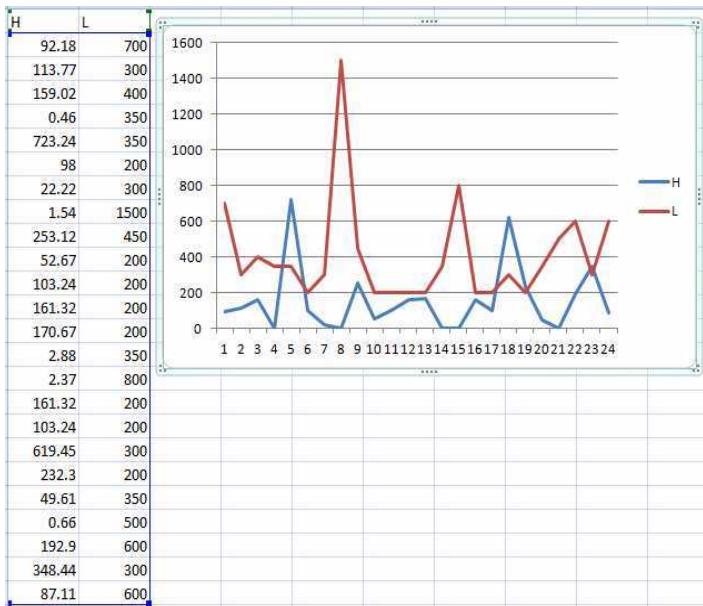
Graph 1- The graph of initial ( $H_o$ ) and final head loss ( $H_f$ ) in the nine loops.



Graph 2- The graph that shows the existing discharge,  $Q$ /the pipe diameter,  $D$ .



Graph 3-The graph that shows the corrected discharge,  $Q$ /the pipe diameter,  $D$ .



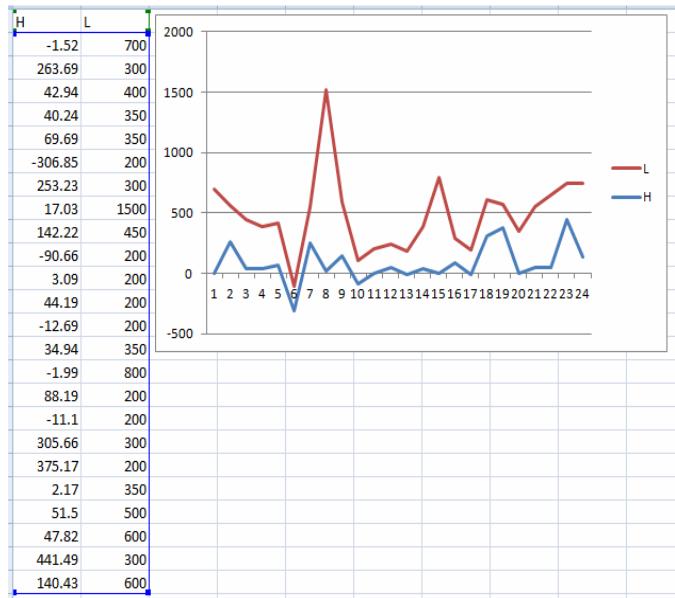
**Graph 4-** The graph that shows the initial head loss  $H_o$ /the pipe length,  $L$ .

## Conclusion

The simultaneous loop flow correction method were applied to the network distribution that involves twenty four pipes and nine loops, which is one of the highest as regards to the number of pipes analyzed so far.

It has been observed that the existing system has a lot of fluctuations in its head loss. Also, the discharge ( $Q$ ) is not proportional to the pipe diameter ( $D$ ). With the application of simultaneous loop flow correction method, the result produced shows a great improvement as it has to do with head loss and the proportionality between the discharge ( $Q$ ) and the pipe diameter ( $D$ ) was highly appreciated in this paper.

Hence, the method is useful aid in designing network for maximum economy. It is believed that the findings from this work will be a great asset in planning, designing and operation of reticulated water pipeline network. The results obtained could also be applied in any part of the world since



**Graph 5-** The graph that shows the corrected head loss,  $H_f$ /the pipe length,  $L$ .

environmental and climatic conditions do not affect the operation of the waterworks. It is hoped that if the results are applied adequately, all Nigerians should have access to potable water.

## Nomenclature

$Q_0$  = Initial assumed flow rate ( $m^3/s$ ),

$\Delta Q$  = Corrective discharge ( $m^3/s$ ),

$D$  = Pipe diameter (m),

$H_L$  or  $H$  = Head losses in pipe (m of fluid),

$Q$  = Flow rate through pipe, (in and out of the node) ( $m^3/s$ ),

$C_F$  = Unite conversion factor (English = 4.66, SI = 10.29),

$f$  = Darcy-Weisbach friction factor,

$C$  = Hazen-Williams coefficient,

$L$  = length of pipe,

$n$  = Manning roughness coefficient,

$i$  = Subscript indicating location,

$j$  = Subscript indicating location,

$\Delta H$  = Head difference between reservoirs in a loop

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# **Development of CNC Program for Piston Production**

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## **Abstract**

*Development of a computer numerical control program for the machining of a piston is a work that involves the casting and machining of a piston on a computer numerical control machine tool. Aluminum scraps were collected and heated. The molten metal at 720°C was poured into a mould and allowed to cool under atmospheric conditions. A computer numerical control program was written for the turning, grooving and boring of the piston. After cooling, the piston was mounted on a Computer numerical control lathe machine and the program was used to machine the piston. Examination of the dimensional accuracy of the piston showed that the piston with Ø52.553mm had a tolerance value of ±0.004mm which falls within acceptable standard of limit for a piston. Comparison of the piston produced shows that it is of reduced price compared with what is present in the market and with shorter time of production.*

**Keywords:** Computer Numerical Control, Turning, Grooving, Boring

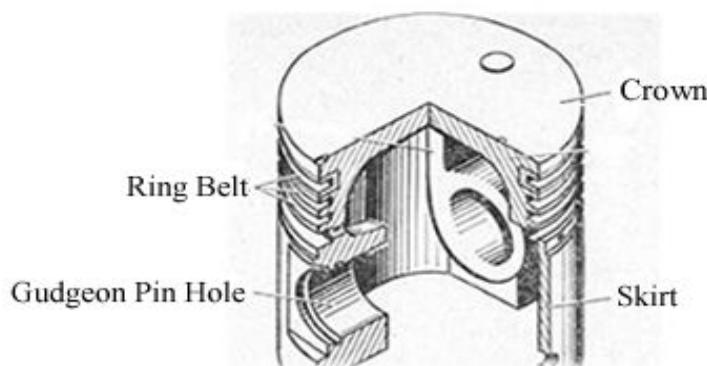
## 1.0 Introduction

A piston is a metal cylinder that slides up and down inside a tubular housing, receiving pressure or exerting pressure on a fluid, especially one of several in an internal-combustion engine [1]. It is the main moving/reciprocating component of a

The main features of the piston are shown in Fig. 1. Pistons are used in a variety of machines to convert one form of energy to another or to transfer fluids (such as water or air) or energy from one place to another.

reciprocating engine and is contained by a cylinder. The usual form of a piston is an inverted bucket-shape, machined to a close (but free sliding) fit in the cylinder barrel [2]. Gas tightness is ensured by means of flexible piston rings fitted closely in grooves turned in the upper part of the piston [3].

In an automobile, pistons are found in the engine, the braking system, the water pump and air conditioners. They are also used in power plants, vacuum pumps, condensers etc



**Fig. 1: Main features of a piston [4]**

Considering the wide uses and importance of pistons, one could possibly imagine that piston manufacturing should be done in every country. Surprisingly, this is not the case. Nigeria and many other third world countries have no piston production company. All the pistons used in these countries are therefore imported from countries like USA (Wiseco

piston company Inc.), Japan (Izumi industries Ltd), India (Anand piston Inc.) etc. Producing pistons in these countries, with Nigeria as an example, will reduce the price considerably since there would be no longer be need for importation.

The major factor of difficulty in piston production is the CNC machining process. To

obtain the desired clearance, the piston skirt should be machined with a tolerance of about  $\pm 0.004\text{mm}$ . This is because the piston must fit loosely enough to allow the piston to move, but tight enough that virtually no air or fluid in the cylinder can leak past it.

Computer Numerical Control (CNC) machines are electro-mechanical integrated products, composed of numerical control

systems of machine tools, machines, electric control components, hydraulic components, pneumatic components, lubricant, coolant and other sub-systems (components) that can reduce human intervention in spare parts production. For consistency in quality especially in the manufacture of complex components, human intervention has to be reduced as much as possible [5].

A typical CNC machining procedure is shown in figure 2.

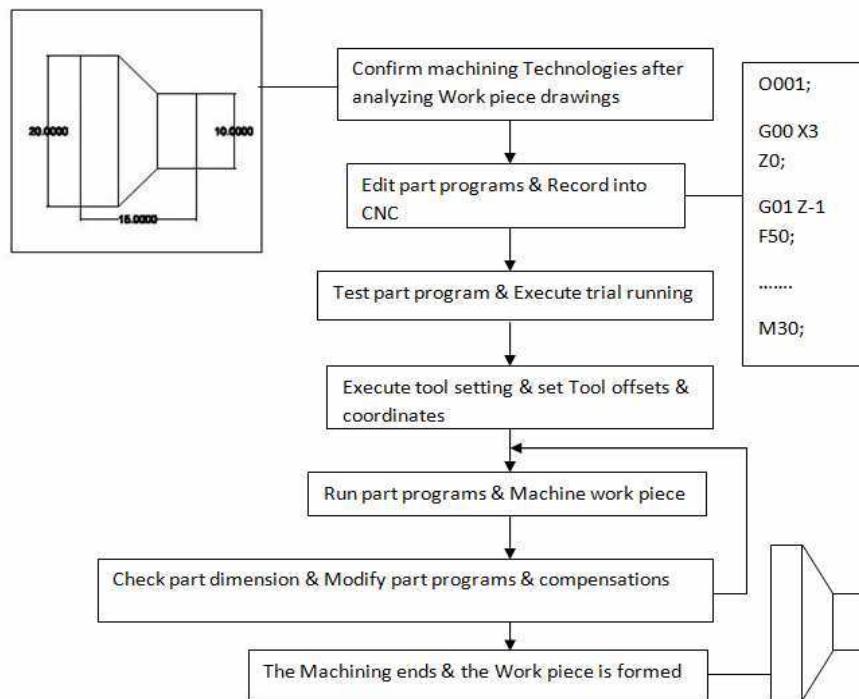


Fig.2: Technological flow of CNC machining process [6]

## 2.0 Materials and Methods

The following modalities were adopted in the execution of this work:

- i) Collection and analysis of various types of already existing pistons.
- ii) Preparation of mold according to the desired specifications. Melting, casting and cooling under appropriate conditions.

- iii) Development of turning, boring and grooving program using GSK980TD turning software.
- vi) Machining of the Piston casted in (iii), using the program developed in (iv).

### 2.1. The Casting Process

Casting is a *manufacturing* process by which a liquid material is usually poured into a *mold*,

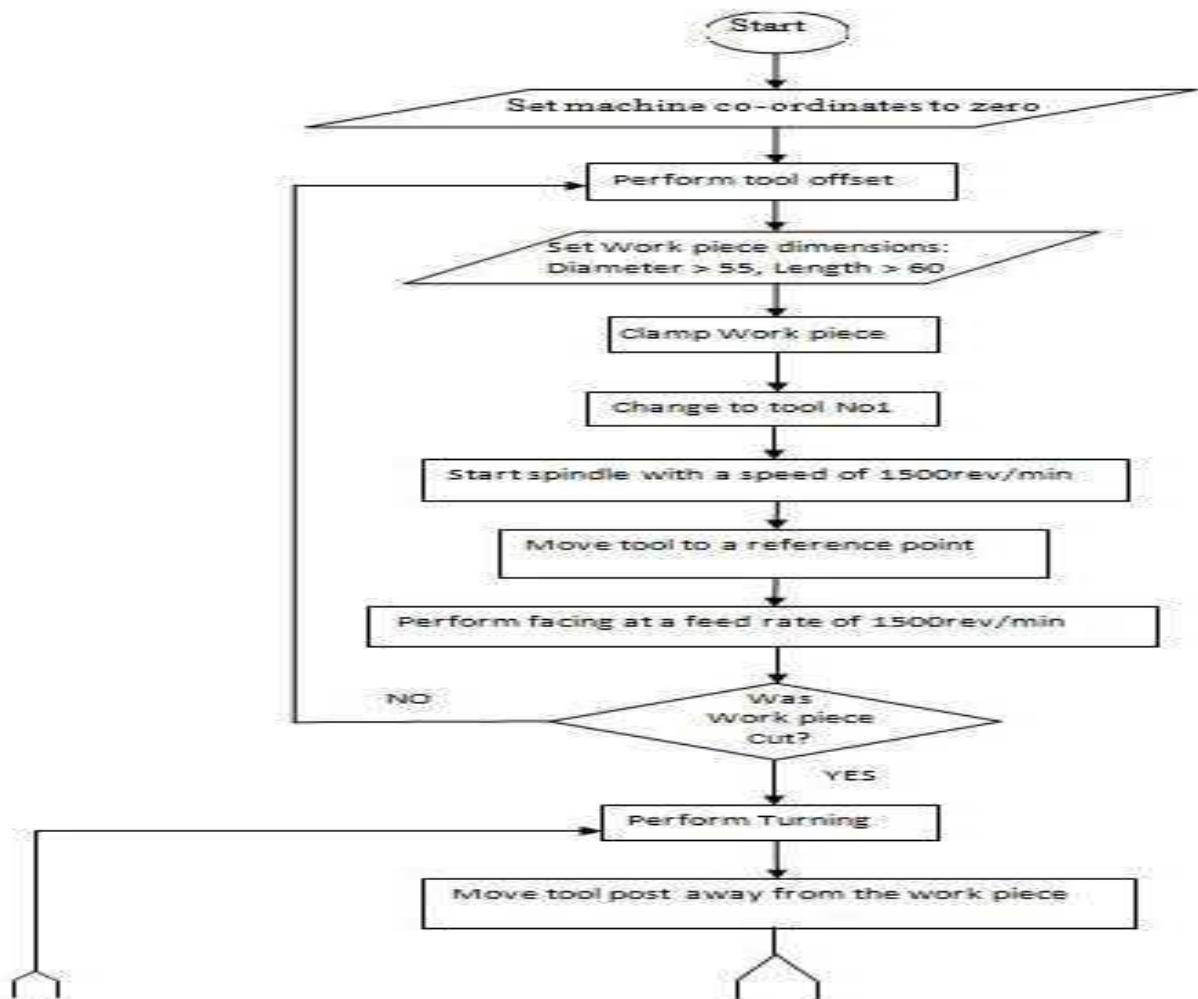
which contains a hollow cavity of the desired shape, and then allowed to solidify. The solidified part is also known as a casting, which is ejected or broken out of the mold to complete the process [7]. There are five different types of casting processes but the type of casting process used in this work is the sand casting process due to its numerous advantages.

## 2.2. Programming Codes and Format

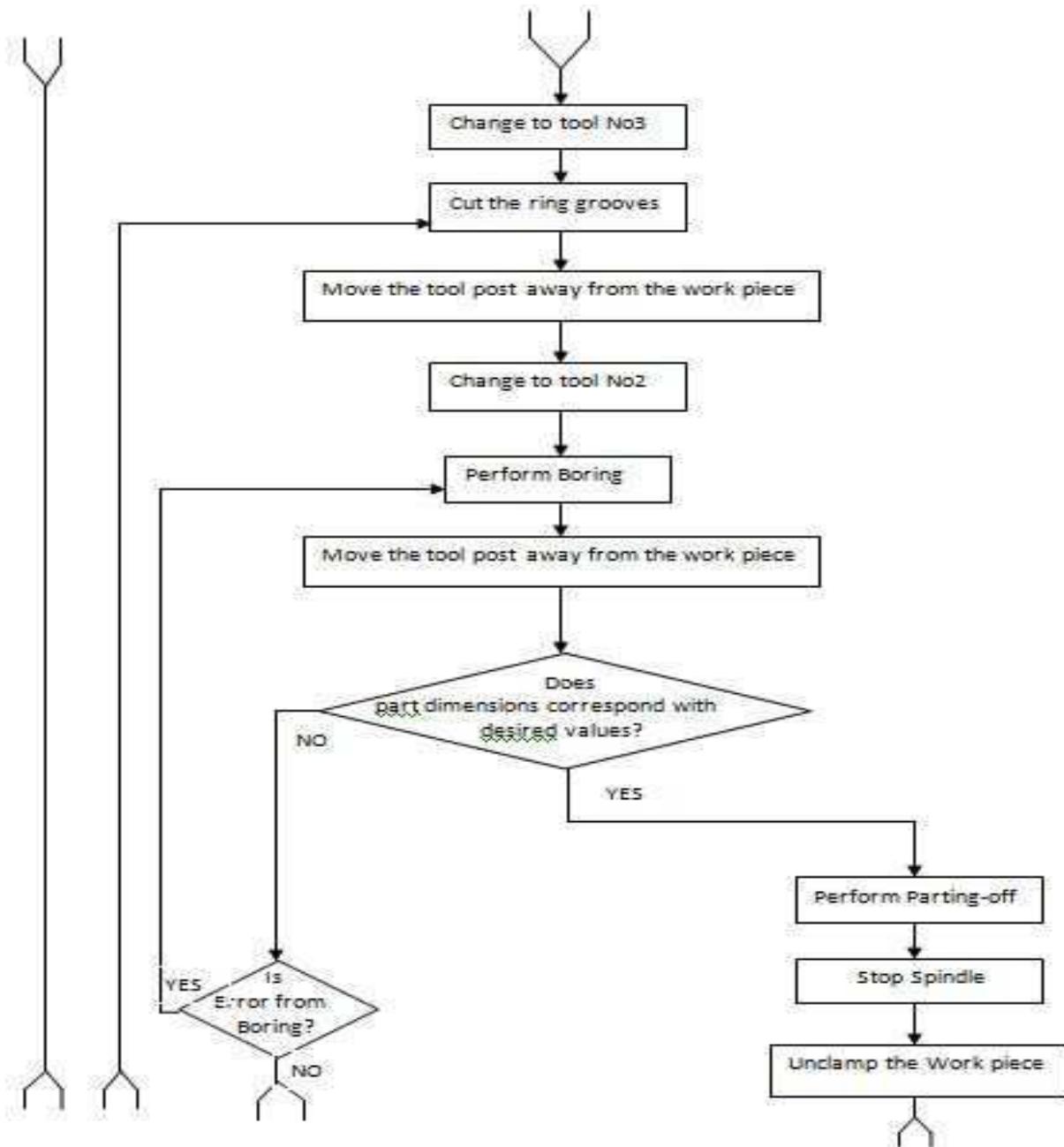
The program was written in the Fanuc compatible control mode which is used in over

80% of the CNC application throughout the world. The flowchart that led to this program is shown in Figs. 3-5.

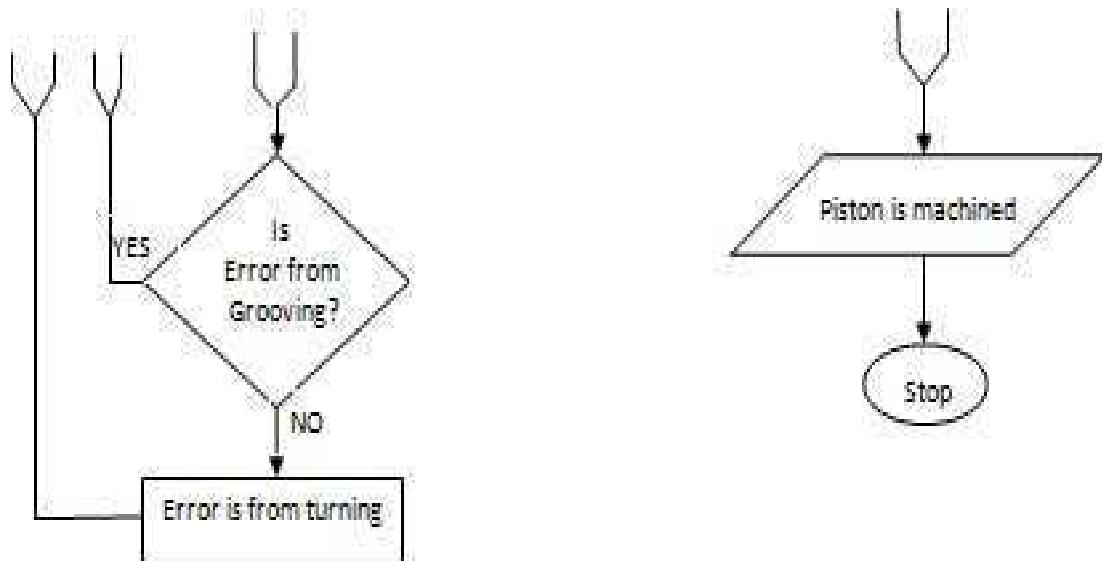
The flowchart consists of three basic machining processes which are: turning, grooving and boring. One important feature of this flowchart is the presence of a decision box after the facing operation. This serves as a means of checking the accuracy of the set tool offset.



**Fig. 3 Flowchart of CNC machining of piston up to the turning step**



**Fig. 4: Flowchart of CNC machining of piston showing the grooving, boring and parting off steps respectively**

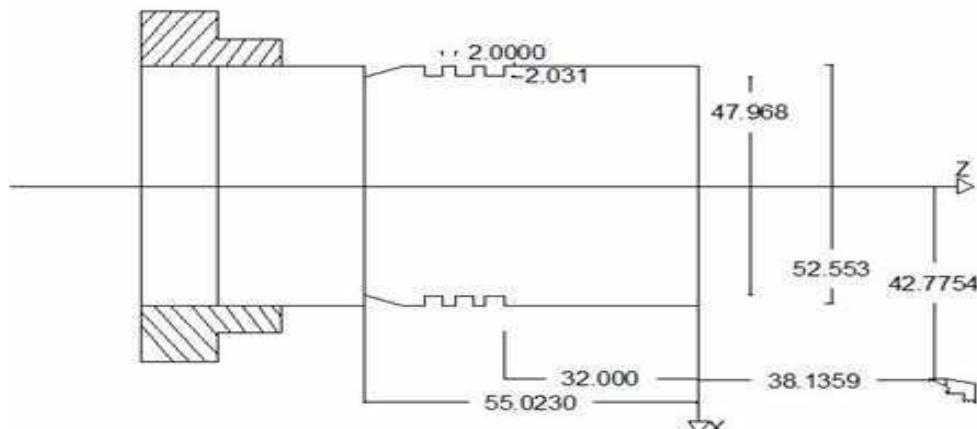


**Fig. 5 Flowchart showing the end of the CNC machining of the piston**

The most common codes used when programming CNC machine tools (which were used in this program) are G-codes (preparatory function) and M-codes (miscellaneous functions). Other codes such as F, S, D and T are used for machine functions such as feed, speed, cutter diameter offset and tool number [8].

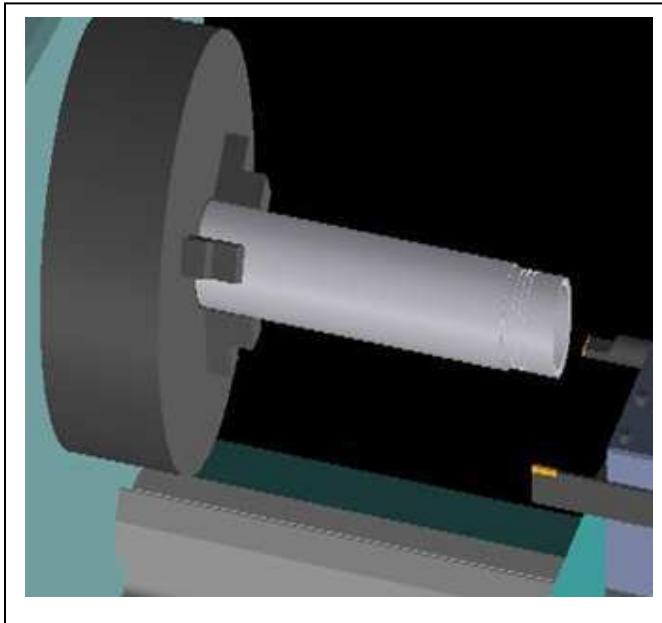
### 3.0 Results and Discussions

The co-ordinate values of the entire work piece were defined and the CNC program was developed following the flow chart in Fig.3. Fig.6 shows the co-ordinate values of the work piece in the absolute system. This was the first stage of the CNC programming process [9]. Here, the diagram of the work piece was drawn using AutoCAD software and dimensions taken. The dimensions were then used to write the program.



**Fig. 6 Co-ordinate values of work piece in the absolute system**

The CNC program for turning, grooving and boring of a piston was developed. After writing the program, it was input to the CNC lathe machine and run. Figure 7 shows the work piece after running the program on the GSK980TD software, before the actual machining on the CNC lathe machine. After



**Fig. 7 Work piece after machining**

The CNC program for turning, grooving and boring of a piston developed in this work is shown below:

```
[O0001].....(Program name)
N0001 M12;.....(Clamp workpiece)
N0002 T0101;.....(Change to tool no1)
N0003 M3 S1500;.....(Start the spindle with 1500rev/min)
N0004 G0 X38.1359;
N0005 Z42.7754;
N0006 G94 X-2 F1500;
N0007 G71 U0.5 R2;
N0008 G71 P8 Q10 U0.5 W0.5;

machining the piston, a micrometer was used to measure the dimensions of the piston. These dimensions were then compared with the dimensions of an existing (imported) piston which was used as a model for this production. The errors recorded ranged from 0.001-0.003mm. This can be termed as "acceptable error".
```

### 3.1. GSK980TD Program Code for Turning, Grooving and Boring Of A Piston

```
N0009 G01 X52.553;
N0010 X55 Z-2;
N0011 Z-32
N0012 G70 P8 Q10;
N0013 G0 X57;
N0014 Z10;
N0015 T0303; .....(Change to tool no3)
N0016 G0 X50.553;
N0017 Z-32;
N0018 G94 X49.5;
N0019 G0 X55;
N0020 Z-55.0230;
N0021 G94 X49.5;
N0022 G0 X57;
N0023 Z-39;
N0024 G94 X50 F500;
N0025 G0 X55;
N0026 Z3;
N0027 G0 X58;
N0028 Z10;
N0029 M98
P0002;.....(Switch to program no2)
N0029 M30;.....(End program)
%
[O0002]
.....(Program name)
N0001 M12;
.....(Clamp workpiece)
```

N0002	T0202;	N0008 G01 X50;
.....(Change to tool no2)		N0009 Z-15;
N0003 M3 S590; .....(Start the spindle with 590rev/min)		N0010 G70 P8 Q9;
N0004 G0 X58;		N0011 G0 X53;
N0005 Z0;		N0012 Z10;
N0006 G71 U0.5 R1 F592;		N0013 M30; .....(End program)
N0007 G71 P8 Q9 U1 W1;		%

### 3.2. Economic Analysis

Adoption of the program developed in this work will lead to production of cheaper pistons with a reduced production time. This program takes advantage of the high flexibility of the GSK980TD turning machine to perform turning, grooving and boring on the same machine. This reduces the number of machines

involved in piston production and the time of production, while the standard of the piston is maintained. It took a total of two and half man hours to produce one piston from casting to finished stage. A breakdown of the cost of producing one piston is shown in Table1:

**Table 1 Cost of producing a Piston**

S/N	ITEM/EVENT	RATE	QUANTITY	PRICE(N)
1	Aluminum	₦100 per kg	1kg	100
2	Diesel	₦130 per ltr	3ltrs	390
3	Electricity consumption	₦85 per hr	1hr	85
4	2" by 3" ply wood			150
5	Glue			200
6	Transportation			350
7	Labour	₦550 per man hr	2½	1375
8	<b>TOTAL</b>			<b>2,650</b>

If this piston is sold with a gain of 10%, the price of the piston will be ₦2,915. An imported piston with the same specifications as the one produced in this work is sold in Nigeria between ₦3,500 - 4,000.

### 4.0 Conclusion and Recommendations

#### 4.1. Conclusion

In this work, an aluminum piston was produced using sand casting process and a standard CNC program was developed for the

machining. The CNC machining operations included turning, grooving and boring. Adoption of this program by indigenous manufacturers will lead to the production of pistons at cheaper cost and shorter time. The same technology or method can be applied to produce other delicate or intricate machine parts and components.

#### **4.2. Recommendations**

Based on this research, the recommendations are made:

- a) Use of CNC machining Procedures should be encouraged.

- b) detailed procedure of piston Production presented in this research work should be encouraged in Nigeria.
- 

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## SECTION B

- Computing
- Mathematics
- Operations Research
- Information Technology
- Software Engineering and Production

# A Parse Tree Model for Analyzing And Detecting SQL Injection Vulnerabilities

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## Abstract

*The recent increase in the growth and use of the Internet for a wide-range of Web-based applications such as e-commerce, e-banking, etc., has brought about the increased popularity of web based applications. This upsurge has made the Internet a potential target for different forms of attacks. The increasing frequency and complexity of web-based application attacks have raised awareness of web application administrators of the need to effectively protect their web applications from being attacked by malicious users. SQL injection attack is a class of command injection attacks in which specially crafted input string result in illegal queries to a database has become one of the most serious threats to Web applications today. An SQL injection attacks targets interactive Web applications that employ database services. In this paper, we developed a model based on grammatical structure of an SQL statement using parse tree to test a query by dynamically generating a parse tree and comparing their structures at runtime. We were able to determine if their structures match or not. If they match, the query is parsed signifying that it is legitimate, otherwise it is suspicious and possibly malicious. Our result shows that the parser detected and prevented malicious SQL queries although there were a couple of false positives and false negatives representing 0.01% of legitimate attacks. This result is good enough because achieving 100% security precision may be too difficult. However, we hope to improve on this result in our future research.*

**Keywords:** SQL injection attacks, parse tree, web applications, attacker.

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## 1.0 Introduction

The recent increase in the growth and use of the Internet for a wide-range of Web-based applications such as e-commerce, e-banking, online stores, social network services, e-governance, etc., has brought about the increasing popularity of web based applications. This upsurge has made the Internet a potential target for different forms

of attacks [10]. The increasing frequency and complexity of web-based application attacks have raised awareness of web application administrators of the need to effectively protect their web applications from being attacked by malicious users.

Attacking Web applications by injecting SQL commands was first described as early

as 1998 [17]. Since 2002, over 50% of total cyber vulnerabilities were input vulnerabilities [19]. SQL injection attack is a class of command injection attacks in which specially crafted input string result in illegal queries to a database [20]. This has become one of the most serious threats to Web applications [14]. An SQL injection attack targets interactive Web applications that employ database services. Such applications accept user input in database requests, typically SQL statements. In SQL injection attacks, the attackers provide user input that results in a different database request than was intended by the application programmer [21].

SQL injection vulnerabilities (SQLIVs) account for 20% of the total cyber vulnerabilities since 2002 [18]. An SQLIV allows input to an SQL statement to change the structure of the statement and allows malicious users to gain unauthorized access to information in a database. As the trend of providing Web-based services continues, the prevalence of SQLIVs is likely to increase [11], [12]. Another concern facing the software development industry is that the number of developers inexperienced in software security outnumbers the number of experienced software security practitioners [3]. The implication is that significant portion of developers fixing SQLIVs will not be experienced with solving security issues [19]. The Open Web Application Security Project [22] report places injection attacks including SQLIAs as the most likely and damaging.

The most widely deployed defense technique today is to train the programmer and web-developers about the security implications of their code and to teach them corrective measures and good programming practices. However, rewriting or revising all or most of the existing legacy codes is quite

a difficult task as it requires lots of hard work, commitments and this will incur additional cost to any organization that may want to embark on such projects. There is therefore the need to develop an automated technique that will guarantee the detection of these vulnerabilities and a fool-proof elimination of SQL injection attacks.

Many techniques have been proposed, these are either static or dynamic. These techniques have failed to address the full scope of the problem. There are many types of SQLIAs and countless variations of these basic types. Therefore, many of the proposed solutions only detect or prevent a subset of the possible SQLIAs [11]. In this paper, we would develop an automatic technique to counter SQL attacks and/or prevent attacks. Our approach combines both the static and dynamic approaches of AMNESIA proposed by [12] and SQLCheck proposed by [24].

## 2.0 SQL Injection Attacks (SQLIAs)

SQL injection is an attacking technique which is used to pass SQL comments through a web application directly to the database by taking advantage of insecure code's non-validated input values. An SQL Injection Attack (SQLIA) is a subset of the unverified or unsanitized input vulnerability and occurs when an attacker attempts to change the logic, syntax, or semantic of a legitimate (benign) SQL statement by inserting new SQL keywords or operators into the statement [21]. SQL injection in web applications works using the dynamically-generated SQL queries. The root cause of SQLIAs is insufficient input validation. SQLIAs occur when data provided by a user is not properly validated and is included in an SQL query [13]. In such a vulnerable application, an SQLIA uses malformed user input that alters the

SQL query issued in order to gain unauthorized access to a database and extract or modify sensitive information [5] SQL flaw can lead to e.g., unauthorized access, data manipulation, or information disclosure.

Normally, web application is a three-tier architecture: the application tier at the user side, the middle tier which converts the user queries into the SQL format, and the backend database server which stores the user data as well as the user's authentication table [1]. Whenever a user wants to enter into the web database through application tier, the user inputs his or her authentication from a login form. The middle tier server will convert the input values of username and password from user entry form into the format shown below.

```
SELECT * FROM user_account
WHERE username='username' AND
passwd='password'
```

If the query result is true then the user is authenticated, otherwise it is denied. But there are some malicious attacks which can deceive the database server by entering malicious code through SQL injection which always return true results of the authentication query. For example, the hacker enters the expression in the username field like “ ‘ OR 1=1- - ’ ”. So, the middle tier will convert it into SQL query format as shown below. This deceives the authentication server. The query result will be:

```
* FROM user_account WHERE
username= ‘ OR 1=1- - ’ AND
passwd='password'
```

Analyzing the above query, the result would always be true. It is because malicious code has been used in the query.

In this query, the mark (‘) tells the SQL parser that the user name string is finished and like “ ‘ OR 1=1- - ’ ” statement appended to the SQL statement would always evaluate to true. The ( - ) is comment mark in the SQL tell the parser that the statement is finished and the password will not be checked. So, the result of the whole query will return true and this authenticate the user without checking password. The login form is used to get the user name and password from the user. The user name field can take some extra values other than alphanumeric characters. It may support some special characters like %, \$, |, #, etc.

SQL injections can be very dangerous for the integrity of web applications. With SQL injection, an attacker can access a database, change information stored in it, delete information, and can even have full control of a database. SQL injection attacker uses multiple statement method to insert his SQL command into the general query string. SQL injection are very prevalent, and ranked as the second most common form of attack on web applications for 2006 in CVE (Common Vulnerability and Exposures). The percentage of these attacks among the overall number of reported attacks rose from 5.5% in 2004 to 14% in 2006 [26]. The 2006 SQLIA on CardSystems solutions that exposed several hundreds of thousands of credit card numbers is an example of how such attack can victimize an organization and members of the general public. Analysts have found several application programs whose sources exhibit these vulnerabilities. Several reports suggest that a large number of applications on the web are indeed vulnerable to SQL injection attacks [20] and the number of the attacks is on the increase.

The most common type of SQL injection attacks is SQL manipulation. The attacker attempts to modify the existing SQL

statement by adding elements to the WHERE clause or extending the SQL statement with set of operators like UNION, INTERSECT, or MINUS, etc. The classic SQL manipulation is during the login authentication. Virtually all Web applications usually check user authentication before granting users access to the database. Usually, when a user submits a query to a database; the web application check user authentication by executing SQL statement. For instance, the following query may be executed:

```
SELECT * FROM users WHERE
username = 'eddy' and passwd =
'password'
```

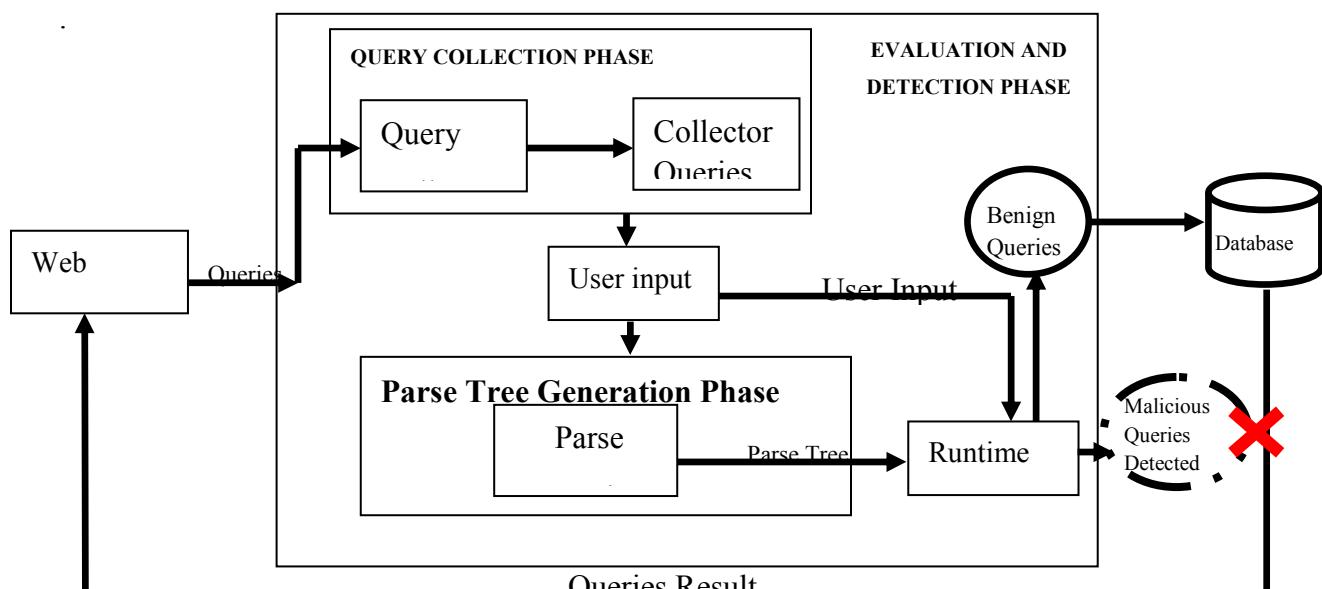
The attacker may attempt to manipulate the SQL statement to execute as follow.

```
SELECT * FROM users WHERE
username = 'eddy' and passwd =
'password' OR 'a' = 'a'
```

In this case the always true for every row and the attacker will automatically gain access to the application.

### 3.0 Methodology

The architecture of the proposed model is shown in figure 1. Usually, when a user input an SQL statement or query through a web application, the query is collected by the query collector and the user extractor extracts the query for processing in the parse tree generation phase when the query has been evaluated. The extracted query is then sent to the parse engine where it is compared with the one that is dynamically generated at runtime by our model to see if the structures are syntactically the same. If they are, the query will be allowed into the database otherwise it will be rejected and blocked



**Fig. 1: Architecture for proposed model**

A parse tree is a data structure for representing a parsed statement. Parsing a statement requires the grammar of the language (quest language, e.g., MySQL, MS-SQL, etc.) that the statement was written. By parsing two statements and dynamically comparing their structures at runtime, we can determine if the two queries are structurally identical. When a malicious user successfully inject SQL query into a database, the parse trees of the intended query and the resulting SQL query do not match. Intended queries are the codes written by the programmer to query the database. The programmer supplied portion is the hard coded portion of the parse tree, and the user-supplied portion is represented as empty leaf nodes in the parse tree. These nodes represent empty literals.

### 3.1 Generation BNF for SELECT Statements

We generated a Backus-Naur Form (BNF) for select statements. The general BNF generated was then used to construct the structure of each select statement syntactically. The BNF of a select statement is shown in the figure 2 below.

```

Input      ::= sql [sql] EOF
<Select-stmt>  ::= SELECT  select_list
from_clause
                  |
                  SELECT
select_list from_clause where_clause
<select_list>   ::= id_list | *
<id_list>       ::= id | id, id_list
<from_clause>   ::= FROM tbl_list
<tbl_list>       ::= id_list
<where_clause>  ::= WHERE bool_cond
<cond>          ::= bcond OR bterm |
bterm
<bterm>         ::= bterm AND bfactor |
bfactor

```

```

<bfactor>      ::= NOT cond | cond
<cond>          ::= value comp value ("--")
")
<value>          ::= id | num | str_lit |
(select-stmt)
<str_list>      ::= 'lit'
<comp>          ::= = | != | < | > | <= | >=

```

**Fig. 2:** A BNF grammar for a select statement

In figure 2, the Left-Hand-Side (LHS) represents non-terminal symbols while the Right-Hand-Side (RHS) represents terminal or non-terminal symbols of the production process.

We collected various SQL statements through web application. We also find the combination of these queries using the UNION, HAVING, ORDER BY clauses so as to have more complicated queries. We also collected queries which are stored procedures and alternate encoding which are very complex forms of queries. This is done to ensure that we have all the various forms of queries represented so that our technique will not be limited to solving only a subset of injection attacks. We also ensure that any possible combination of queries that an attacker can combine and use in future attacks are countered since it is a well known fact that just as security experts are finding ways to counter injection attacks, hackers will also be looking for new ways to hack well secured web sites. This we did by ensuring that certain query combinations are well verified and wherever keywords like UNION, HAVING, ORDER BY, LIKE, etc., are used in query combinations are first categorized as suspect and are well verified by the parser engine.

### 3.2 Parse Trees for SQL Statements

A parse tree is a data structure for representing a parsed statement. Parsing a

statement requires the grammar of the language (quest language, e.g., MySQL, MS-SQL, etc.) that the statement was written. By parsing two statements and dynamically comparing their structures at runtime, we can determine if the two queries are structurally identical. When a malicious user successfully inject SQL query into a database, the parse trees of the intention query and the resulting SQL query do not match. Intended queries are the codes written by the programmer to query the database. The programmer supplied portion is the hardcoded portion of the parse tree, and the user-supplied portion is represented as empty leaf nodes in the parse tree. These nodes represent empty literals. The programmer intends that the user supplied values to these empty leaves. In figure 3(a), the empty leaves are the placeholders represented by question mark (“?”) which are empty leaves where the user is expected to supply his username and password; which are expected to be validated before they are passed into the database. These question marks are substituted for and they represent placeholder meta-character. A placeholder in an intention statement represents an expanding point, where each expansion must conform to the corresponding grammatical rule intended by the developer. Here, a placeholder is an intention grammar which helps to regulate the instantiation of a placeholder dynamically at runtime. Each intention rule is mapped to an existing non-terminal symbol (e.g., comp) or terminal symbol (e.g., identifier) of an SQL statement.

In our technique, we developed pre-defined queries and the user input parser using the syntactic structure of the query. The syntactic structure of the user queries are compared with the pre-defined queries generated at runtime in order to see if they

are equal. In our technique, we combine the security of using Windows API. We did this by embedding the syntax of the guest language (MySQL) into the syntax of the host language. This is to avoid the problem of grammar ambiguities so that only one type of parse tree is generated for a particular type of query [4], [25]. At the parser engine, the parser generated parse tree structures are compared at runtime and they are found to be syntactically the same, the query is then determined to be legitimate or malicious. If legitimate, it will be parsed to the database to find the result of the query. The result once found will be returned to the web application. However, if the query is malicious, the decision trees will automatically classify the query into the SQL injection attack type. For example, the following SQL statement was used as one of our case studies.

```
SELECT * FROM user WHERE  
uname='?' AND password='?'
```

As shown in figure 3 (a), the placeholders are represented with question marks (?) and are underlined. These are the fields where users are expected to supply their inputs. We represented this by question marks (?) because we want to make the placeholder empty since it is believed that different users have different username and passwords. In figure 3 (b), parse tree of the SELECT statement is then drawn which indicate the programmer’s intended query. This query is further checked by the decision engine and through its leaner’s input data, the query is found to be legitimate (benign) and it is passed to the database. When another query is supplied, the parse tree is suspected to be different and it was classified as malicious. The query is shown below.

```
SELECT * FROM user WHERE  
uname='eddy' AND password=passwd  
OR 1=1
```

Subsequently, the query is rejected and blocked from getting to the database. This parse tree is shown in figure (c). Similar explanation can also be giving for figures (d) and (e). In figure(d), user supplied an SQL SELECT statement.

```
SELECT * FROM usertable WHERE  
username='eddy' AND password='abc12'
```

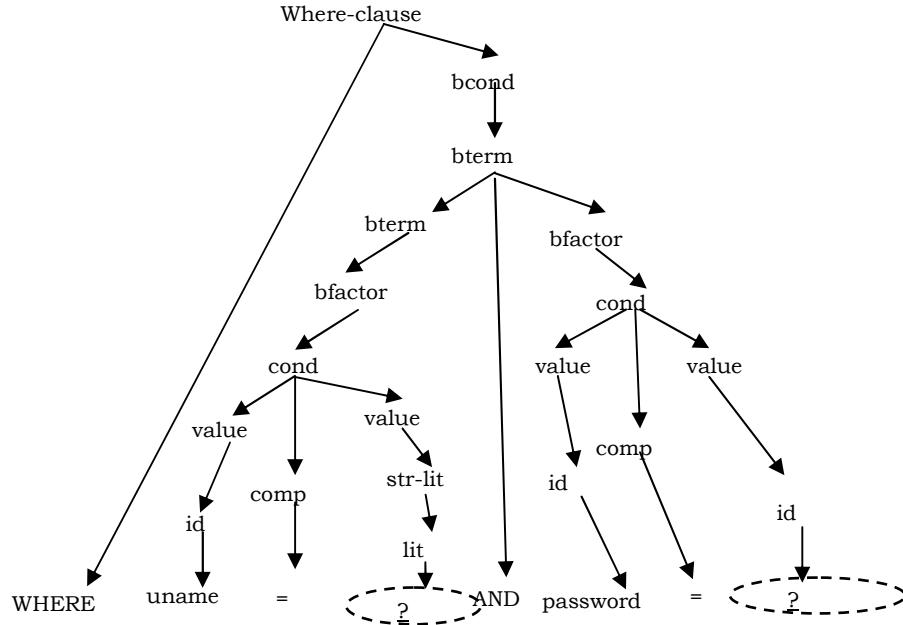
However, when a comment was introduced into the query, the attacker is able to gain access into the database and get the information in the database. This is

shown in the figure 3 (e). As can be seen from figures (d) and (e), the parse trees are syntactically different. Thus the second query figure (e) will be blocked from entering the database.

```
SELECT * FROM usertable WHERE  
username='eddy' AND  
password='abc12' AND  
password='secret'
```

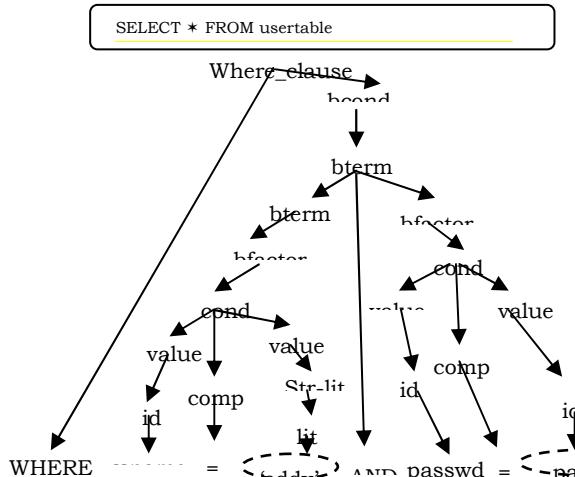
The parse trees shown below in figures 3(a-e) represent sample SELECT statements that shows how the parser will actually work whenever a query is injected into the database through the user input and password fields.

```
SELECT * FROM userstable
WHERE username= ? AND password= ?
```

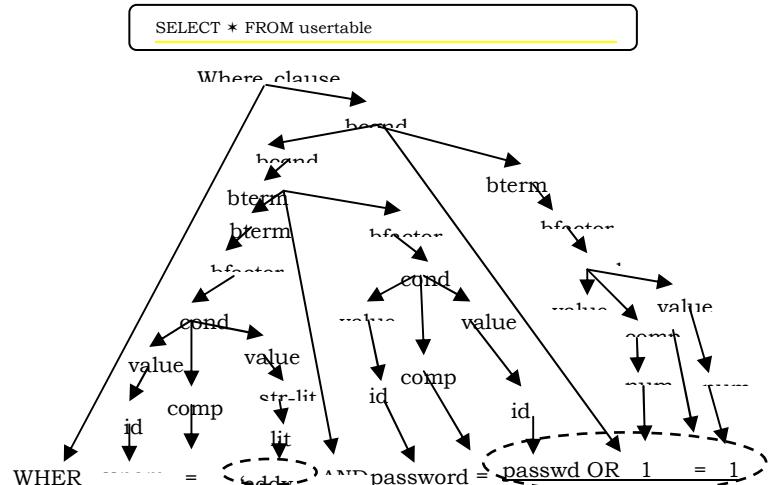


**Fig. 3(a):** A parse tree for a select statement. The username and password are not supplied

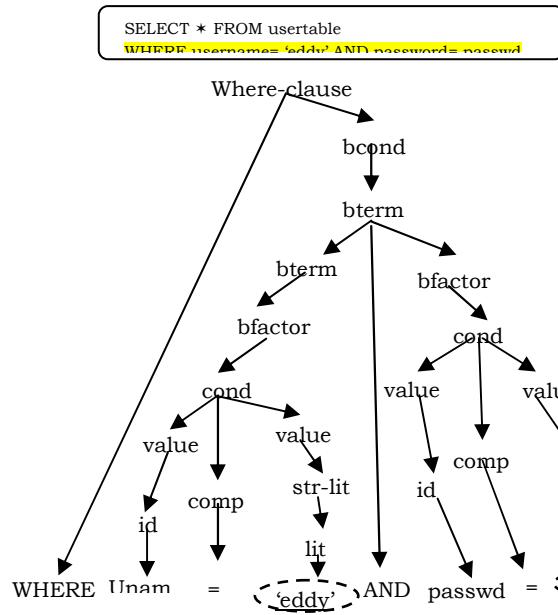
Figure 3(a) shows a parse tree for an SQL statement where the placeholders where the user is expected to supply his username and password. The placeholders are represented by question marks indicating that it is left open since any user can supply her username and password. The parse tree is drawn based on the production of the terminals and non-terminals representing the production on the SELECT statement by the Backus-Naur Form (BNF) in figure 2.



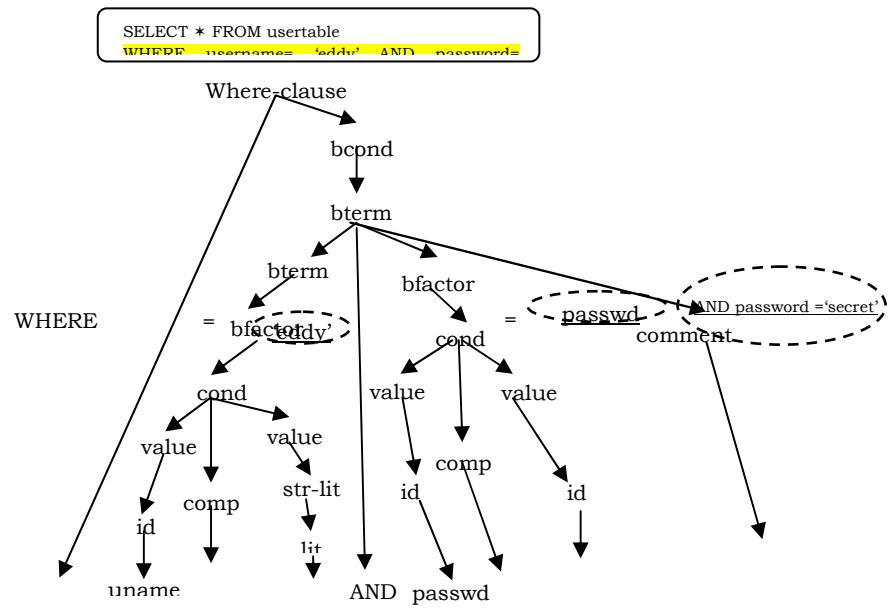
**Fig. 3 (b)** Benign select statement



**Fig. 3 (c)** A malicious query



**Fig. 3 (d)** A benign query



**Fig. 3 (e)** A malicious query

#### 4.0 Experimental Setup

We used real world applications from AMNESIA testbed [12] which has been previously used by other techniques. We used this testbed since it allows us to have a common point of reference with other approaches that have used it for their evaluation. The AMNESIA testbed consists of both legitimate and malicious queries. It is a standard testbed used for evaluating code injection prevention techniques. It consists of seven applications: Bookstore, Classifieds, Portals, Employee Directory,

Events, Checkers, and Office Talk. The AMNESIA testbed provides a set of subject Web application that are vulnerable to SQL injection attacks, along with test inputs that represent legitimate and malicious queries. They are publicly available at <http://www.gotocode.com> and <http://www.cc.gatech/~whalfond/testbed.html>. The purpose of these testbed is to facilitate the evaluation of SQL injection detection and prevention techniques. The AMNESIA testbed is shown in the table 1 below.

**Table 1: Information about subject application**

Subject	LOC	DBIs	Servelet
Bookstore	16,957	71	28
Portal	16,453	67	28
EmplDir	5,658	23	10
Classifieds	10,949	34	14
Events	7,242	31	13
Checkers	5,421	5	61
Office Talk	4,543	40	64

Our application demonstrates command injection attacks, where user-supplied command can be executed on the host by tempering with HTTP parameters. We specifically work on SQL injection attacks as an example of command injection attacks where supplying a malicious input in an HTML form results in a query being executed on the host that reveals secret data. The table below illustrates the list of

vulnerabilities as well as injection attacks exploiting these vulnerabilities.

#### 4.1 Generation Of Test Inputs

For each application in the testbed, there are two sets of inputs: LEGIT, which consists of legitimate inputs for the application, and ATTACK, which consists of attempted SQLIAs. This is shown in the table 2 below.

**Table 2: Set of legitimate and attacks used**

Subject	Total No. of Attacks	Successful Attack	Legitimate Attack
Bookstore	6,154	1, 999	607
Portals	6, 403	3, 016	1, 080
EmplDir	6, 398	2, 066	658
Classifieds	5, 968	1, 973	574
Events	6,207	2, 141	900
Checkers	4,431	922	1,359
Office Talk	5,888	499	424

The result of this attack strings contained 30 unique attacks that had been used against applications similar to the ones in the testbed.

#### 4.2 Evaluation

In our experiment, to ensure that our results are correct, we first disabled the decision engine. We then tested our

technique against all legitimate and malicious queries. After testing, no false negatives were found but there are couples of false positives for each subject, which was tested.

The result shows that with the use of only parser as a tool, parser produces false positive but it produces no false negatives.

**Table 3: The number of false positives and false negatives detected**

Subject	Total No. of Attacks	No. of Legitimate Accesses	False Positives	False Negatives
Bookstore	6,154	607	3	2
Portals	6,403	1,080	5	3
EmplDir	6,398	658	3	1
Classifieds	5,968	574	2	2
Events	6,207	900	3	0
Checkers	4,431	1,357	6	3
Office Talk	5,888	424	1	1
<b>Total</b>	<b>41,449</b>	<b>5,602</b>	<b>23</b>	<b>12</b>

The table above shows that out of 41,449 total numbers of attacks, there are 23 false positives. This is approximately 0.0041% of total attacks. This is quite high. The reason for this is that if any of these attacks is very dangerous, it could cause serious damage to any individual or organization. Although, this result is good enough considering the fact that virtually all parser-based approaches used in the past have suffered from this same problem. In future, we hope to introduce another tool called decision tree classifier, a machine learning approach that will automatically classify queries into their respective groups (i.e., legitimate, malicious, and unclassified). This tool will be used in combination with the parser to correct the problem which the parser suffers from.

#### 4.2.1 Discussion of Results

As seen in table 3, when only parser is used as the only tool for detecting and preventing SQL injection attack, there are 23 false positives out of 5,602 legitimate accesses representing 0.41% of the total accesses. Though this percentage is very small, it could cause a lot of great trouble to a database if sensitive information is returned to a malicious user whose intention is to have access to sensitive information that could be used for theft such as credit card numbers. The table also shows that the number of false positives is zero (0) indicating that when parser is used to detect and prevent SQL injection attacks, it is very effective in curbing queries that are malicious in that it completely prevent them.

#### 4.2.2 Complexity Analysis and Optimization

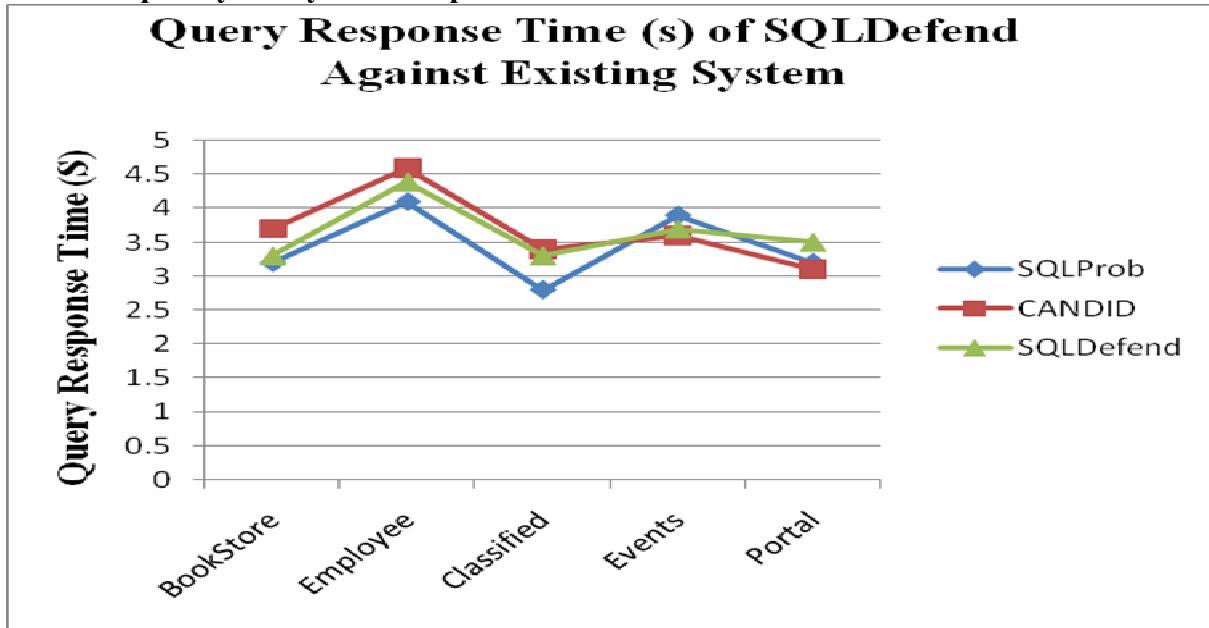
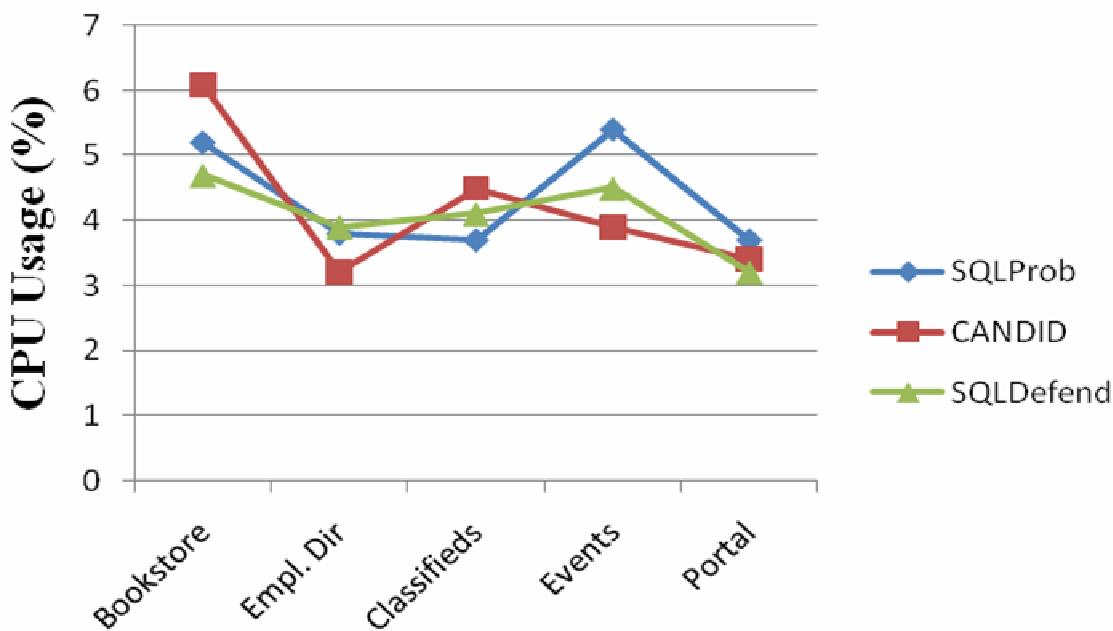


Fig. 4a

## CPU Usage of SQLDefend Compared with Other Tools



**Fig. 4 b**

### 5.0 Related Work

In [12] the authors used AMNESIA technique to secure vulnerable statement by combining static analysis with statement generation and runtime monitoring. They used static analysis of Java programs to compute a finite-state machine model that captures the lexical structure of SQL queries issued by a program. They analyzed the vulnerable SQL statement, then generate a general acceptable SQL statement model, and allow or deny each statement based on how it compares to the model at runtime. In the study they conducted, they used five real world Web applications and applied AMNESIA to each of the applications. SQL injection attacks cause SQL queries issued by the program to deviate from this model

and were detected. Although the technique is effective because it detects injection attacks and it avoids runtime taint-tracking, it suffers some drawbacks. Their solution uses exceptions to indicate potential attacks which could cause overhead on the part of the developers. Also, the conservative nature of its static analysis and its inability to distinguish different courses of inputs can lead to a higher rate of false positives.

In [7], the authors proposed SQLGuard technique for detecting injection attacks. They use SQLGuard to secure vulnerable SQL statements by comparing the parse tree of an SQL statement before and after user input and only allow SQL statements to execute if the parse trees match. In their study, they used one real-world Web

application for each application. They technique was able to stop all the SQLIAs after testing it and it generated no false positives. However, their technique had some overheads. First, the developer must rewrite all the SQL codes to use their custom libraries. This is quite a difficult time, consuming and costly task on the part of the application developers. There is also the problem of computational overhead due to dynamic statement validation by removing vulnerability and allowing all inputs. Therefore, SQLGuard is not flexible enough, because the source code of the application must be modified in many positions. This is a very tedious task on the part of the programmer which may be very difficult to achieve.

SQL Document Object Model (SQL DOM) technique was proposed by [16]. This is an API dependent stored procedure technique for detecting injection attacks. SQL DOM analyzes the database schema at compile time and writes codes to customize the SQL query construction classes. The resulting DOM is a tree-like structure based on a generic template, mapping the possible variations of SQL queries according to tables and column definitions. They used three (3) main classes, SQL statements, table columns and where conditions. These classes have strong-typed methods mapping the data types in the database schema. This enables them to validate data types automatically. The constructor of column classes escape strings (i.e., replace each quote by a double quote) at runtime to sanitize them. Although the approach was able to prevent application layer injection attacks, it however had some limitations. It has some overheads for developer training and code rewriting, as query-generating code needs to be rewritten. Its full-object criterion lead to additional cost. Also, since

the technique uses stored procedures, it remains unprotected. The technique does not execute queries (it only generates them). While this could improve database integration and perhaps further reduce the attack surface, the technique neither describes its string sanitization strategy nor elaborates on exception handling and thus did not address how the SQL DOM would behave if a null value is passed on as a criterion.

In [24] the authors proposed SQLCHECK technique to prevent SQLIAs. Their approach employs context-free grammars for data validation. Data that is dynamically added to foreign code statements has to fulfill specifically constructed grammars. By tracking dynamically added values through the application's processes, SQLCHECK can identify un-trusted values before the query is parsed to the database. These values are parsed by the constructed grammar to validate their correctness. They analyzed the parse tree of the query, generated customs validation code, and then wrap the vulnerable statement in the validation code. They used five real-world Web applications in their study and applied their technique to each of the applications. Their wrapper stopped all of the SQLIAs in their attack set without generating false positives. However, the technique assumes the client will not be able to produce the magic marker symbol. This is very dangerous to assume since Web applications can “echo” SQL queries to the user if an error occurs, the user may trick the Web application into revealing its markers [6]. Also, the technique is still subject to denial-of-service attack. This is because, at runtime, it can only flag errors and prevents them from escalating into a full security compromise.

## 6.0 Conclusion and Future Work

The recent increase in the growth and use of the Internet for a wide-range of Web-based applications such as e-commerce, e-banking, online stores, social network services, e-governance, etc., has brought about the increasing popularity of web based applications. This upsurge has made the Internet a potential target for different forms of attacks. In this paper, we developed pre-defined queries and the user input parser using the syntactic structure of the query. The syntactic structure of the user queries are compared with the pre-defined generated at runtime. We embedded the guest language (MySQL) into the syntax of the host language (Java). This is to avoid the problem of grammar ambiguities so that only one type of parse tree is generated for a particular query.

Our result shows that the parser was able to detect malicious queries, although it also

produces false positives and false negative. This is approximately 0.01% of legitimate attack. This is quite high. The reason for this is that if any of these attacks is very dangerous, it could cause serious damage to any individual or organization. Although, this result is good enough considering the fact that virtually all parser-based approaches used in the past have suffered from false positives. In future work, we hope to introduce another tool called **decision tree classifier**, a machine learning approach that will automatically classify queries into their respective groups (i.e., legitimate, malicious, and unclassified). This tool will be used in combination with the parser to correct the problem which the parser suffers from. This way we hope the problem of false positives and false negative will be solved.

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# Embedding Quality Function Deployment In Software Development: A Novel Approach

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## Abstract

*Software development differs widely in concept, requirement and framework. Therefore the software engineer has enormous task in engineering functional software that can work and be delivered on time.. This paper focuses on how customers' voice can be heard in order to reduce development and manufacturing costs, improve product quality, provide features that satisfy customer needs, and reduce development time. Quality Function Deployment has proven very successful in producing products that appeal to customers. Metaphorically, the customer speaks one language and the manufacturer speaks another. Quality Function Deployment provides linguistic continuity from customer to manufacturer and brings corporate knowledge to bear on the product that achieves multifunctional consensus. This paper adopted a new approach by extending the Quality Function Deployment matrix beyond the House of Quality.*

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## 1.0 Introduction

The reliance of modern Society on Computer System and the dependency on software makes it permanent that software engineers, researcher and software development organizations should devise processes to make software products and their quality unique, reliable and free from developmental problems. Serious efforts should be made to fabricate tools to help this development and reduce the time that it takes the finished products to get to the customers. This paper provides a novel **Quality Function Deployment** model and framework that will aid the development process [2].

### 1.1 What is Quality Function Deployment (QFD) ?

*Quality Function Deployment (QFD)* was developed by Yogi Akao [1] in Japan in 1966 and by 1972 the power of the approach had been well demonstrated by Mitsubishi Heavy Industries Kobe Shipyard (Sullivan 1986 and 1978). The first book on the subject was published in Japanese and later translated into English in 1994 (Mizuno and Akao 1994)[1].

*Quality Function Deployment* is a customer-oriented approach to product and service innovation. It guides managers through the conceptualization, creation, and realization of new products and services. The QFD process encourages you to gain an

in-depth understanding of the requirements of your customers needs and wants thus enabling you to prioritize the features and benefits of your product or service to these requirements, meeting customer needs and providing superior value. This focus on satisfying the customer's needs places an emphasis on techniques such as Quality Function Deployment to help understand those needs and plan a product to provide superior value.

The "*voice of the customer*" is the term to describe these stated and unstated customer needs or requirements. The voice of the customer is captured in a variety of ways: direct discussion or interviews, surveys, focus groups, customer specifications, observation, warranty data, field reports, etc. This understanding of the customer needs is then summarized in a product planning matrix or "house of quality". These matrices are used to translate higher level "what's" or needs into lower level "how's" - product requirements or technical characteristics to satisfy these needs.

While the Quality Function Deployment matrices are a good communication tool at each step in the process, the matrices are the means and not the end. The real value is in the process of communicating and decision-making with Quality Function Deployment. Quality Function Deployment is oriented towards involving a team of people representing the various functional departments that have involvement in product development: Marketing, Design Engineering, Quality Assurance, Manufacturing or Manufacturing Engineering, Test Engineering, Finance, Product Support, etc. The active involvement of these departments can lead to balanced consideration of the requirements or "what's" at each stage of

this translation process and provide a mechanism to communicate hidden knowledge - knowledge that is known by one individual or department but may not otherwise be communicated through the organization. The structure of this methodology helps development personnel understand essential requirements, internal capabilities, and constraints and design the product so that everything is in place to achieve the desired outcome - a satisfied customer. Quality Function Deployment helps development personnel maintain a correct focus on true requirements and minimizes misinterpreting customer needs. As a result, Quality Function Deployment is an effective communications and a quality planning tool.

## **2.0 Quality Function Deployment Phases**

The basic Quality Function Deployment methodology involves four basic phases that occur over the course of the product development process. During each phase one or more matrices are prepared to help plan and communicate critical product and process planning and design information.

**Phase 1, Product Planning:** Building the House of Quality. Led by the marketing department, Phase 1, or product planning, is also called The House of Quality. Many organizations only get through this phase of a QFD process. Phase 1 documents customer requirements, warranty data, competitive opportunities, product measurements, competing product measures, and the technical ability of the organization to meet each customer requirement. Getting good data from the customer in Phase 1 is critical to the success of the entire QFD process.

**Phase 2, Product Design:** This phase 2 is led by the engineering department. Product design requires creativity and innovative team ideas. Product concepts are created during this phase and part specifications are documented. Parts that are determined to be most important to meeting customer needs are then deployed into process planning, or Phase 3.

**Phase 3, Process Planning:** Process planning comes next and is led by manufacturing engineering. During process planning, manufacturing processes are flowcharted and process parameters (or target values) are documented.

**Phase 4, Process Control:** And finally, in production planning, performance indicators are created to monitor the production process, maintenance schedules, and skills training for operators. Also, in this phase decisions are made as to which process poses the most risk and controls are put in place to prevent failures. The quality assurance department in concert with manufacturing leads Phase 4.

Quality Function Deployment begins with product planning; continues with product design and process design; and finishes with process control, quality control, testing,

equipment maintenance, and training. As a result, this process requires multiple functional disciplines to adequately address this range of activities. QFD is synergistic with multi-function product development teams. It can provide a structured process for these teams to begin communicating, making decisions and planning the product. It is a useful methodology, along with product development teams, to support a concurrent engineering or integrated product development approach.

Quality Function Deployment, by its very structure and planning approach, requires that more time be spent up-front in the development process making sure that the team determines, understands and agrees with what needs to be done before plunging into design activities. As a result, less time will be spent downstream because of differences of opinion over design issues or redesign because the product was not on target. It leads to consensus decisions, greater commitment to the development effort, better coordination, and reduced time over the course of the development effort. QFD requires discipline. It is not necessarily easy to get started with. The following is a list of recommendations to facilitate initially using QFD.

### 3.0 House of Quality

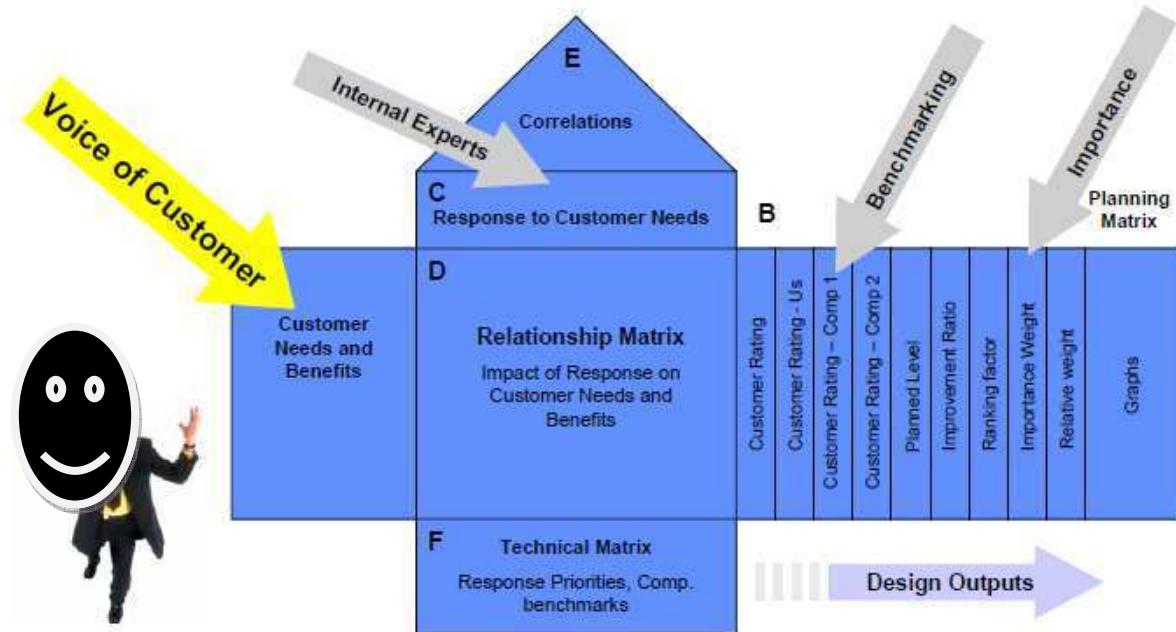


Fig. 1: House of Quality

QFD uses a matrix. This matrix of QFD is called the "**House of Quality**". The first phase in the implementation of the Quality Function Deployment process involves putting together a "House of Quality" [4] such as the one shown above. Clausing [4], one of the pioneers of Quality Function Deployment usage, points out that Quality Function Deployment's primary goal is to overcome three major problems:

- 1) disregard for the "voice of the customer",
- 2) loss of information, and
- 3) different individuals and functions working to different requirements.

Quality Function Deployment consists of well-developed formats (matrices and charts) and a style of organizational behaviour that facilitates a novel response to customer needs [[4]]. Quality Function

Deployment can benefit an organization by increasing the company's market share and profit. It does this through reduced development and manufacturing costs, improved product quality, provision of features that satisfy customer need, and reduced development time. Quality Function Deployment has proven very successful in producing products that appeal to customers.

Metaphorically, the customer speaks one language and the manufacturer speaks another. Quality Function Deployment provides linguistic continuity from customer to manufacturer and brings corporate knowledge to bear on the product that achieves *multifunctional consensus*.

The key idea presented in [4] is that Quality Function Deployment is needed to deploy customer needs throughout the

corporate communication circle and return to the customer a new product that fully meets those needs. Quality Function Deployment is a product development methodology that systematically deploys customer requirement priorities into the product design and guides production operation on the factory floor. Quality Function Deployment provides a win-win development approach for the manufacturer and customer.

Although these ideas about Quality Function Deployment have been developed for building quality products in the product industry, there are compelling reasons for integrating this methodology in software development processes. This key concept provides a foundation for this paper. It provides the necessary information to transfer these product manufacturing management techniques into a novel model for software acquisition and development.

In Hauser [7], Hauser and Clausing present the "house of quality" (HOQ) as the basic implementation construct of the management approach known as Quality Function Deployment (QFD). The "*house of quality*" provides a conceptual, abstract view of a product design and provides the means for inter-functional planning and communication. The authors point out that the main challenge in design (product design, software design, etc.) is to learn from customer experience and reconcile what customers say they want with what engineers can reasonably build. The house of quality provides such a mechanism for product design, development, and manufacture. Traditionally, the house of quality has been used in the automobile industry and other factory environments, but the same challenge of managing design complexity that Quality Function

Deployment tackles in the product industry also plagues the software development industry.

### **3.1 Methodology**

Every Software Engineering should describe a unique set of framework activities for the software processes it adopts and regardless of the process model that is selected software engineers have traditionally chosen a generic process framework so the framework for software development process is no doubt a complicated one. The end product follows a chain of analysis, design, development and testing process. At each stage, it is important to follow a well-defined methodology to ensure a quality end product. For large scale projects, each stage in the whole process is a challenge. At this technical level we look at two software engineering approaches namely - *The Waterfall Model and Prototyping*

### **3.2 The waterfall Model**

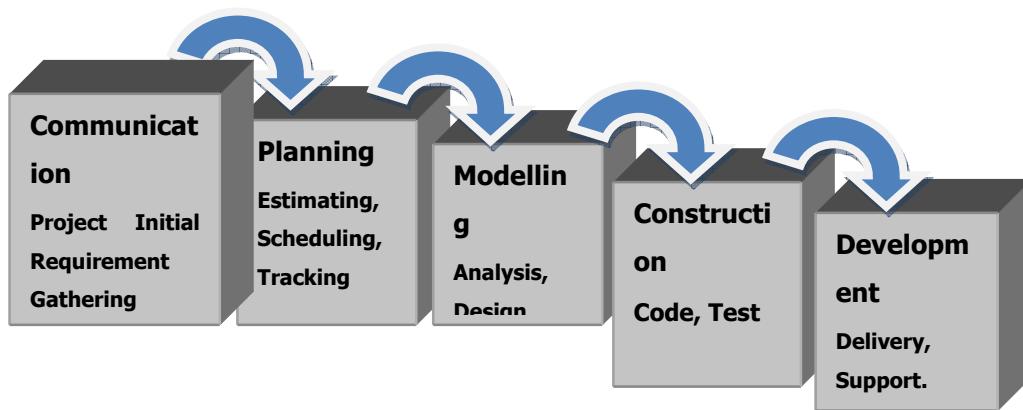
There are times when the requirement of a problem are reasonably well-understood-when work flows from communication through deployment in a reasonably liner fashion. This situation is sometimes encountered when well-defined adaptations or enhancements to an existing system must be made (e.g. accounting software that has been mandated because of changes to government regulations). It may also occur in a limited number of new development efforts but only when requirements are well defined and reasonably stable.

The waterfall model sometimes called the Classic Life Cycle, suggest a systematic sequential approach to software development that begins with customer specification of requirements and progress

through planning, modeling, construction and deployment , culminating in on-going support of the completed software. The waterfall model is the oldest paradigm for software engineering. However, over the past three decades, criticism of this process model has caused even ardent supporters to question its efficiency. Among the problems that are encountered when the waterfall model is applied are:

- (1) Real projects really follow the sequential flow that the model proposes. Although the linear model can accommodate iteration, it does it indirectly. As a result, changes can cause confusion as the project team proceeds.

- (2) It is often difficult for the customer to state the entire requirement explicitly. The waterfall model requires this and has difficulty accommodating the natural uncertainty that exist at the beginning of many projects.
- (3) The customer must have patience. A working version of the program(s) will not be available until late in the project time span. A major blunder, if undetected until the working program is reviewed can be disastrous. Today software is fast paced and subject to never ending stream of changes. The waterfall model is often inappropriate for such work.



**Figure 2 The Waterfall Model**

### **3 Prototyping**

Often a customer defines a set of general objectives for software, but does not identify detailed input *ab initio*, processing or output requirements. In other cases, the developer may be unsure of the efficiency of an algorithm, the adaptability of an operating system or the form that human machine interaction should take. In this and many other situations, a prototyping paradigm may offer the best approach.

Although prototyping can be used as a standalone process model, it is more

commonly used as a technique that can be implemented within the context of any one of the process model like incremental model or Rapid Application Development Model. Regardless of the manner in which it is applied, the prototyping paradigm assists the software engineer and the customer to better understand what it is to be built *when requirements are fuzzy*.

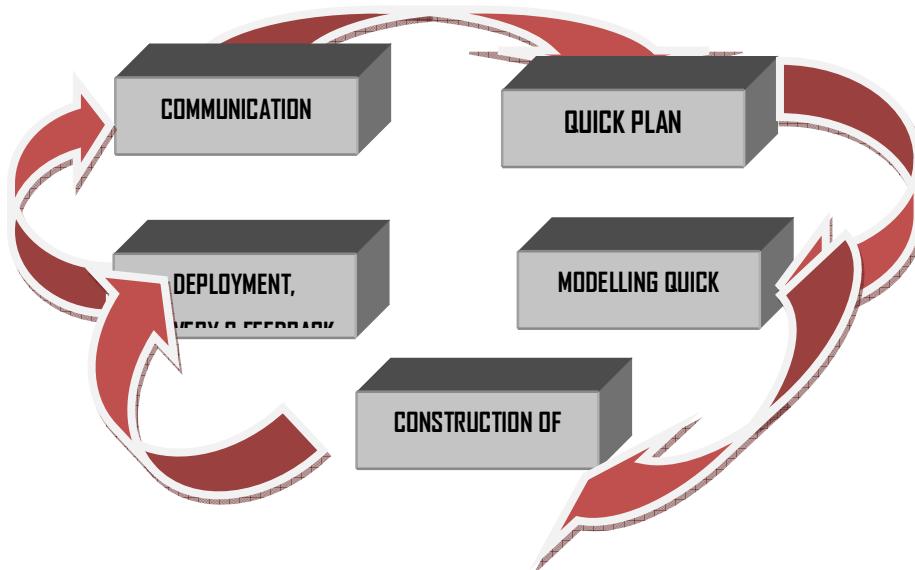
The prototyping paradigm in Figure 3 begins with communication. The software engineer and customer meet and define the overall objective for the software, identify

whatever requirements are known and outline where further definition is mandatory. A prototyping iteration is planned quickly and modeling in form of a “quick design” occurs. The quick design focuses on a representation of those aspects of the software that will be visible to the customer and end user e.g human interface layout or output display format. The quick design leads to the construction of a prototype. The prototype is deployed and then evaluated by the customer or user. Feedback is used to refine requirement for the software. Iteration occurs as the prototype is tuned to satisfy the needs of the customer, while at the same time enabling the developer to better understand what needs to be done.

Ideally, the prototype serves as a mechanism for identifying software requirements. If a prototype is built, the developer attempts to make use of existing

program fragments or applies tools (e.g. report generators, window managers etc) that enable working programs to be generated quickly. Prototyping can be problematic for the following reasons:

- (1) The customer sees what appears to be a working version of the software, unaware that the prototype is held together “with chewing gum and bailing wire”, unaware that in the rush to get it working we have not considered overall software quality or long-term maintainability.
- (2) The developer often makes implementation compromise in order to get a prototype working quickly. An inappropriate operating system or programming language may be used simply because it is available and known, an inefficient algorithm may be implemented simply to demonstrate capability. However, in this paper we have opted for prototyping model.



**Figure 3: The Prototyping Model**

### **3.4 Quality Function Deployment Steps**

#### **Step 1: Customer Requirements - "Voice of the Customer"**

The first step in a QFD project is to determine what market segments will be analyzed during the process and to identify who the customers are. The team then gathers information from customers on the requirements they have for the product or service.

#### **Step 2: Regulatory Requirements**

Not all product or service requirements are known to the customer, so the team must document requirements that are dictated by management or regulatory standards that the product must adhere to.

#### **Step 3: Customer Importance Ratings**

On a scale from 1 - 5, customers then rate the importance of each requirement.

#### **Step 4: Customer Rating of the Competition**

Understanding how customers rate the competition can be a tremendous competitive advantage.

#### **Step 5: Technical Descriptors - "Voice of the Engineer"**

4.0

The technical descriptors are attributes about the product or service that can be measured and benchmarked against the competition.

#### **Step 6: Direction of Improvement**

As the team defines the technical descriptors, a determination must be made as to the direction of movement for each descriptor.

#### **Step 7: Relationship Matrix**

The relationship matrix is where the team determines the relationship between

customer needs and the company's ability to meet those needs.

#### **Step 8: Organizational Difficulty**

Rate the design attributes in terms of organizational difficulty. It is very possible that some attributes are in direct conflict.

#### **Step 9: Technical Analysis of Competitor Products**

To better understand the competition, engineering then conducts a comparison of competitor technical descriptors.

#### **Step 10: Target Values for Technical Descriptors**

At this stage in the process, the QFD team begins to establish target values for each technical descriptor.

#### **Step 11: Correlation Matrix**

This room in the matrix is where the term House of Quality comes from because it makes the matrix look like a house with a roof.

#### **Step 12: Absolute Importance**

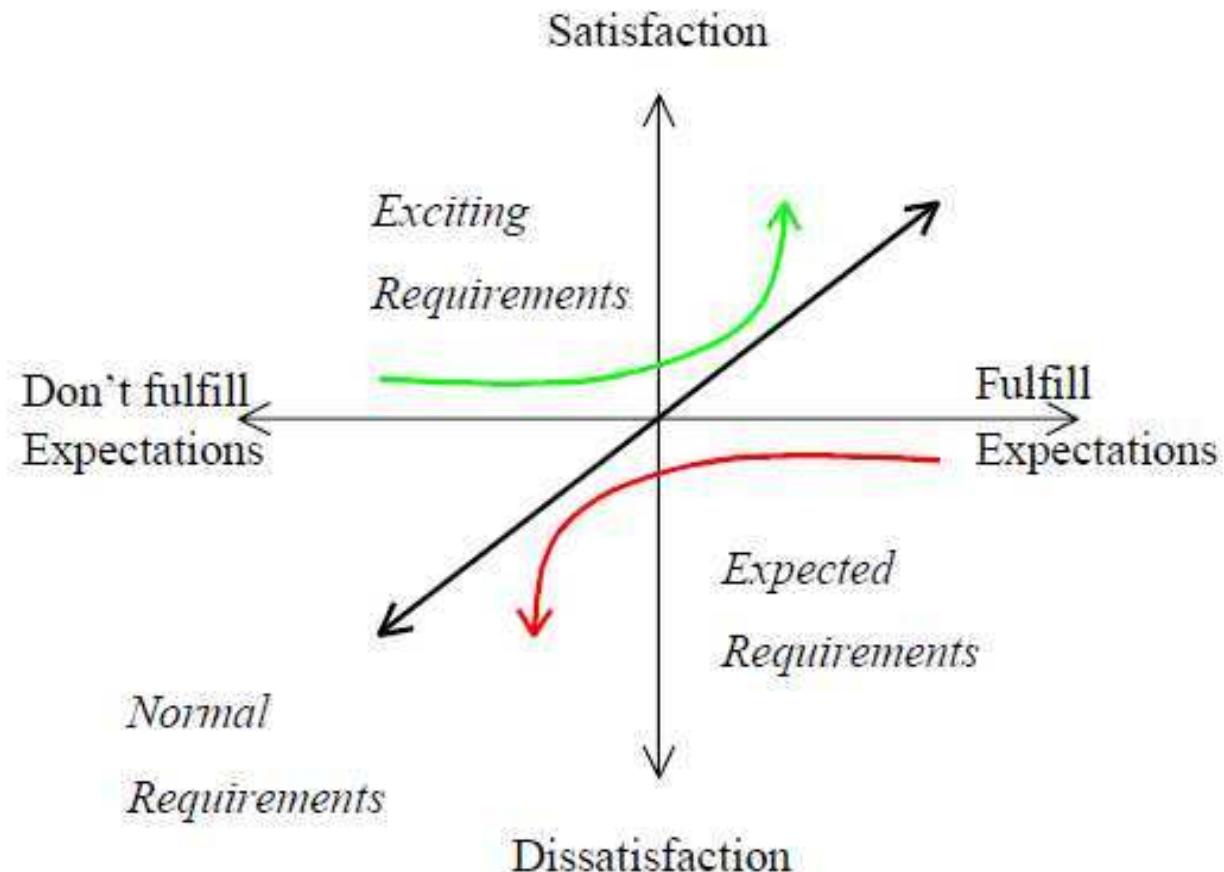
Finally, the team calculates the absolute importance for each technical descriptor

#### **QFD Deployment in Software Development**

Traditional development is incoherent. Quality Function Deployment focuses the development effort on those aspects of the design that are of greatest importance to the customer(s). Quality Function Deployment maintains this focus throughout the entire development process, from requirements to design, to coding, to documentation. Kano et. al. (as cited in Zultner [13,14] provides the Kano model that characterizes three types of requirements (exciting, normal, and expected) based on their influence on customer satisfaction (see Figure 4). Quality Function Deployment is critical because

customers cannot typically articulate all of their exciting and or expected requirements. Quality Function Deployment provides a customer centred software development approach that helps in this requirements

elicitation process. Customer requirements can be explored through specification (why customer wants it), exploration (what is required to build great software), and design (how to build great software).



**Figure 4 Customer's Satisfaction Requirement**

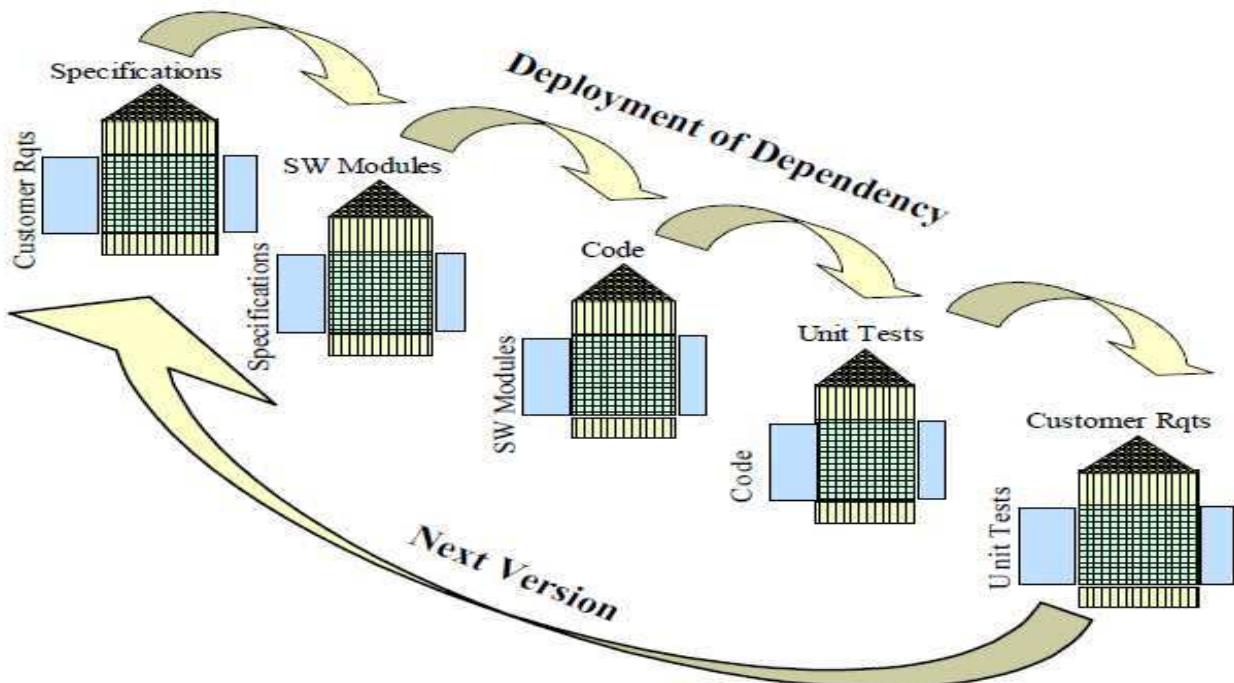
Quality Function Deployment provides a process that conveys requirements throughout a development effort's data and process models. This process includes four steps: capturing raw customer expressions; translation of those expressions into clear, concise, and concrete objective items; organization of the expressions and

objective items into a hierarchy that is meaningful to the customer; and prioritization of requirements (e.g. 1 to 5 scale, or by a more advanced method). Customer requirements can come from many sources and consist of several types (exciting, normal, and expected). Software engineers must meet these requirements to

build excellent software. Expected requirements deliver on expectations that the customer will not be disappointed. Normal requirements are the easiest customer requirements to uncover and generally have a direct relationship to customer satisfaction – giving the customer more of a “normal” requirement satisfies him more, giving him less satisfies him less. Exciting requirements are the most difficult requirements to uncover, but “wow” the customer instead of just satisfying them. Kano’s model of how these three types of requirements correspond

to customer satisfaction is shown in Figure 4.

In order to deploy the “voice of the customer” throughout the software development process it is necessary to employ a chain of matrices (see Figure 5). In this case, the analysis and design is shown as a five phased process of matrices consisting of: customer requirements/specifications, specifications/software modules, software modules/code, code/unit tests, and unit test/customer requirements matrices.



**Figure 5 Chain Matrices**

The key idea in [13,14] is that Quality Function Deployment is a development process to improve software products, process, and strategy. This is accomplished by making software development more coherent, building quality into the product, and providing rationale for development decisions. Tools are required to deal with the

complexity of developing software systems with Quality Function Deployment.

Quality Function Deployment makes software development more coherent so that the best effort of one phase of the software development process feeds the best effort of the next phase of the process, and so on. Each of these best efforts can be directly traced back to what the customer views as

the most important part of the design and forward to future components of the design. Quality Function Deployment gives the software development effort a solid foundation for embedding quality into the product. Software quality can take on many different forms (e.g. functionality, efficiency, reliability, usability, maintainability, and portability), but Pressman [9] emphasizes the following three important points about software quality:

- Software requirements are the foundation from which quality is measured. Lack of conformance to requirements is lack of quality.
- Specified standards define a set of development criteria that guide the manner in which software is engineered. If the criteria are not followed, lack of quality will almost surely result.
- A set of implicit requirements often goes unmentioned (e.g., the desire for ease of use and good maintainability). If software conforms to its explicit requirements but fails to meet implicit requirements, software quality is suspect.

Quality Function Deployment provides a methodology for handling these important points. Quality Function Deployment identifies and implements positive values of customer satisfaction (based on Kano's model). [Puett 2003] emphasizes "Traditional software engineering has generally focused on just removing the "dissatisfiers" i.e. the defects – this approach is necessary, but not sufficient!" Quality

Function Deployment is critical to software development because it provides a methodology for handling the important characteristics of software quality. Quality Function Deployment provides the mechanism for the deployment of quality throughout a software design through the use of linked houses of quality. This linkage helps

#### **4.1 The Quality Function Deployment Solution**

Quality Function Deployment provide partial solutions to the following problems:

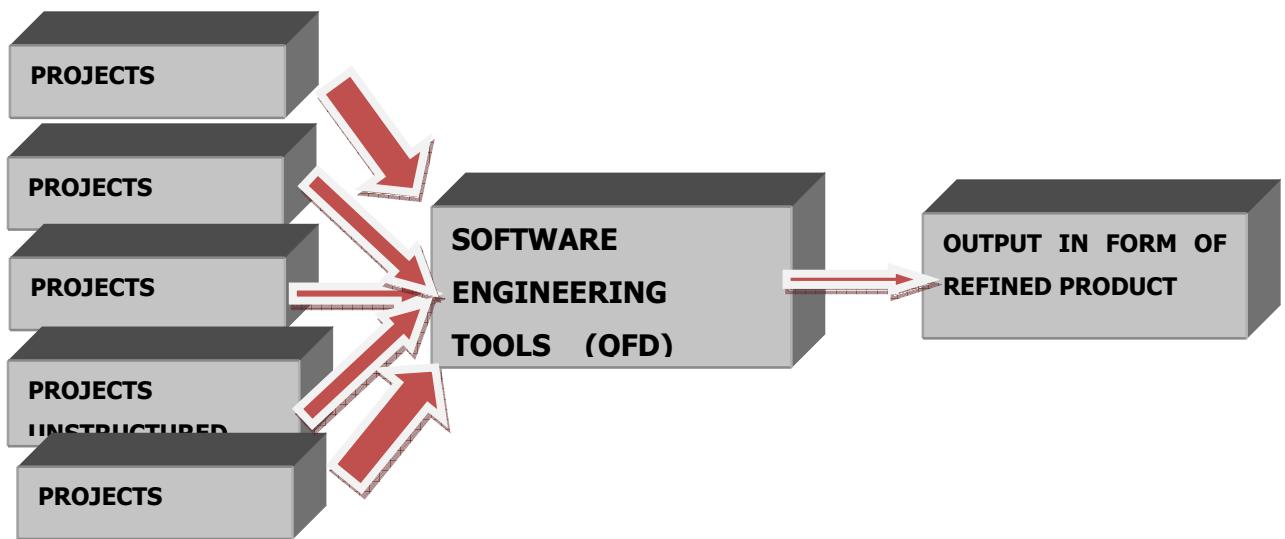
(1) ***The Software Crisis.*** This crisis is caused by the difficulty in and the failure of successfully evolving complex software systems.

(2) ***Increased Demand for Quality Software.*** Software demand is increasing at an astounding rate; industry has found it difficult to find the necessary professional talent required for meeting this software development demand.

(3) ***Inadequate Customer-Developer Communication.*** Better communication between software customers and developers is needed. There is currently inadequate communication of requirements and risk throughout the development life cycle.

(4) ***Lack of High Assurance Systems.*** Industry requires ever increasing numbers of high-assurance software systems, particularly in mission-critical activities, business financial transactions, and life-critical medical applications.

#### 4.2 A Novel Approach (Far Beyond House of Quality)



**Figure 6 New Model Design Approach**

For the current product development project, QFD supports the co-ordination of development assignments for specialized development groups. As such, QFD serves as an organizer of product innovation projects. The most valuable assets of QFD application lie in the:

- Coherence and consistency of development assignments, facilitating concurrent engineering and development:

- Concreteness of development assignments that is meaningful to each development group, because they will be stated in their own language;
- Fine-tuning of improvement efforts. The project will only claim development resources that will have a direct impact on customer satisfaction.

Furthermore, in applying QFD you could use several “houses” to include the voice of the customer into downstream development processes. Design attributes are engineering measures of product performance. For

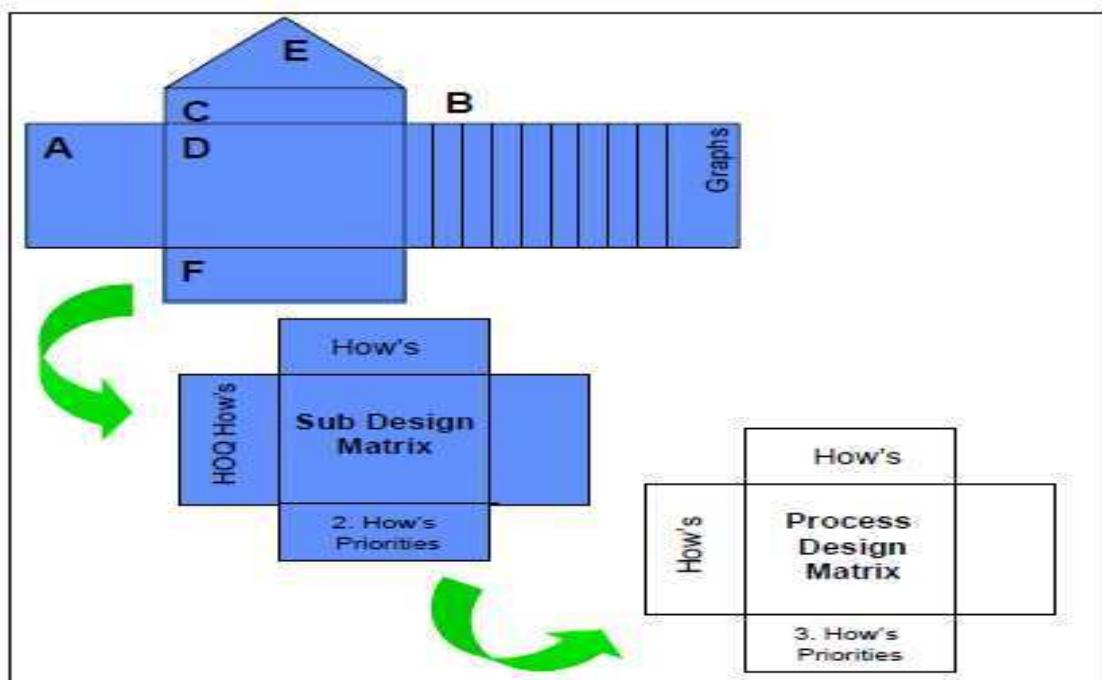
example, a computer customer might state that he (she) needs something, which makes it “easy to read what I’m working on”. One solution is to provide computer customers with monitors for viewing their work. Design attributes for the monitor might include the measured values for the illumination of alphanumeric characters, for character resolution, for legibility judged at a distance of 50 centimetres (on an optometric scale) etc.

The second house of QFD links these design attributes to the kind of action the company can take. For example, a product-development team might change the product features of the monitor. The product development team could modify the design attribute of legibility at 50 centimetres (as measured on an optometric scale) by changing the number of pixels, the size of the screen, and the intensity of the pixels or the refreshment rate. Changing or replacing monitor screen material also affects the

design attributes. A more radical step might be to eliminate the monitor altogether and provide a system which projects the work onto a wall or onto very small stereoscopic screens which the user wears as goggles.

The third house of QFD could link action to implementation decisions in areas like manufacturing process operations. For example, the third house might be used to identify the manufacturing procedures that produce the material selected for the

monitor's screen. The final house of QFD in this example links implementation (manufacturing process operations) to production planning. Finally, substantial benefits from QFD come from re-using matrices. The results of a QFD study will be very useful in the definition and development of the next generation of the product and will have a significant spin-off for related products.



**Figure 7 A New Design Matrix**

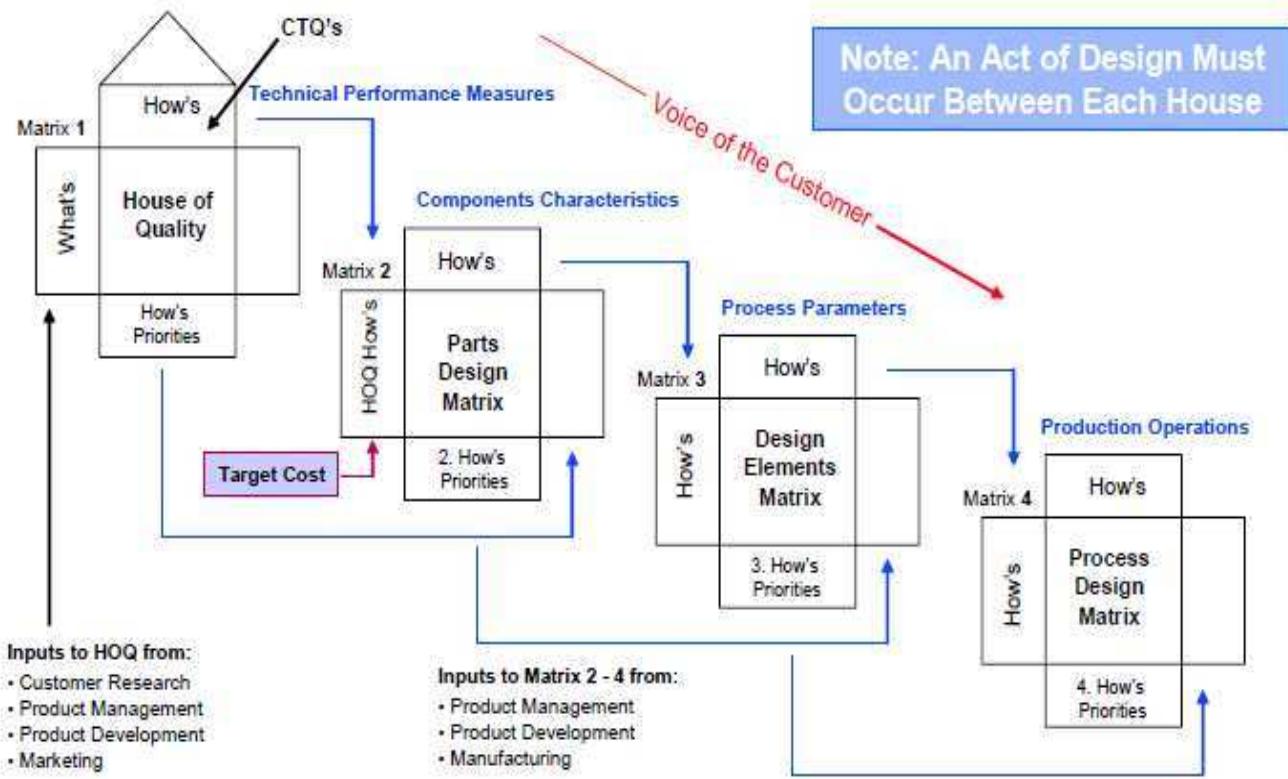


Figure 8: Novel Approach

### 5.1 Conclusion

QFD is a systematic means of ensuring that customer requirements are accurately translated into relevant technical descriptors throughout each stage of product development. Therefore, meeting or exceeding customer demands means more than just maintaining or improving product performance. It means designing and manufacturing products that delight customers and fulfill their unarticulated desires. This paper has shown when it is properly deployed in the software development industries it will yield good results.

QFD provides open, modular software architecture for future improvements. The flexibility of this tool allows software engineers to interface with existing and future software development tools and models while providing a holistic framework to view and reason about dependency information. Such capability hopes to reduce total life cycle costs, improve software product quality, and reduce evolution timelines. Companies growing into the 21st century will be enterprises that foster the needed novel innovation to create new markets.

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# E-Skill Information Acquisition Software: A Key to Poverty Alleviation Or Self Reliance

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## Abstract

*Unemployment is now eating deep into the Nigerian economy. This has greatly affected most of our youths. The Federal, State and Local Governments are making frantic effort towards solving this chronic problem but the effort is not enough. The traditional method of transferring knowledge has not helped matters. This project is about developing an e-skill transfer using software. The software developed here has simplified skill acquisition. It has also made such effort more cost effective. and less expensive for people to learn new skills such as paint production. **E-Skill Information Acquisition Software (ESA)** can enhance speedy acquisition of skills by any interested learner. This project is achieved using Showcasing approach. **Paint production** has been chosen as a case study.. The same method can be used in other following internationally accepted software engineering principles.. PHP and MYSQL were deployed as programming platform for the production of the software. The project integrates visual and audio aids for easy demonstration and comprehension. ESA is recommended to organizations such as the National Directorate of Employment (NDE) and other acquisition training centers to reduce the burden vocational skill acquisition. The output of this research provides a key to enhanced skill acquisition towards self employment and self reliance.*

**Key Words:** unemployment trauma, e-skill acquisition, NDE, self employment, self reliance

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## Introduction

The key motivation for this research is the alarming rate of youth unemployment which has led many youths into crime. With the alarming rate of graduates being turned out from diverse tertiary institutions with no place for absorption, there is increasing tension in the land, particularly insecurity leading to near anarchy [6]. The resulting social malaise includes armed robbery, car snatching, kidnapping, assassinations and suicide bombing to

mention but a few. Street roaming is also the order of the day. To worsen the situation these graduates with NCE, Diplomas, and Degrees are idle for five years or more without functional skills but with paper qualifications.

One may ask; what is the cause of this unemployment? Unemployment in this country is mainly caused by our battered economy which has seriously affected individuals. It is however structural.

Those who have acquired functional skills are busy and contribute to the national economy. The unemployment situation in Nigeria has been reinforced by total dependence on the mono-product crude oil in the economy [1]. Also the implementation of the present system of education makes it impossible to achieve a proper utilization of their natural skills and capabilities. It encouraged quest for white collar jobs of our colonial masters. To this effect, both Federal and State Governments have tried in one way or the other to reduce this unemployment by establishing skill acquisition bodies to handle such training. Such bodies include National Directorate of Employment (NDE), Basic Apprenticeship Training Center (BATC) [2]

It is true that government in the bid to reduce unemployment established some of these agencies; the impact of these programs is very minimal as they are not properly coordinated. Government spends lots of money on this venture but due to mismanagement, little or nothing has been achieved [5]

In order to make skill acquisition focal project of national importance in Nigeria, individuals, Local, State and Federal governments have to put in more effort to make our people realize the importance and the role they play in youth employment and self reliance [4]. In the light of the above, this E-Skill Acquisition Software is being developed. This project will help many of the unemployed graduates to learn skills that will help them to be self employed and be employers of labour, rather than looking or hoping to get white collar jobs. Time has come when we all must have to think and work in the direction of the popular saying of John Kennedy, *“Ask not for what your country can do for you but ask for what you can do for your country”*.

### **Problem Statement**

Unemployment has become a cankerworm in the Nigerian society. This has led to different types of crimes in the society, such as stealing, bribery, corruption, kidnapping, car snatching, suicide bombing to mention but a few. Street roaming is the order of the day. To crown it all, large turnout of graduates with NCE, Diplomas and Higher Degrees cannot even defend the bunch of credentials at hand but constitute a danger because of idleness and un-employability.

### **Objective of the study**

The objectives of this research include:

- To develop an E-Skill acquisition software for human capacity development.

In order to achieve this objective, the following procedure would be adopted:

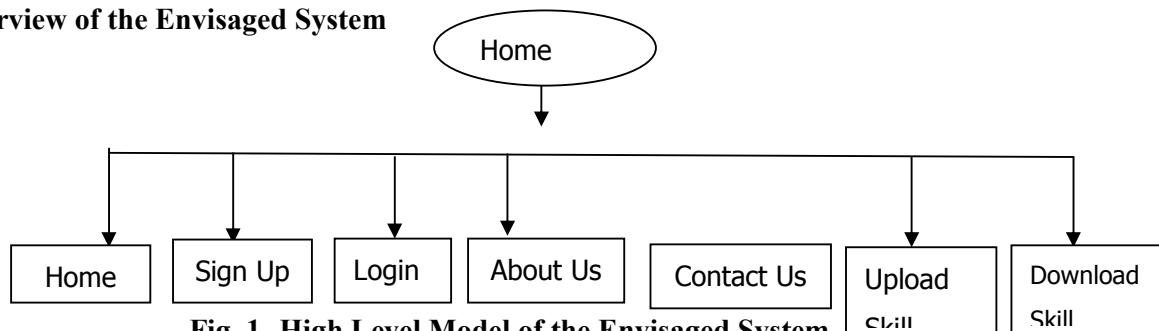
- Design a webpage or portal for skill acquisition search
- Develop links to the e-skill acquisition sites.
- Design software called computer aided teaching/learning system for acquiring different skills.
- Develop a dynamic website for people to upload and download different skills.

### **Significance of the study**

- i. To develop software for computer aided teaching on different skills so that interested learners can access them and acquire desired skill(s) of interest.
- ii. To develop a dynamic website for resource persons to upload and download their different skills learning courseware.
- iii. To reduce unemployment and help people to be self-employers of labor rather than to be job seekers.
- iv. To reduce crimes and other vices in the society.

- v. To improve the economy of the country as well as reduce migration from rural to urban cities.
- vi. To accelerate rural development as those who have acquired such skills can establish in rural communities.
- vii. To assist in reducing accommodation problems in urban cities. Therefore the benefits accruing from this project cannot be over emphasized.

### Overview of the Envisaged System



**Fig. 1 High Level Model of the Envisaged System**

### Design Approaches

The design of the project is carried out based on the following guidelines:

- Database Design and Specifications
  - User's Module
  - Admin Module
  - Input / Output Specifications
  - Input Specification and Design
  - Output Specification and Design

### System Design

#### Objective of Design

The objective of the new system is to design a platform for e-skill information acquisition software with the following modules:

- Online Materials on paint production
- Online materials on computer maintenance
- Online materials on bead making
- Online materials on soya beans processing

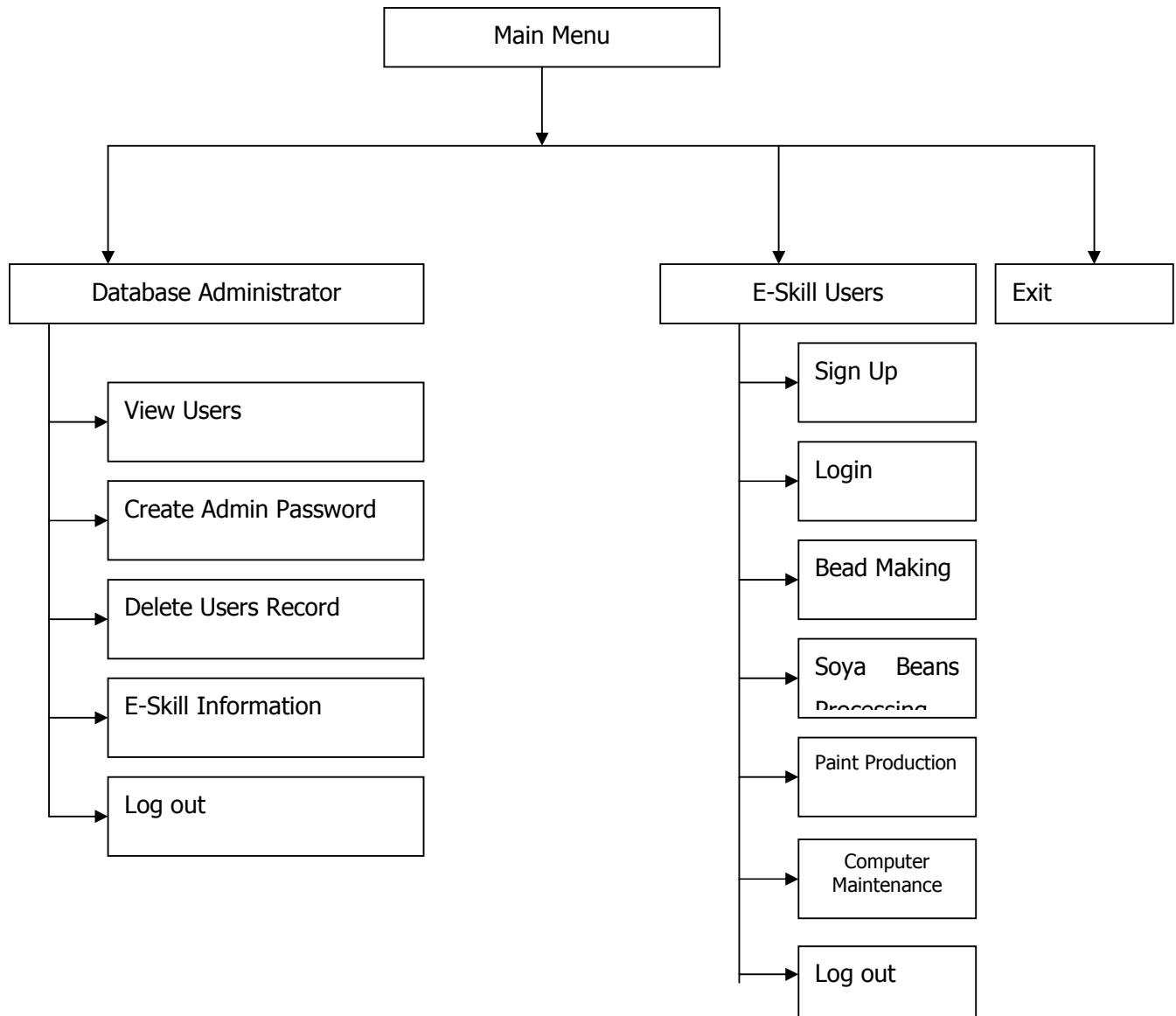
- Uploading and downloading skills
- Online users registration
- Online security checks on the database
- Restriction of unauthorized users from gaining access to restricted information.
- Maintain a database for Admin

#### The Control Centre (Main Menu)

The main menu shown in figure 1 has two main modules namely:

- The Database Administrator's Module and
- The E-Skill User's Module

The admin module is used to view both the admin and user's report of login and to create admin password. It can also be used to view e-skill information. The e-skill user's module is used to sign up as well as login to e-skill acquisition information of any interest by filling in the user registration form. This shall be implemented through the use of tree data structure and PHP/MYSQL script.



**Fig. 2: The control Centre of the E-Skill Acquisition Software**

### Program Modules Specification

The program was designed using Top – Down Approach. It makes use of the fundamental program solving techniques. The software is structured in such a way that each subsystem is selected and executed independently. The task is divided into several modules, which comes together to give the solution to the problem. The modules are as follows

### The Admin Module

The Database Administrator's module is used to create admin users id, maintain the database, and view e-skill user's information. It can also enable the administrator to view e-skill user's information.

### The E-skill User's Module

The user's module is designed to enable users sign up for the purpose of login. On registration, the user obtains user name and password. Only valid user accounts can be used by the user in login. The E-skill users can also use this module to learn how to produce paint, maintain

computer system or any other skills of interest.

### Database Design and Specifications

MySQL database was used in the design of the new system database. The structure of the data tables in the database includes: Username, password, level, full name, address, phone, Email, State and country as shown in table 4.1 below.

**Table 1:** The structure of the data tables userlogin

Field	Type	Null	Key
Username	varchar(40)	NO	PRI
Password	varchar(20)	NO	
Level	int(5)	NO	
full name	varchar(40)	YES	
Address	varchar(100)	YES	
Phone	varchar(30)	YES	
Email	varchar(30)	YES	
State	varchar(40)	YES	
Country	varchar(40)	YES	

The structure of the data tables in the database for uploading and downloading

of skills include: Name, Subject, Topic, Date, and Pic as shown in table 4.2 below

**Table 2:** The structure of the data tables

Field	Type	Null	Key
Name	varchar(100)	YES	
Subject	varchar(100)	YES	
Topic	Varchar(100)	YES	
Date	Date	YES	
Pic	varchar(200)	YES	

### Input Specification and Design

The input specification and design in the new system is structured to capture user's information as well as some administrative updates. Below is some of the input forms designed in the new system.

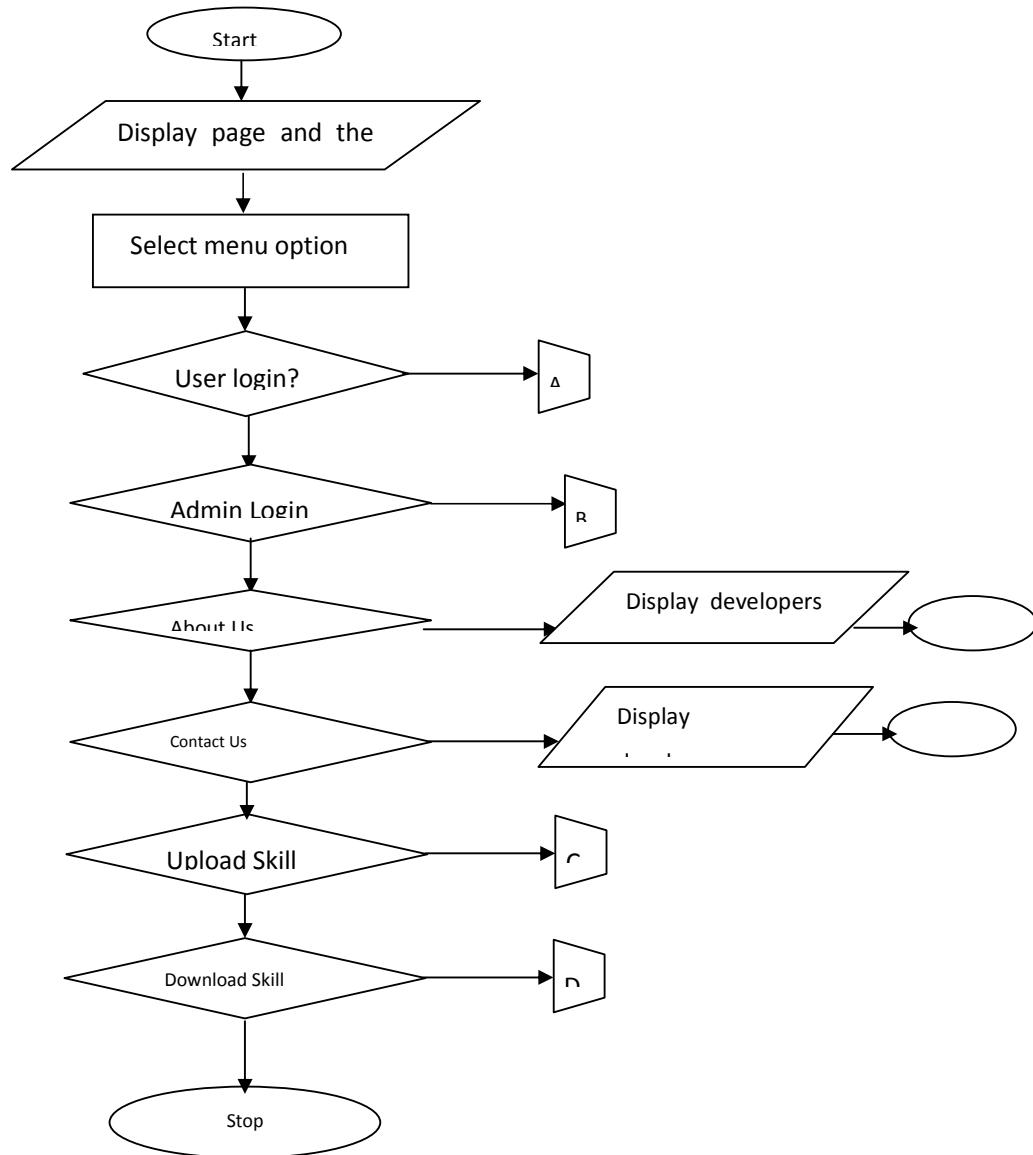
- The Home Page and Login Page
- Admin Password Creation Form
- User Registration Form
- Upload Skill User Registration Form
- Download Skill User Form

## **Output Specification and Design**

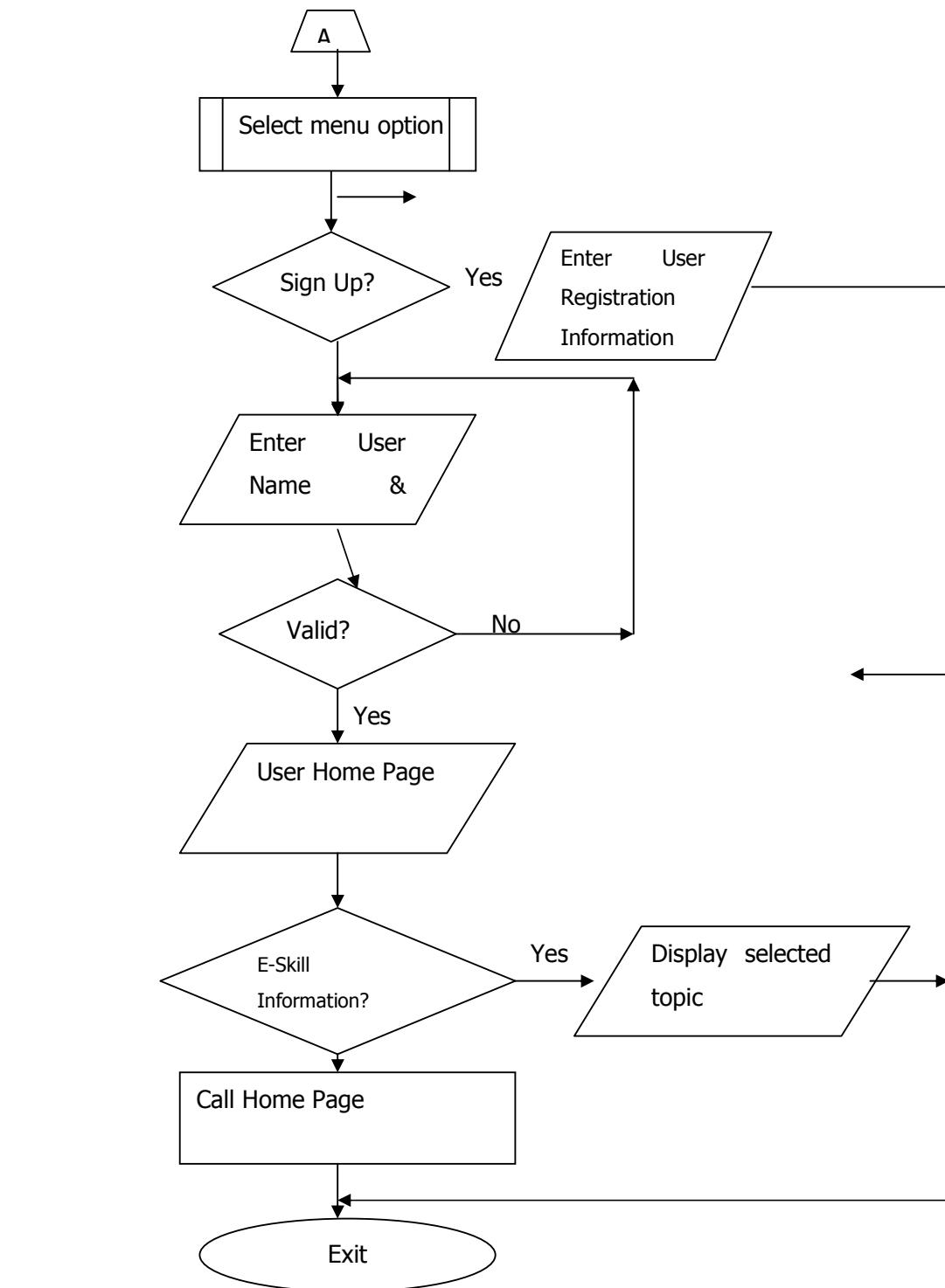
The website is created to enable admin users to view vital information from the site for management use. Reports on users file and admin user report can be generated from the system. Below is some of the report formats designed in the new system.

- E-Skill Users Report
- Admin Users Report
- E-Skill Information Home Page
- Paint Production Page
- Computer Maintenance Page

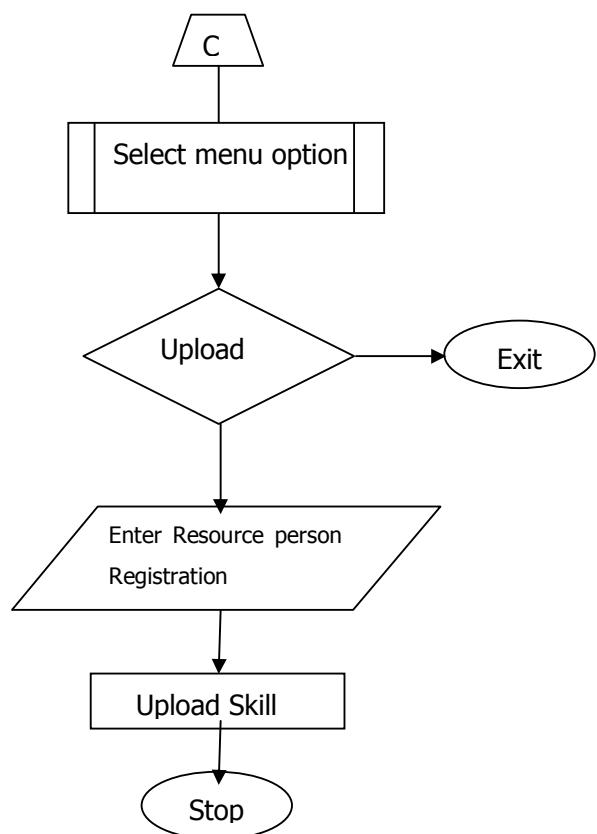
## **Logic implementation algorithms**



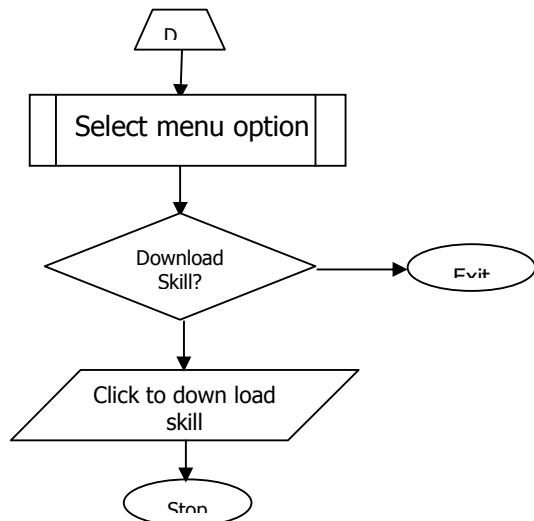
**Fig.3 Menu Logic Flow for data selection**



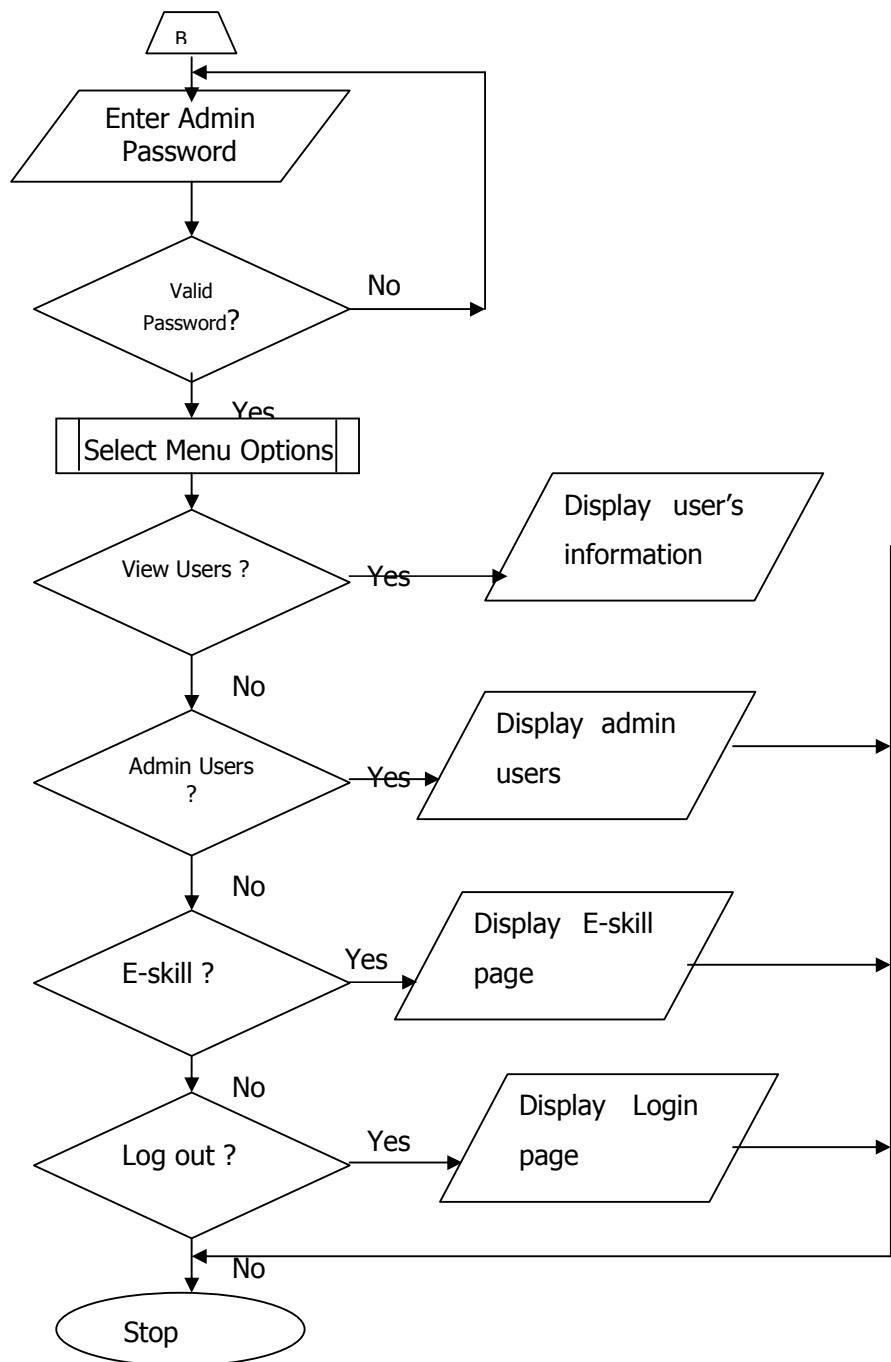
**Fig. 3b:** User login flow diagram



**Fig. 3c Admin login flow diagram**



**Fig. 3d: Uploading Skill Flow Diagram**



**Fig. 3e Download Skill Flow Diagram**

## **System Implementation**

### **System Requirement**

Computer system is made up of units that are put together to work as one in order to achieve a common goal. The requirements for the implementation of the new system are:

- The Hardware
- The Software

### **Software Requirement**

For the effective implementation of the new system, the following software has to be installed on the computer system.

- Windows Xp, Windows 2000 , Vista or window 7
  - PHP
  - Dream Weaver
  - Web Server
  - Swish Max
  - Fireworks
  - Mysql

### **Hardware Requirement**

- Pentium VI and Above
- 1GB Ram and above
- 40GB HD
- Printer
- Internet Access

### **How to Install Software**

The Software was stored in a CD. To install it on the system to run from the hard disk, follow the procedure below.

- i. Click Start Button on the desktop
- ii. Select program
- iii. Click Windows explorer
- iv. Click Drive D:
- v. Select the folder “**eskill**”
- vi. Click Edit
- vii. Click Copy
- viii. Select drive C:
- ix. Select Wamp
- x. Select www

- xi. Click paste to Copy the Folder “**eskill**” from drive D: to Drive C:
- xii. The folder contains the entire sub program that makes up the software developed.
- xiii. Open internet explorer by keying in:  
**localhost/eskill/index.php**

### **Development Tools**

The PHP and web server technology used in the development of the system is capable of interfacing with several development tools. It has interface that is compatible with virtually all Database Management System (DBMS). The database employed in this work is MySql, which is used to design back ends of the system (ie data and knowledge base). For the design of the front ends of the work, Macromedia Dreamweaver is used.

### **System Security**

Any important or valuable information system must have some kind of security. Permissions are usually given to authorized users; this can easily be noticed in client/server system where the user always has to log onto the system using an account, which comprises a username and a password. Just as it is in any other client/server system, this project is password protected. The functionality of a user is predetermined by his/her login details. Every authorized user can change his/her password at will to enhance more security. Typical examples of the login page and admin users create forms are shown in figure 4 and 5 respectively..



Fig. 4: Home page and login output form

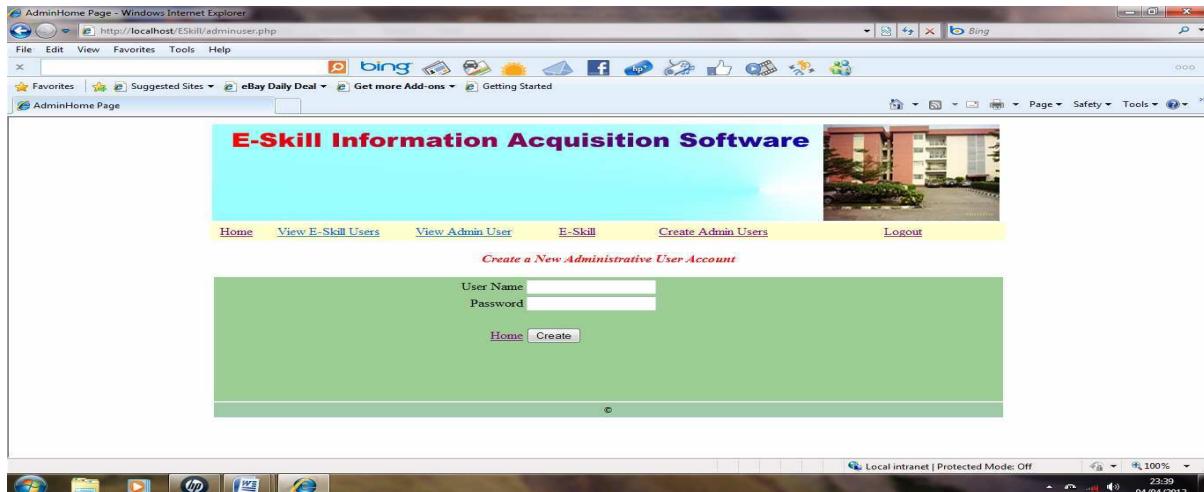
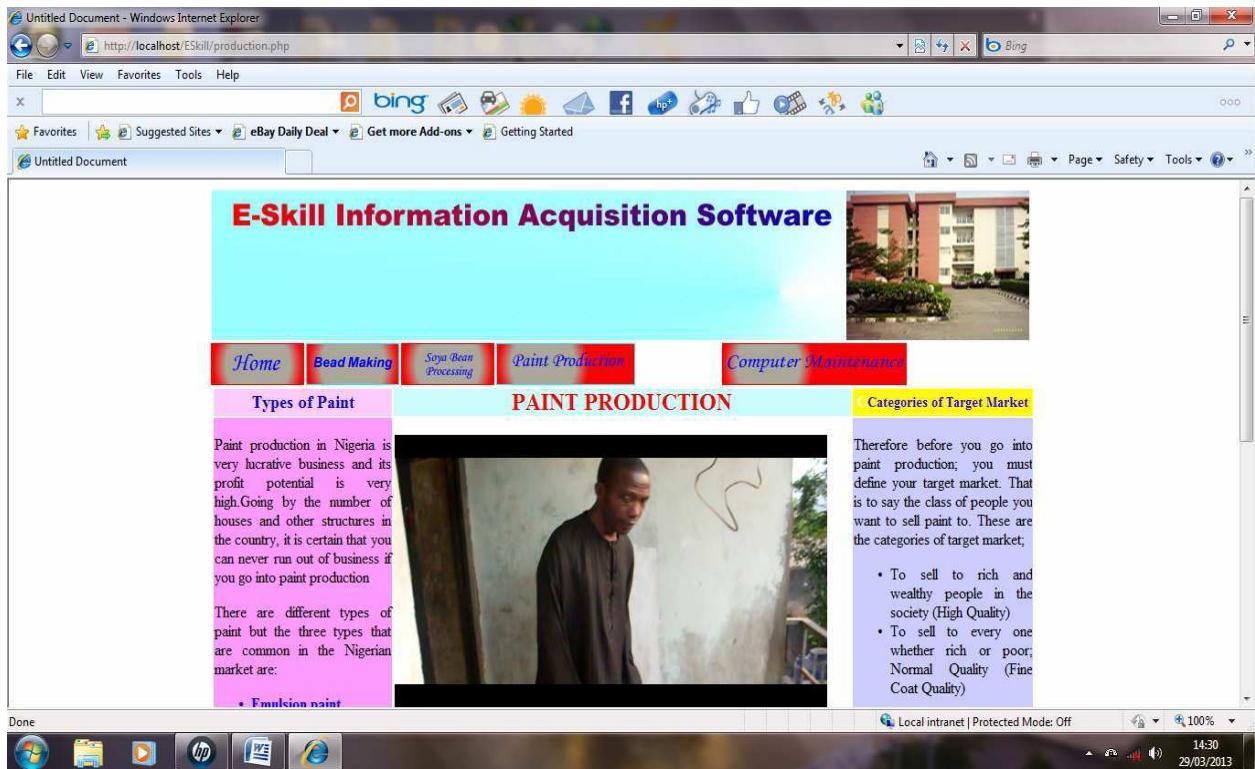


Fig 5: Admin users create password



**Fig.7: E-skill information both audio visual output report**

The E-skill information output report shows the materials, equipment and procedures of how to learn a particular skill in a virtual and audio

form as shown in figures 7 and 8 as for paint production



**Fig. 8: E-skill information output both audio and visual.**

## Conclusion

The project has succeeded in developing an e-learning tool for skill acquisition. The database in the e-skill information acquisition software has been carefully stored in the computer in such away anyone can login upon

given access to learn any skill of interest. The project is also made dynamic so that interested resource persons can upload their skills for people to download. It is an open source platform. It is recommended for deployment by all Skill Acquisition training centres in Nigeria

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# **Building Trust and Confidentiality in Cloud computing Distributed Data Storage**

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## **Abstract**

*Cloud computing delivers massively scalable computing resources as a service with internet technologies. Resources are shared among a vast number of consumers allowing for a lower cost of IT ownership. Enterprises can store or rent data storage as a service in a “pay-per-use” manner. As with new technology, this new way of doing business brings with it new challenges, especially when considering the security and privacy of the information stored and processed within the cloud. In this paper, we looked at data security, described the current state of data security in the cloud and the possible threats obtainable in cloud computing. We described how the combination of existing research thrusts has the potential to solve many threats concerning confidentiality and adoption of cloud. We proposed that with continued research and adoption of trusted computing and computation-supporting encryption, maintaining integrity of data in the cloud will be a success.*

**Keyword:** Cloud computing, Security, privacy, internet services, virtual machines.

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## **1.0 Introduction**

Information technology has become pervasive in organizations and an inevitable key success factor in business. Organizations can create, communicate and collaborate faster, more efficiently and reliably than ever before. In the late 1960's, the computer scientist John McCarthy once brought the concept of utility computing in which he postulated that life cycle of technology will not only stick as tangible products, but will indeed become products. As a matter of fact, he took the conceptual leap to predict that computer resources will be provided like nowadays water

and electricity as a utility,i.e. as a service [2]. However in the last couple of years internet services offered online took on an even new dimension. Software is now capable of being offered online including big fast machines in someone else's data centre running an application that is accessed using a familiar web browser, although someone else owns the application. Cloud computing delivers massively scalable computing resources as a service with Internet technologies, resources are shared among a vast number of consumers allowing for a lower cost of IT ownership [7]. Cloud computing provides on-demand

computing resources dynamically, which allows companies to fundamentally change their information technology strategy.

As with any new technology, this new way of doing business brings with it new challenges, especially when considering the security and privacy of the information stored and processed within the cloud. This article examines these challenges and proposes unique solutions in building trust in a distributed Data storage to solve the core security problems of cloud computing.

Utility cloud computing allows users to rent *Virtual Machine (VMs)* from a service provider, placing an organization's sensitive data in the control of a third party [5][10]. We propose a management and security approach for utility cloud computing called the *Private Virtual Infrastructure (PVI)* that shares the responsibility of security of data in cloud between the service provider and client, decreasing the risk exposure to both. To address the core security challenge of distributed data in cloud computing where an information owner creates and runs a virtual environment on a platform owned by a separate service provider from the inside, we introduce a new approach for rooting trust in a cloud computing environment called the *information centric approach*.

## 2.0 Data Security.

Security has been a major problem in the real world, not only in the IT world. So taking information and making it secure, so that only yourself or a select few can see it, is obviously not a new concept. However, it is one that we have struggled with in both the real world and the digital world. In the real world, even information under lock and key, is subject to theft and is certainly open to accidental or malicious misuse. In the digital world, this analogy of lock-and-key protection of

information has persisted, most often in the form of container-based encryption. But even our digital attempt at protecting information has proved less than robust, because of the limitations inherent in protecting a container rather than in the content of that container [6][9]. This limitation has become more evident as we move into the era of cloud computing: Information in a cloud environment has much more dynamism and fluidity than information that is static on a desktop or in a network folder, so we now need to start to think of a new way to protect information.

Before we embark on how to move our data protection methodologies into the era of the cloud, perhaps we should stop, think, and consider the true applicability of information security and its value and scope. Perhaps we should be viewing the application of data security as less of a walled and impassable fortress and more of a sliding series of options that are more appropriately termed "risk mitigation" [9]. Susan Morrow in an article on "data security in the cloud" said that she wants people to start to view data security as a lexicon of choices, as opposed to an on and off technology. In a typical organization, the need for data security has a very wide scope, varying from information that is set as public domain, through to information that needs some protection (perhaps access control), through to data that are highly sensitive, which, if leaked, could cause catastrophic damage which nevertheless need to be accessed and used by selected users. Computer technology is a form of the toolkit that we have developed since human prehistory to help us improve our lifestyle. If we can view data security as more of a risk mitigation exercise and build systems that will work with humans (i.e., human-centric) [6], then perhaps the approach we proffer for securing data in the cloud will be successful.

## **2.1 The current state of data security in the cloud.**

At the time of writing this article, data storage in cloud computing is at a tipping point: It has many arguing for its use because of the improved interoperability and cost savings it offers. On the other side of the argument are those who are saying that data storage in the cloud cannot be used in any type of pervasive manner until we resolve the security issues inherent when we allow a third party to control our information. These security issues began by focusing on the securing of access to the datacentre's that cloud-based information resides in. However, it is quickly becoming apparent in the industry that this does not cover the vast majority of instances of data that are outside of the confines of the data centre, bringing us full circle to the problems of having a container-based view of securing data [9]. But we are not in any way inferring that data-centre security is not used or has been replaced.

Going back to our previous statement that security is better described as “risk mitigation,” we can then begin to look at securing data as a continuum of choice in terms of levels of accessibility and content restrictions: This continuum allows us to choose to apply the right level of protection, ensuring that the flexibility bestowed by cloud computing onto the whole area of data communication is retained.

Susan Morrow, in one of her articles said that IT industry is beginning to wake up to the idea of content-centric or information-centric protection, being an inherent part of a data object. This new view of data security has not developed out of cloud computing, but instead is a development out of the idea of the “*de-perimerization*” of the enterprise [6]. She further stated that this idea was put forward by

a group of Chief Information Officers (CIOs) who formed an organization called the **Jericho Forum**. The Jericho Forum was founded in 2004 because of the increasing need for data exchange between companies and external parties—for example: employees using remote computers; partner companies; customers; and so on. The old way of securing information behind an organization’s perimeter wall prevented this type of data exchange in a secure manner. However, the ideas forwarded by Morrow about the Jericho Forum are also applicable to cloud computing. The idea of creating protection within the data object itself, allows the security to move with the data, as opposed to retaining the data within a secured and static wall (firewall). This simple but revolutionary change in mind-set of how to secure data is the ground stone of securing information within a cloud and will be the basis of this discussion on building trust in a distribute data storage in the cloud.

### **2.1.2 Identified Treats in Cloud Data centre. Hypervisor and Rootkit Malware**

A new class of attacks has evolved around building malicious hypervisors and operating system rootkits that subvert the built in security measures of many operating systems. These malwares utilize a hypervisor or rootkit that allows them operate at a privilege level above that of the guest operating system (OS) or maintain root access to the system. The malware at the higher privilege level can then intercept system calls from a victim OS and modify the calls in a manner that thwarts the security mechanisms of the victim VM [4].

The malware can gain access to protected memory, intercept passwords or cryptographic keys, and perform a multitude of other malicious acts that the guest OS has no chance of defending against as it would be able to do on a physical machine. An example of this type

of attack is SubVirt created by a University of Michigan research team, which is essentially a *Virtual-Machine Based Rootkit (VMBR)*. SubVirt has been used to implement a phishing web server, a keystroke logger, a service that scans the target file systems system looking for sensitive files, and a defensive countermeasure that defeats a virtual-machine detector [10][4]. The Blue Pill attack is another example of this type of attack. The Blue Pill is an attack to virtualize a Windows operating system by installing a malicious hypervisor underneath the kernel that is theoretically undetectable even though the algorithm and code are publicly available. It avoids detection by trapping all attempts by the victim OS to determine it is in a virtualized environment and reporting fake information back to OS to make it believe it is operating normally [4]. The Blue Pill attack can be performed on already virtualized machine, thus nesting itself between the real hypervisor and the victim machine. By verifying the validity of the hypervisor and host OS, we can determine if any malware was present in hypervisor and OS at boot time; however, an infection after boot time may not be detected. For this reason, we use encryption of data to reduce the risk of data exposure.

### Data Loss and Leakage

Enterprises are lot more concerned about data loss and leakage. The threat of data compromise is much greater in the cloud. There are many ways data may be compromised in the cloud including deletion or alteration of records without a backup, loss of or changing an encryption key that results in the effective destruction of any data stored with the key, and unauthorized access by insiders or other cloud users. Again, encryption of sensitive data reduces the exposure of data loss and leakage.

Another area of vulnerability of the VM is while the VM is at rest (*i.e.* inactive) [4]. A VM that uses a virtual file system – as opposed to a physical one – is susceptible to data modification while the system is at rest. It is possible for an attacker to modify the configuration of the VM by manipulating the virtual file system and alter the behaviour, properties, and data stored on the VM. If an attacker gains access to a virtual file system, the data are vulnerable to theft as the attacker has full access to all data contained in the file system. Additionally, encryption of data in the VM image with keys locked to specific platforms reduces the exposure of *data at rest attacks* and data loss.

### Malicious Insiders

A malicious insider is anyone in the service provider's organization that possess authorized access or privilege to the cloud information systems that is moved to compromise information confidentiality, integrity, and availability [4][3][5]. The insider threat is compounded when combined with lack of transparency into service provider processes and procedures. There is often little or no visibility into the hiring practices for cloud provider employees. For example, a provider may not reveal how it monitors employees or grants access to physical and virtual assets. Depending on the access granted, an insider could collect confidential data or even gain control of the cloud services with little or no risk of detection.

There are several attacks against the VMs that can be performed by malicious actors inside the *Cloud Virtual Fabric (CVF)*. A malicious administrator can secretly attack a VM in the cloud in a way that no one can notice using her higher privileged access to inspect memory, monitor VM communications, and perform suspend and reboot attacks [4].

This attack is very difficult to defend against as the insider needs to have these privileges to administer and maintain the host systems and it is difficult to determine legitimate access versus malicious access. Therefore, the confidentiality and the integrity of the data would be violated when an adversary controls a node or the node administrator becomes malicious. Encryption of sensitive data reduces the exposure.

### Network-Based Attacks

Virtual machines are vulnerable to network-based attacks, especially during attestation and live migration. These network attacks that can be performed include eavesdropping, man-in-the-middle, data modification, spoofing, etc. [4]. It is imperative that the network communication be thoroughly understood and examined to understand all the possible attacks against it. Most approach does not provide any direct protection from network attack; but encryption protocols do use cryptographic protocols which limit the exposure to network attacks.

### 3.0 Our Approach to building Trust and Confidentiality

There are at least two concerns when using the cloud; one concern is that

1. Users do not want to reveal their data to the cloud service provider. For example the data could be sensitive information like medical records. Another concern is

2. Users are unsure about the integrity of the data they receive from the cloud, therefore within the cloud more than conventional security mechanisms will be required for data security.

Yu Chen et al in his article *secure distributed data storage in the cloud* presented technologies for data security in the cloud computing from four different perspectives; [6]

- i) Database outsourcing and query integrity assurance
- ii) Data integrity in untrustworthy storage
- iii) Web- application based security
- iv) Multimedia data security storage.

All the technologies mentioned by Yu Chen are all effective, but will be more effective when being viewed from an information-centric security approach. Let us quickly look at what information centric security means.

### Information-Centric Security

For us to maintain trust and confidentiality and extend control of data in the cloud, we propose *shifting from protecting data from the outside to protecting data within*. This is referred to as **information-centric**. This implies protecting the data content itself. Data needs to be encrypted and packaged with usage policy [10][1]. Information centric security is a natural extension of the trend towards finer, stronger and more usable data protection [3].

In our vision, we propose the use of trusted computing which ensures integrity of cloud infrastructure and in addition to the use of cryptographic protocols supporting computation on cipher text. Specifically, dual encryption approach is recommended for data object to a distributed data in the cloud [1][10]. This will enable cross examination of the outsourced data, which consists of  
(a) the original data stored under a certain encryption scheme and  
(b) another small percentage of the original data stored under a different encryption scheme.

Users will then generate queries against the additional piece of data and analyze their results to obtain integrity assurance. Cloud computing, more than any other form of digital communication technology, has created a need to ensure that protection is applied at the inception of the information, in a content

centric manner, ensuring that a security policy becomes an integral part of that data throughout its life cycle.

### **Summary and Conclusion**

Cloud computing has acquired considerable attention from both industry and academia in recent years. Among all the major building blocks of cloud computing, data storage plays a very important role. As mentioned earlier that the most security issues that arise for enterprise through the use of cloud computing is due to the fact of lack of control on the physical infrastructure [6][7]. Enterprises do not know where their data is resided and which security mechanism is applied to protect it. Users require security and privacy to access their

personal data objects. Users require secure access to the data for discovery, browsing and computing. In our vision, we propose the use of trusted computing and use of cryptographic computation protocols which supports a dual encryption approach to sensitive data prior to being uploaded to the data cloud storage. To avoid unauthorized access to the sensitive data, any application running in the cloud should not be allowed to directly decrypt the data.

Consequently we surveyed a lot of threats that is associated with cloud data centres. It is anticipated that the approach suggested in this article will contribute to paving the way for securing and building confidentiality in distributed data storage environment within cloud computing platform.

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# **Optimization of costs of Port Operations in Nigeria: A Scenario For Emerging River Ports**

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## **Abstract**

*This study attempts to optimize the cost of port operations in Nigeria. The quantitative estimates are concerned with the activities associated with the operations of Nigerian ports, the costs and the benefits derived by users of these ports. A Linear Programming Model was formulated from the cost components associated with the vessel-port relationships. With the aid of QM for Windows Software, an optimal solution was derived. The result shows the minimum cost of port operations as well as determining the optimal time frames for the decision variables of port operations. This provides a basis for future projection to determine the range of values of the constraints and decision variables for which the solutions will continue to be optimal.*

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## **1.0 Introduction**

In many markets, firms compete over time by expending resources with the purpose of reducing their costs. Sometimes, the cost reducing investments operate directly on costs. In many instances, they take the form of developing new products that deliver what customers need more cheaply. Therefore, product development can have the same ultimate effect as direct cost reduction. In fact if one thinks of the product as the services rendered to customers, then product development often is just cost reduction.

The globalization of trade and subsequent breakdown in trade barriers has generated tremendous growth in maritime transportation. Thus the stiff competitions among port operators have increased the

desire to attract port uses. Therefore, port operators will have to optimize the cost of their operations if they must benchmark good productivity and performance for their terminals. There is no doubt that the maritime sector especially the port system is vital and instrumental to the national economic survival of the country. Nigeria is a popular nation, renowned for her international nature of business. Quality customer service is the benchmark principle for the maritime professional and customer care techniques. Therefore, the economic justification of a port is its ability to satisfy its customers at a lower price and also be able to make profits.

With regards to costs emanating from the vessel, it can be affirmed that port costs, above all are the most significant, since they

depend on the gross tonnage of the vessel and the time it spends in the port. Bulk carriers are those which tend to spend most time in port as well as being the greatest in size. The costs of towing, which depend on the circumstances of the movement, tend to represent approximately 10% to 15% of the cost scale of the vessel [5]. More so, other costs due to the vessels stay at port, including agency fees average approximately 5 or 10% of the total. The port tariffs on the merchandise are situated at less than 50% of the total. Where all costs of unloading are considered in relation to port costs, the former are situated at about 70% of the total where all costs are also included storage, weighing etc. With a clear tendency to drop when using cranes of greater efficiency and capacity, about 30% would correspond to port costs.

It is evident that Nigerian ports operate at very low optimal capacity, in spite of the expected large volume of cargo traffic that passes through it. It is very pertinent to note that vessel delay period is a very serious problem that contributes to over 60% of our ports low productivity problem in recent times. Ndikom [3], further confirms that regrettably, at Lome port, dock workers load 700mts per day as against less than 250mt per day at Nigerian ports. The five days difference in loading arrangements between Nigerian ports and other ports in terms of ship delay rate billings of US\$4,000 is rather too staggering and unfortunate. In clear terms, this is enough to deny Nigerian ports cargo and revenue that would ordinarily have come our way.

Kaspi, et al, [2], looked at the minimization of cost and optimum port performance as anchored on reducing port turnaround time. They developed a regression model to relate turnaround time

and port cost which was highly related with allocation of port facilities. Beatriz et al [1], argues that the optimal organization of the industry can be studied by means of cost and production functions. They reviewed the literature on econometric ports' structure and propose that the calculation of key cost indicators (economics of scale, scope and so forth) is best in determining optimal port structure in order to minimize the cost of port operations.

In the light of the above, this study attempted bridging the gap by offering an optimal cost to port operations in Nigeria. In relation to this problem, the broad objective of the study is the analysis of optimum cost of port operations. The specific objectives include:

- Determination of the minimum cost of port operations.
- Determination of the optimal time frames for the decision variables of port operations.
- Determination of the optimality range of cost variability.
- Determination of the optimality range of resource variability.
- Determination of the amount to be paid in hiring a unit of the resources for the objective function to be optimal.

## 2.0 Research Methodology

### 2.1 Sources of Data

Data required for this study were collected from primary and secondary sources. The primary source of data was through oral interviews administered to some Nigerian Ports Authority (NPA) as well as some employees of renowned shipping lines. Secondary source of data was a survey of existing documents and published materials such as the NPA

Simplified Tariff, NPA Handbook, NPA Annual Reports, Current Publication, Journals and from the internet.

## 2.2 Method of Data Analysis

In order to provide empirical answers to the research questions; Linear programming technique is applied by the use of QM for windows software for the analysis.

### 2.2.1 The Linear Programming Model

Linear Programming deals with the optimization of a function of variables known as objective functions, subject to a set of linear equalities or inequalities known as ‘constraints’. The objective function in this study is cost which is to be obtained in the best possible or optimal manner. The constraints in this study are imposed by Gang time, ship turnaround time and warehouse time.

Linear programming is a mathematical modeling technique designed to optimize the usage of limited resources.

### 2.2.2 Definition of The Variables For Objective Function

The variables for the objective function with respect to this study are:

**Service Cost** include all the cost associated with providing Tugs, Pilots, Anchorage, Launch, Radio/Radar, Services, Surveyors, Dockage .

**Burnkers Cost** includes the cost of oil, water and other liquid fuel.

**Loading and Discharge Cost** Comprises the cost associated with Stevedoring, Clerking and checking, Watching, Clearing and fitting, Equipment rental, Agency fee and other related costs.

**Supplies Cost** includes the cost of Chandler and provisions laundry, medical, waste disposal, security and other related cost.

**Inland Movement Cost** include the cost of using Long Distance Truck, Short Distance Truck, Barge, Air transport, Rail transport, Pipeline transport and other modes.

**Government Requirement Cost** includes cost paid to customs, Entrance/clearance, Quarantine, Fumigation and other associated cost.

**In-transit Storage Cost** includes cost paid for Wharfage, Yard Handling, Demurrage, Warehousing, Auto and truck storage, Grain storage, Refrigerated storage and other related costs.

**Cargo Packing Cost** includes the cost of export packing, container packing, stuffing/stripping, cargo manipulation and other related cost.

With respect to this study, the above mentioned variables are symbolized for the sake of developing the LP model as follows:

Service:  $X_1$ ; Bunkers:  $X_2$ ; Loading/Discharge:  $X_3$ ; Supplies:  $X_4$ ; Inland Movement:  $X_5$ ; Government Requirement:  $X_6$ ; Intransit Storage:  $X_7$ ; Cargo Packing:  $X_8$

## 3.0 Results and Discussion

### 3.1 Data Presentation and Description

This study identified the major cost variables in port operations and the constraints militating against them hence developed a linear programming model which was used to provide minimum cost of port operations in Nigeria. Data in Table3.1 are ship and port activities and expenses

generated which were used in model formulation.

These activities are influenced by the following constraints:

- Gang time (including idle time)
- Ship turnaround time
- Warehouse time

On an average, gang time is estimated as 28 days per month multiplied by 24hours in a day = 672 hours. Average ship turnaround time in a Nigerian port is 12days in a month multiplied by 24hours = 288hours. Warehouse time is the average time a cargo can stay in storage without accumulating excess demurrage given as 6 days multiplied by 24 hours = 144 hours. Time allocated for

the various port activities are obtained by multiplying the fraction of the cost of the port activity relating to the constraint by the available time for each constraint.

It is observed that the various constraints are affected by a combination of variables. Gang time is related with service, loading and discharge, inland movement, in-transit storage and cargo packing. Ship turnaround time is related with service and bunkers while warehouse time is related with government requirement and in-transit storage. The constraints and the decision variables form the linear programming model as illustrated in Table 3.2.

**Table 3.1 Ship/Port Activities And Expenses Generated Based On Averages Of Different Kinds Of Cargo**

SHIP/PORT ACTIVITY	AVERAGE EXPENSES PER TONNE
Services	12.23
Bunkers	5.46
Load/Discharge	31.19
Supplies	0.55
Inland movement	46.95
Government requirement	3.37
In - transit storage	4.28
Cargo packing	10.62
Total	114.65

**Source:** Computed from NPA Handbook, NPA simplified Tariff and Abstract of Transport Statistics as compiled by Nze, (2008).

Subject to Table 3.2, linear programming model obtained is as follows:

$$\begin{aligned} \text{Min } Z &= 12.23x_1 + 5.46x_2 + 31.0x_3 + 0.55x_4 \\ &+ 46.95x_5 + \\ &3.37x_6 + 4.28x_7 + 10.62x_8 \end{aligned}$$

Subject to;

$$\begin{aligned} 71.52x_1 + 182.88x_2 + 275.28x_5 + 25.20x_7 + \\ 62.16x_8 &\geq 672 \\ 30.72x_1 + 13.68x_2 + 1.44x_4 &\geq 288 \\ 4.08x_7 + 5.28x_8 &\geq 144 \\ x_1, x_2, x_3, x_4, x_5, x_6, x_7, x_8 &\geq 0 \end{aligned}$$

Solution:

The optimum solution (using QM for windows software) is

$$\begin{aligned} Z &= \text{Minimum cost of port operations} = 231.38 \text{ dollars.} \\ x_1 &= \text{Service cost} = 9.375 \text{ dollars} \\ x_2 &= \text{Bunkers cost} = 0 \text{ dollars} \\ x_3 &= \text{Loading/discharge} \end{aligned}$$

$x_4$	=	cost = 0 dollars Supplies cost = 0 dollars	$x_8$	=	Cargo packing cost = 0 dollars
$x_5$	=	Inland movement cost = 0 dollars	The activities having zero as their time frames do not mean that no time should be allocated to them. Rather, the solution provides a range of values for which time can be allocated. The ranging table and solution list are shown in Tables 3.3 and 3.4.		
$x_6$	=	Government requirement cost = 0 dollars			
$x_7$	=	Intransit storage cost = 27.273 dollars			

**Table 3.2 Linear Programming Model for Nigerian Ports**

Time	Gang Time	Ship Turnaround Time	Warehouse Time
Available time per month in hours	672	288	144
Port Activity			
Service ( $X_1$ )	71.52	30.72	
Bunkers ( $X_2$ )		13.68	
Loading/discharge ( $X_3$ )	182.88		
Supplies ( $X_4$ )			
Inland movement ( $X_5$ )	275.28		
Government requirement ( $X_6$ )			4.08
Intransit storage ( $X_7$ )	25.20		5.28
Cargo packing ( $X_8$ )	62.16		

**Source:** Computations using obtained data

**Table 3.3 RANGING Table**

Variable	Value	Reduced	Original Value	Lower Bound	Upper Bound
$X_1$	9.375	0	12.23	0	12.2611
$X_2$	0	0.0138	5.46	5.4462	Infinity
$X_3$	0	31.19	31.19	0	Infinity
$X_4$	0	0.55	0.55	0	Infinity
$X_5$	0	46.95	46.95	0	Infinity
$X_6$	0	0.0627	3.37	3.3073	Infinity
$X_7$	27.273	0	4.28	4.28	4.28
$X_8$	0	10.62	10.62	0	Infinity
Constraint	Dual Value	Slack	Original Value	Lower Bound	Upper Bound
Const. 1	0	685.7727	672	-Infinity	1,357.773
Const. 2	-0.3981	0	288	0.0001	Infinity
Const. 3	-0.8106	0	144	0.3143	Infinity

**Source:** Model run from Software

**Variable definition Table - Table 3.4: Solution List**

VARIABLE	STATUS	VALUE
X <sub>1</sub>	Basic	9.375
X <sub>2</sub>	Non Basic	0
X <sub>3</sub>	Non Basic	0
X <sub>4</sub>	Non Basic	0
X <sub>5</sub>	Non Basic	0
X <sub>6</sub>	Non Basic	0
X <sub>7</sub>	Basic	27.2727
X <sub>8</sub>	Non Basic	
Surplus 1	Basic	685.7727
Surplus 2	Non Basic	0
Surplus 3	Non Basic	0
Optimal value (Z)		231.3835

**Source:** Model run from Software

### 3.2 Result Discussion

Results are discussed here based on research questions.

#### Question 1

What are the optimal costs of port operation?

From the solution offered by the software used (QM for windows) shown in table 4.3, the optimal cost is given as 231.3835 US dollars per ton handled in a Nigerian port. This means that for optimal cost of operations in Nigerian ports, the cost should be kept at \$231.3835 as charge for handling a ton of cargo.

#### Question 2

What are the optimal time frames of the decision variables for port operation?

The optimal time frames computed using the model developed is given as:

$$\begin{aligned} X_1 &= \text{Service} = 9.375 \text{ hours} \\ X_2 &= \text{Bunkers} = 0 \text{ hours} \\ X_3 &= \text{Loading/discharge} = \end{aligned}$$

$$\begin{aligned} &0 \text{ hours} \\ X_4 &= \text{Supplies} = 0 \text{ hours} \\ X_5 &= \text{Inland movement} = 0 \text{ hours} \\ X_6 &= \text{Government requirement} = 0 \text{ hours} \\ X_7 &= \text{In-transit storage} = 27.2727 \text{ hours and} \\ X_8 &= \text{Cargo packing} = 0 \text{ hours} \end{aligned}$$

#### Question 3

To what extent will cost (i.e. coefficient of the objective function) vary for the solution to remain optimal?

For the solution to continue to remain optimal, the coefficient of the objective function can vary as follows;

$$\begin{aligned} \text{For } X_1 &= \text{Service, the cost can vary from 0 to } \$12.2611 \\ \text{For } X_2 &= \text{Bunkers, the cost can vary from } \$5.4462 \text{ to Infinity} \\ \text{For } X_3 &= \text{Loading/discharge, cost can vary from 0 to infinity} \\ \text{For } X_4 &= \text{Supplies, cost can vary from 0} \end{aligned}$$

- to Infinity
- For  $X_5$  = Inland movement cost can vary from 0 to infinity
- For  $X_6$  = Government requirement cost can vary from \$3.3073 to infinity
- For  $X_7$  = In transit storage cost can vary from \$4.28 to \$34.28
- For  $X_8$  = Cargo packing cost can vary from 0 to infinity.

#### **Question 4**

To what extent will the resources vary (i.e the right hand side of the equation) for the solution to remain optimal?

The resources which are the available time for gang labour, ship turnaround and warehousing will continue to remain optimal as long as gang time lies between negative infinity to 1357.773 hours; ship turnaround time must be between 0.0001 hours to infinity and warehouse time between 0.3143 hours to infinity

#### **Question 5**

What amount can be paid in hiring a unit of the resources for the objective function to remain optimal?

685.7727 US dollars can be paid in hiring a unit of the gang time while 0 US dollars can be paid in hiring a unit of ship turnaround time and warehouse time for the objective function to continue to remain optimal.

### **4.0 Conclusions and Recommendation**

#### **4.1 Summary of Findings and Conclusion**

The results reveal that our ports are not optimally operated. Thus, there is an overcharge of price of services of port operations and wastage of the available resources for the decision variable components.

The study further proves that the application of sensitivity or post-optimality analysis on the model reveals the extent to which the cost and the resources can vary while the solution remains optimal. This in essence helps us to achieve the objectives of this research work whose prime is to determine the optimum cost of port operations in Nigeria.

#### **4.2 Recommendations**

For effectiveness of port operations in Nigeria as well as providing services at optimum prices for competitiveness, the following recommendation are made:

The port should be operated as an economic unit which it really is. It should therefore make profit, maintain itself and provide reliable and efficient services for the revenue it receives.

The use of mathematical models like linear programming is a very reliable tool for management decision as it makes use of quantitative analysis and provides more reliable outcomes. Establishments other than ports can take advantage of these models.

- The administration of the solution should be a dynamic one as other factors can affect its reliability. Example of this may be a change in the mode of packaging of cargo which can consume a large amount of the available resources.

- Port authorities should strive to maintain the resources and decision variables within the range specified for the solutions to continue to remain optimal.

Further research should be done in this area to be able to understand and decipher more variables and constraints which can be used to develop more models for use in optimizing cost of port operations in Nigeria.

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# A Tactical Emergency Response Management System (TERMS) Framework

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## Abstract

*Effective accident management requires the organization of large amounts of information. This information consists of reference information which rarely changes during an accident and decision support information which changes very rapidly. Much of the rapidly changing information is a result of collaboration between accident response personnel. In Nigeria, the three major organizations involved in emergency response are the Nigerian Police Force, the Road Safety Commission and the Nigerian Fire Brigade. These organizations each have their separate procedures for handling emergencies which can be problematic when inter-agency collaboration is needed. This paper discusses the design and implementation framework for a Tactical Emergency Response Management System (TERMS) which unifies all these different processes into a single process to be handled from a single point. TERMS also includes the use of mobile technology to enhance communication between emergency response personnel. The test results obtained revealed that if fully implemented, this technology can improve the speed of intervention between the use cases.*

**Key words:** Tactical emergency Response, mobile technology, intervention,

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## 1.0 General Background

Emergencies are incidents that threaten public safety, health and welfare. If severe or prolonged, they pose a serious threat to lives and property. Such incidents range widely in size, location, cause, and effect, but nearly all have an environmental component. Response is an effort to mitigate the impact of an emergency on the public and the environment. Emergency response

is a term for a series of appropriate actions and precautions in the event of an accident or disaster.

Emergency services are organizations which ensure public safety and health by addressing different emergencies [1]. Some agencies exist solely for addressing certain types of emergencies whilst others deal with ad hoc emergencies as part of their normal responsibilities.

The main organizations involved in emergency response in Nigeria include the Nigerian police, the Federal Road Safety Commission and the fire brigade. For the purpose of handling crisis and emergency related incidents, the three different organizations receive reports from the general public and respond to them according to their own emergency response procedures. The fire department provides firefighters to deal with fire related rescue operations, the police force is responsible for providing community safety and acting to reduce crime against persons and property, and the Nigerian Road Safety Commission ensures the safety of road users by responding to road traffic crashes. Emergency response operations can benefit from the use of information systems that reduce decision making time and facilitate co-ordination between the participating units. When faced with crisis or an emergency situation, effective real time and reliable exchange of information plays a very critical role in responding to an incident. Information systems designed for emergency response operations can provide valuable help for better planning and coordination during an ongoing crisis. The time-critical nature in emergency situations necessitates fast decision making and reliable communication with emergency personnel and rescuers.

Nowadays, the use of mobile technologies is so broadening that people are depending on this technology in their day to day activities to effectively communicate and collaborate with each other whether handling their personal or business activities. Here in Nigeria, the number of mobile phone users has exploded over the past few years. It is now a common sight to

see even the youngest of children with their own personal cell phones.

One of the features of mobile technologies that have come to be broadly used is Short Messaging Service (SMS) which enables the user to send and receive text messages using mobile phones. SMS technology is being broadly used from commercial applications to health applications. In Nigeria, SMS messaging is being widely used for socializing purpose where people exchange text message for birthday wishes, holiday wishes, and making appointments etc. Different SMS based applications are currently being developed globally by different organizations for different purposes in the business world, health, monitoring and supply chain management.

### **Problem Statement**

Effective accident management requires the organization of large amounts of information. During an accident, decisions about resource allocations must be made quickly and correctly [3]. These decisions are made in response to the rapidly changing needs of current accidents and they require a large amount of collaboration between emergency response personnel which include police officers, firemen and road safety officers. Workers at the scene of the accident and resource allocators located at an emergency operations center must work together to identify the needs of each accident and ensure that the available resources are allocated efficiently. This cooperative decision making requires a large amount of communication and shared information. Unfortunately most emergency response agencies in Nigeria do not have the capability to meet this need effectively due to the fact that their emergency response

activities are still handled manually. This makes collaboration with other agencies very difficult and uncoordinated.

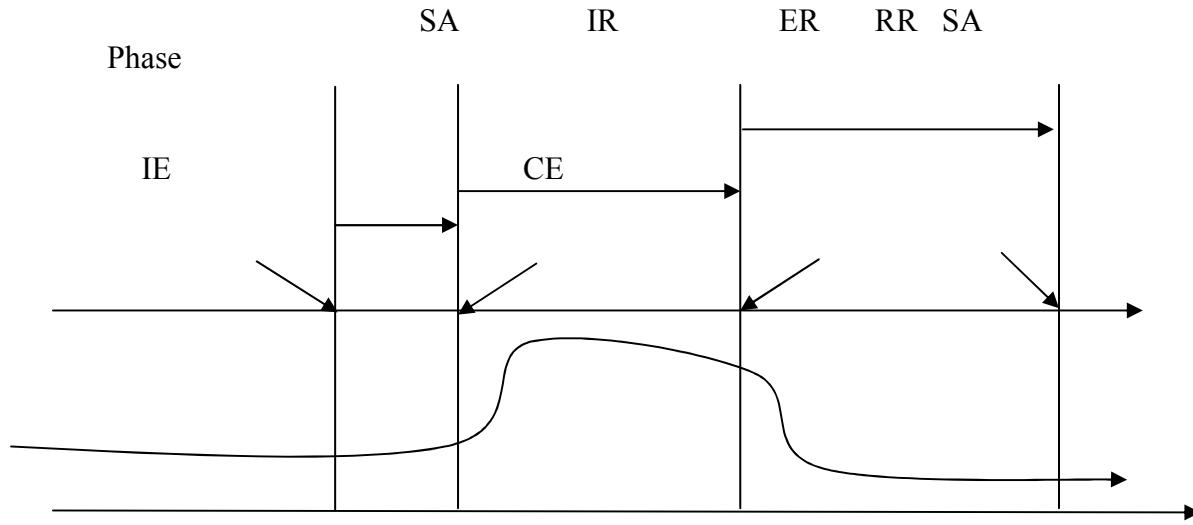
## 2.0 Related Work

Emergency Response Systems are used by organizations to assist in responding to an emergency situation. These systems support communications, data gathering and analysis, and decision-making. Emergency Response Systems are very much needed and must function well and without failure. Designing and building these systems requires designers to anticipate what will be needed, what resources will be available, and how conditions will differ from normal [10]

A standard model for an Emergency Response System is made of a database, data analysis capability, normative models, and an interface. This model is only somewhat useful as it fails to address issues such as how the Emergency Response System fits into the overall emergency response plan, Emergency Response System infrastructure, multiple organization spanning, knowledge from past

emergencies, and integrating multiple systems. Emergencies are high stress situations that require organizations to respond in a manner that is different from their normal operating procedures. Emergency stressors, in addition to fatigue, include dealing with a complex, unpredictable and dynamic response, time pressure, and communications, dealing with the media, and operating within an integrated emergency management context ([2], [12]).

Emergencies are also a series of four phases: Situational Analysis (SA), Initial Response (IR), Emergency Response (ER), and Recovery Response (RR); and five decision/hands off points: the Initiating Event (IE), the control event (CE), the Restoration Event (RE), the Normalizing Event (NE), and a Terminating Event (TE). Figure 1 shows the phases and decision points and includes a general plot of the amount per unit time of immediate responses and decisions that need to be made as a timeline plot following some initiating event, IE.



**Figure 1: Phases and timeline of a typical emergency.**  
(Source: [11])

## **Organizations in the first emergency phase**

Figure 1 shows that organizations are constantly in the first emergency phase, SA, which is a data gathering and assessment phase that has a base level of activity.

The application of new technologies to emergency mitigation, response and recovery and some issues associated with the technology used in an Emergency Response System were discussed. These issues include information overload, loss of information, retention of outdated information, the greater likelihood of the diffusion of inappropriate information, further diminution of non-verbal communication, and the inevitability of computer failures.[6]

Some additions to Emergency response systems to increase their effectiveness might include technologies such as CD/DVD based storage media, Web/Internet sites as a common infrastructure providing access for disaster response teams distributed across multiple locations or organizations, and e-mail for improving communications. Geographical Information System (GIS), Satellite capabilities to the Emergency/Crisis Response System, Intelligent agents were also advocated, but the major challenges are the difficulties in integrating them with other technologies ([8], [9], [11]).

### **3.0 Emergency Response systems As Cooperative Information Systems**

During an accident, decisions about resource allocations must be made quickly and correctly. These decisions are made in response to the rapidly changing needs of current accidents and they require a large

amount of collaboration between accident management personnel. Workers at the scene of the accident and resource allocators located at an Emergency Operations Center must work together to identify the needs of each accident and ensure that the available resources are allocated efficiently. This cooperative decision making requires a large amount of communication and shared information [3].

In a cooperative information system, multiple users view and modify a shared set of data. The users may access the data simultaneously or serially. This shared use of a common set of data by multiple users or systems is a defining feature of Cooperative information Systems. Furthermore, in some Cooperative Information Systems( CIS) applications, it is important that all users view the most recent data in the shared set at all times. The large amount of collaboration between emergency response system users, who view and modify a common set of rapidly changing data, distinguish it as a cooperative information system and make its design and implementation challenging. Several other factors specific to the domain of accident management further complicate the design problem.

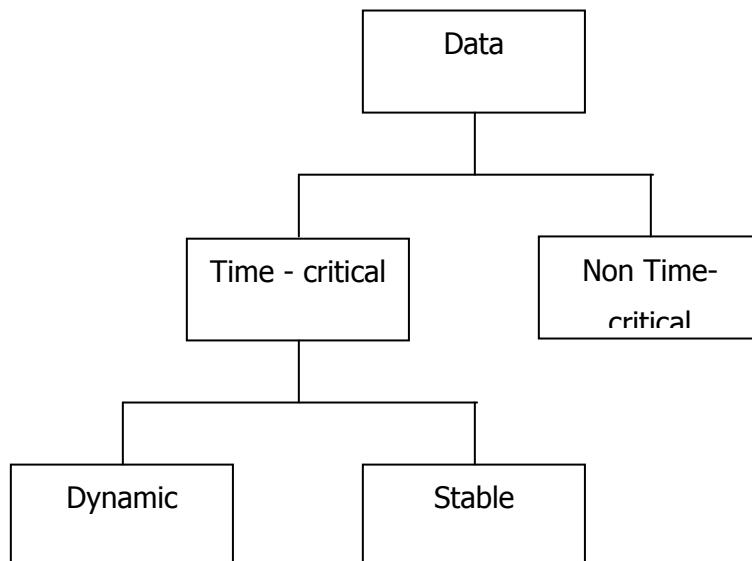
It is the nature of accidents that the collaborative communication often occurs in bursts of activity. Large amounts of communication occur at the beginning of an accident and at other crucial points during its management. Once resource needs have been identified and the situation of the accident has stabilized, communication slows as workers concentrate on performing

their tasks rather than planning them. The mobility required by accident management personnel requires emergency response systems to employ state-of-the art wireless communication technology. This combination of communication characteristics and sometimes unreliable communication medium makes the design and implementation of an effective emergency response management system an extremely challenging shared information problem at many different levels.

The primary purpose of emergency response systems is to provide users concurrent access to a set of shared information. In this way, it is similar to ordinary information systems. One requirement that separates emergency response systems from traditional information systems is that concurrent users

must see changes to the data as quickly as possible. This requirement is further complicated by the fact that information about active accidents changes very rapidly.

A final consideration is that the data utilized by emergency response systems can often be owned by geographically distributed organizations, each maintaining its own databases on site. The first two requirements, rapid change in the data and user awareness of the change, necessitate an understanding of the types of data which emergency response system must manage. Towards this end, the data has been classified according to two criteria: whether it is critical that all users view the most recent changes at all times and whether the data will change rapidly. The Figure below shows this classification.



**Figure 2: Classification of data in an emergency response system.**  
 (Source: [3])

### **3.0 Mobile Technology and Its Applications in Emergency Response Systems**

Much work has been done exploring the use of cellular phones for emergency communication, especially related to large scale targeted warnings [7]. The cellular network provides a unique capability to infer the position of people in an affected area and to provide them with specific and relevant instructions.

There is an increasing awareness of the advantages associated with the use of cell phones and Personal Data Assistants (PDAs) in the management of disasters [5].

## **5.0 Methodology**

### **System Analysis**

Unified Modeling Language (UML) is a notation that resulted from the unification of Object Modeling Technique (OMT) and Object-Oriented Software Engineering (OOSE). UML has also been influenced by other object-oriented notations. The goal of UML is to provide a standard notation that can be used by all object-oriented methods and to select and integrate the best elements of precursor notations. For example, UML includes the use case diagrams introduced by OOSE and uses many features of the OMT class diagrams. UML also includes new concepts that were not present in other major methods at the time, such as extension mechanisms and a constraint language. UML has been designed for a broad range of applications. Hence, it provides constructs for a broad range of systems and activities such as distributed systems, analysis, system design, and deployment[4].

### **Current systems**

#### **1. Federal Road Safety Commission:**

The Nigerian Road Safety commission Bauchi command is responsible for

responding to Road Traffic Crashes (RTC) in and around the Bauchi metropolitan area. There are five unit command offices in Bauchi. These include RST 12.1 (Bauchi), RST 12.11 (Azare), RST 12.12 (Darazo), RST 12.13 (Alkaleri) and RST 12.14 (Toro). Their activities include rescue operations during Road Traffic Crashes (RTCs). They are responsible for the administration of first aid and conveying of victims to hospital. They work in close collaboration with the police force, as they are required to report all road accidents to the police.

The primary mode of receiving emergency reports is via telephone calls by civilians or officers on patrol. An average of 3 to 4 calls might be received daily. The information required when an incident is being reported include the location of the accident i.e. the specific route the accident has taken place and the location of the accident. The nature of the accident is also required. Calls are received from the public via telephone calls placed to the Rescue Officer who is responsible for deploying team members to the scene of the accident.

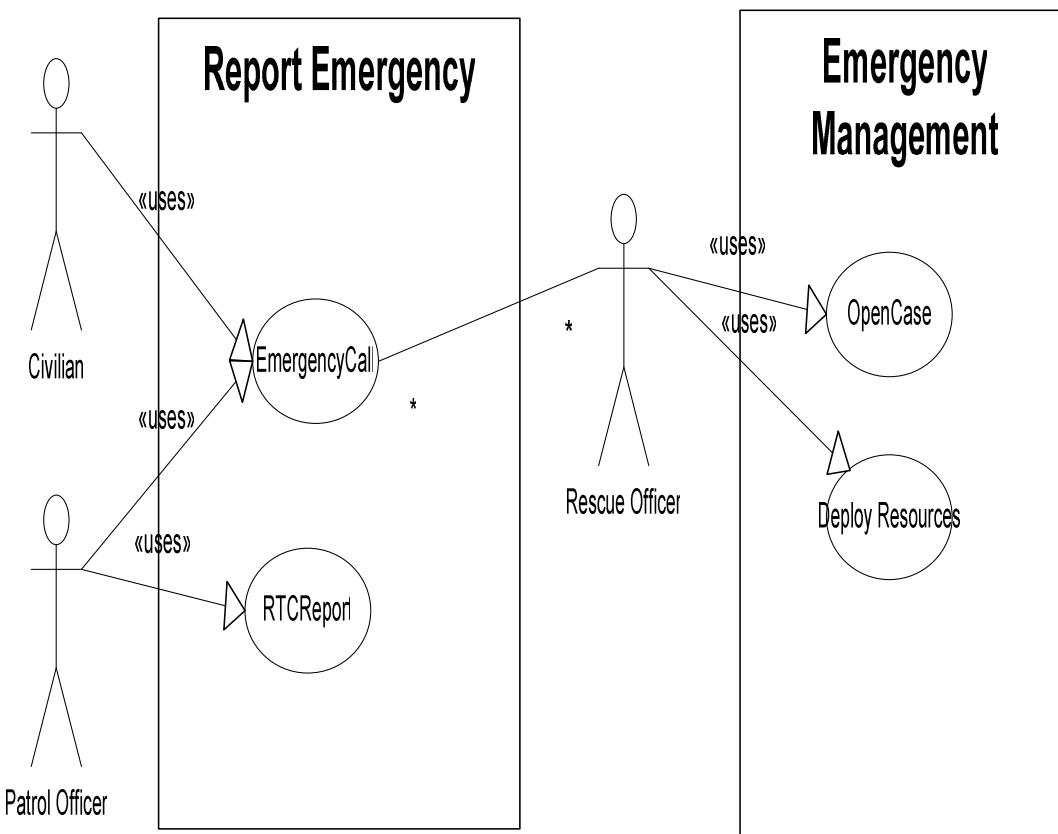
A typical rescue team consists of four members, a driver, rescue team leader as well as two other team members. The officers communicate with each other via the use of standard issued cell phones operating on the Glo network. These cell phones make use of a **closed user group**, which means that calls placed to team members are not charged. The team leader is the point of contact between his team members and the unit command. He is in charge of keeping the unit command updated on the status of each incident.

After successfully managing an incident, the team leader is responsible for the filing of Road Traffic Crash reports via SMS to the Abuja Headquarters. The contents of the

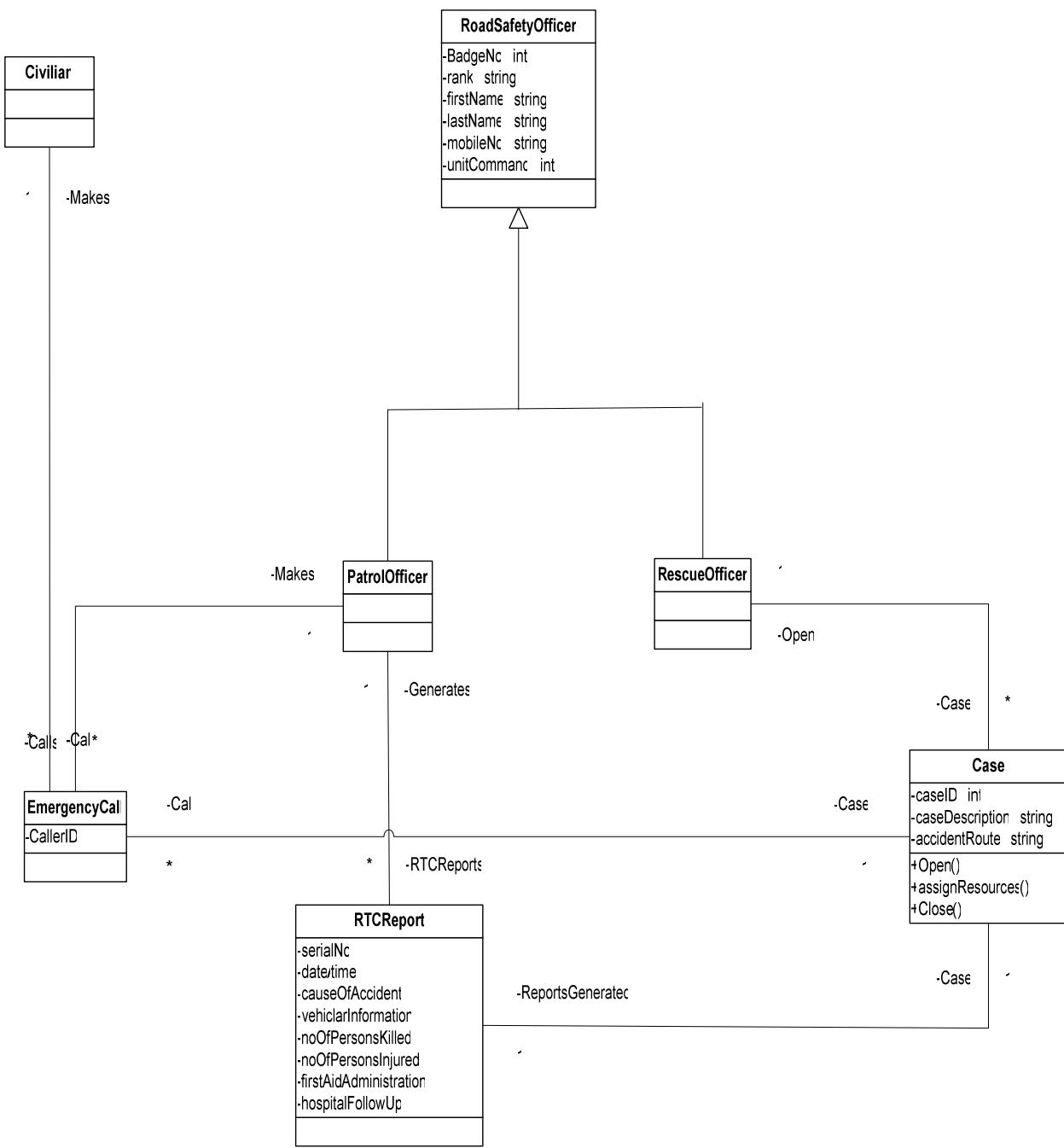
text message includes the command code, time of accident, route, location, number of people involved, number of injured which includes number of females, males and children involved. The number of people killed which includes the numbers of females, males and children. The cause of

the Road traffic crash and the names of the drivers involved. He is also expected to submit a hard copy road traffic crash report form.

The use case and class diagrams are shown in figures 3 and 4 below:



**Fig 3: Use case diagrams for emergency operations of the Road Safety Commission**



**Figure 4: Class diagrams for emergency operations of the Road Safety Commission**

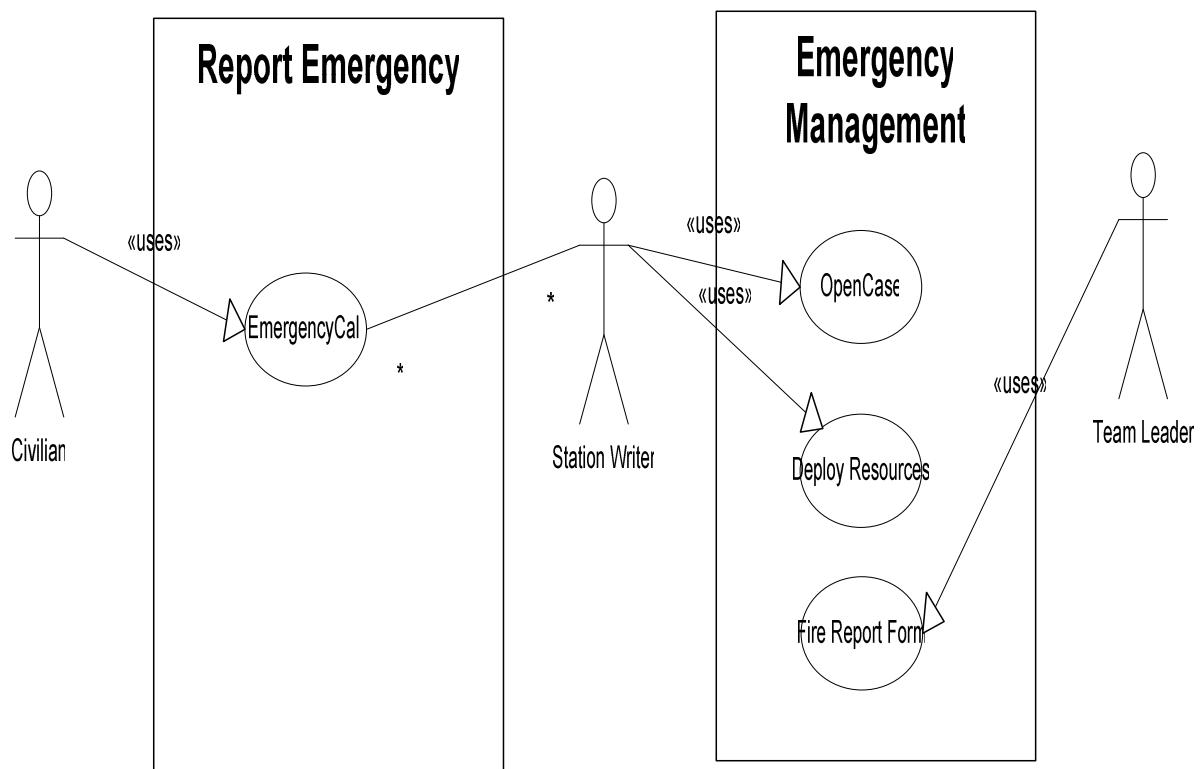
The Nigerian Fire Brigade Bauchi command is responsible for responding to fire related incidents in around the Bauchi metropolitan area. There are two fire brigade stations in Bauchi state; they include the Headquarters which is in Bauchi city and the Azare station. Their activities include rescue activities in fire related incidents. In the absence of the police, they are responsible for administration of first aid to victims as well as the conveying of the victims to hospitals.

The primary method of receiving reports is via telephone calls from civilians. The calls are received in the control room by the station writer. An average of five incidents is reported daily. The information required during the reporting of an incident includes the name of the reporter and the location of the incident. The location might include the area, street, house number. In other cases it might be necessary for the reporter to lead them to the scene. There are sometimes

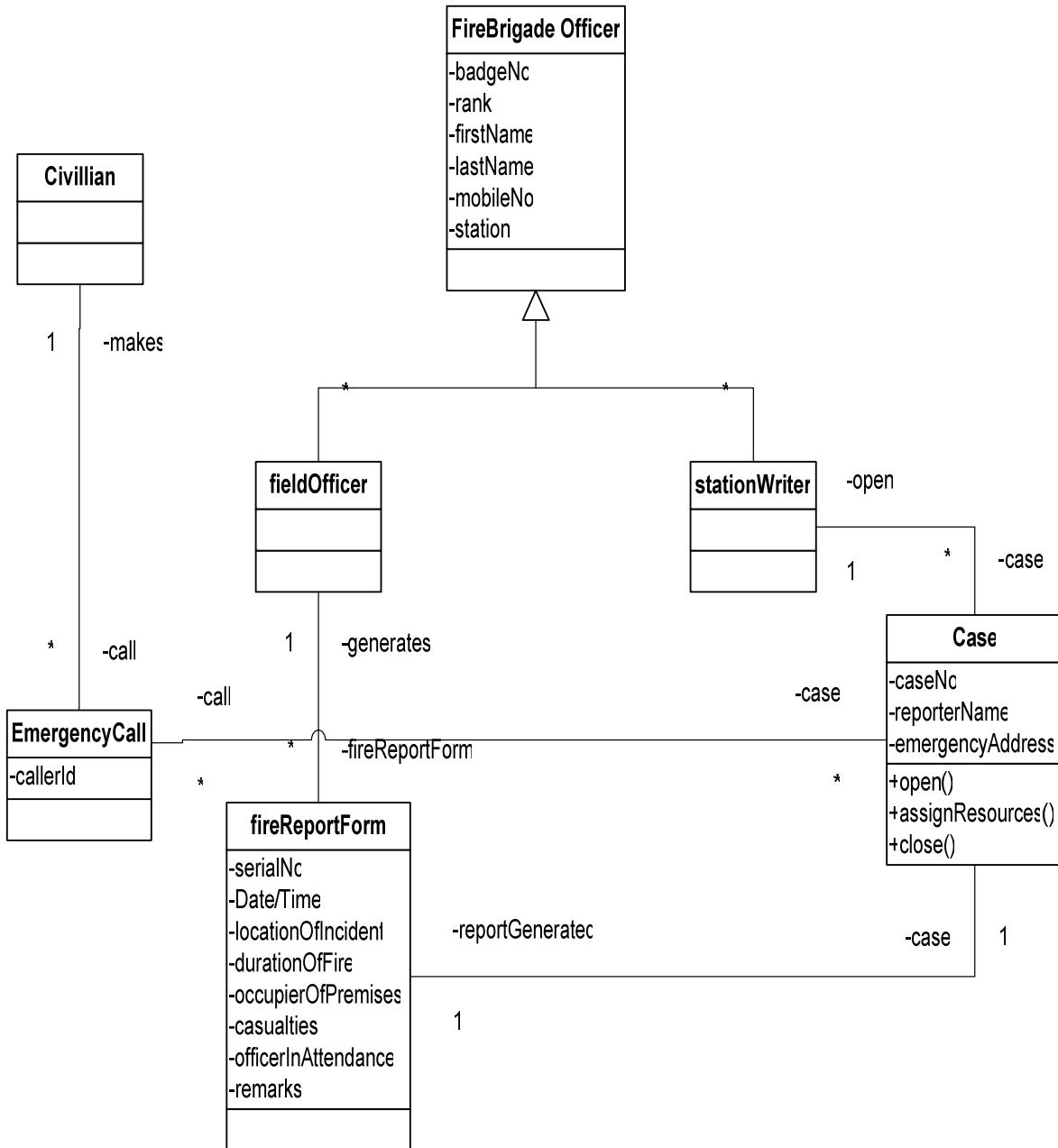
cases of false reports and the fire service has no method of validating the authenticity of a report.

A typical rescue team consists of five officers per fire truck. The officers communicate with each other via cell phone operating on the Starcomms network. One among the five officers is the team leader and is responsible for keeping the control room updated with the status of an incident. The team leader is also responsible for the placing of assistance messages to the control room incase more resources are needed to tackle the incident.

After an incident has been successfully resolved, the team leader is responsible for the filing of a fire report form. After every six months a summary report is compiled and sent to the Abuja headquarters for analysis. The summary report includes information about the amount of total fire incidents in the area and total number of casualties



**Figure 5:** Use case diagram for Emergency Operations of the Nigerian Fire Service.



**Figure 6: Class Diagram for emergency operations of the Nigerian Fire Service**

### Proposed System and Modeling

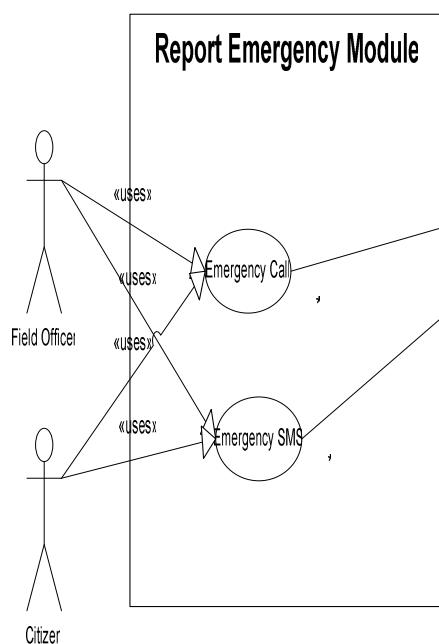
The Tactical Emergency Response Management System (TERMS) is to be built to handle all communication required during the handling of an emergency situation. As

mentioned earlier, the effective handling of an emergency situation requires interaction between the various emergency response agencies. The main objective of TERMS will be the unification of all emergency

response procedures of the various agencies into a single architecture to be handled from a single point. TERMS will also make use of SMS technology to report emergency situations as well as enhance the communication between officers involved in emergency response.

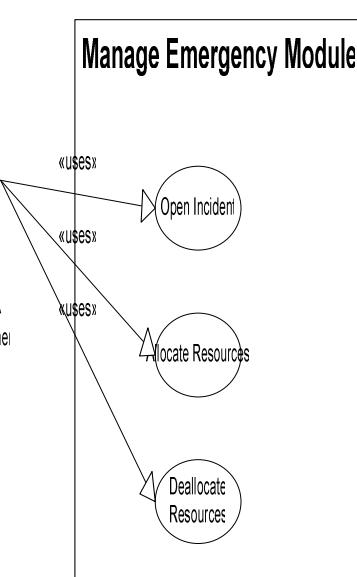
## System Modules

### 1. Report Emergency Module



This module is responsible for all the handling of emergency reports submitted either by field officers or civilians via SMS or phone calls. The use case diagram is shown below:

:



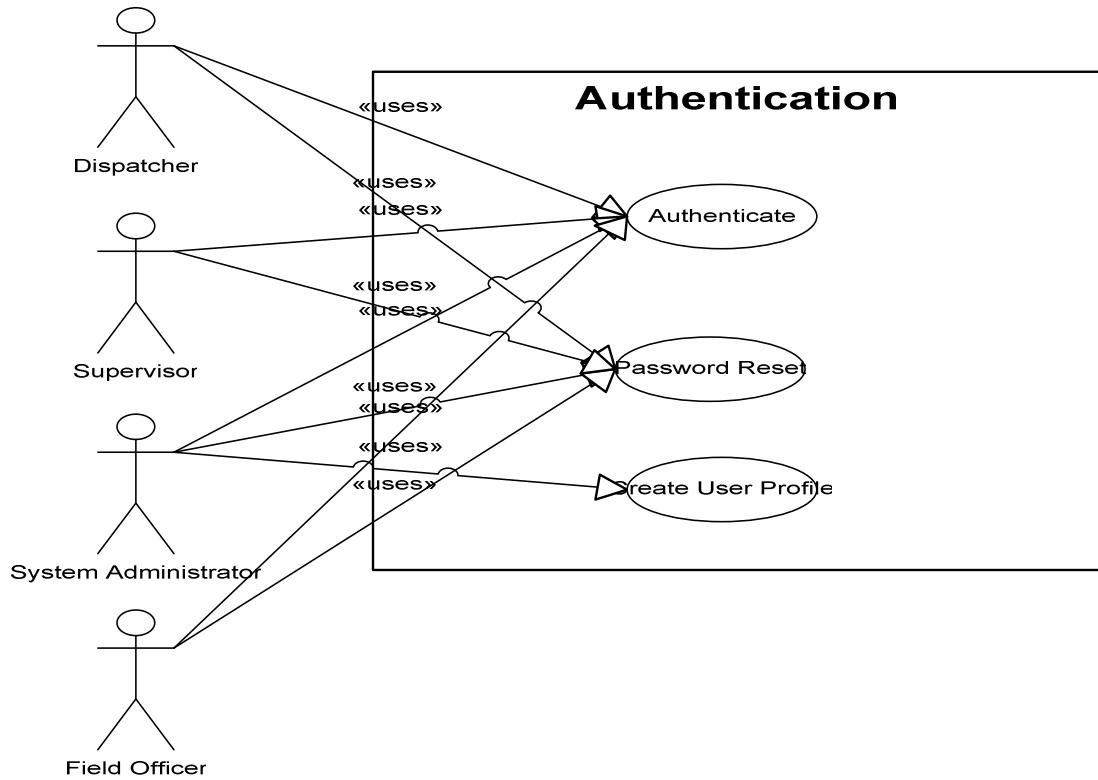
**Figure 7: Use case diagram for Report Emergency and Manage Emergency Module**

### 2. Authentication Module

This module manages all user information which includes usernames,

:

passwords and well as user roles. The use case diagram is given below

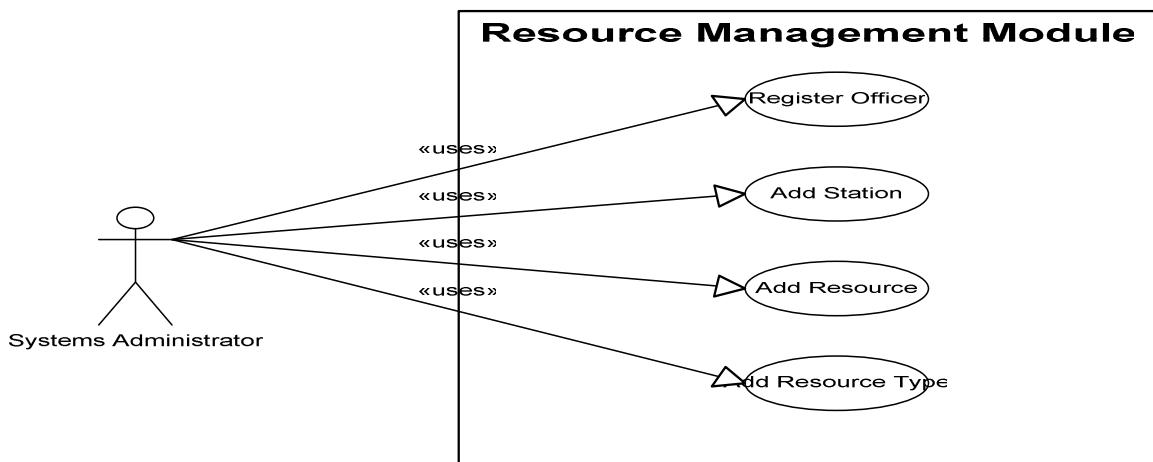


**Figure 8: Use case diagram for authentication module**

### 3. Resource Management Module

This module handles the management of all resources used in the management of

resources. The use case diagram is given in figure 9.



**Figure 9: Use case diagram for resource management module**

## Design Goals

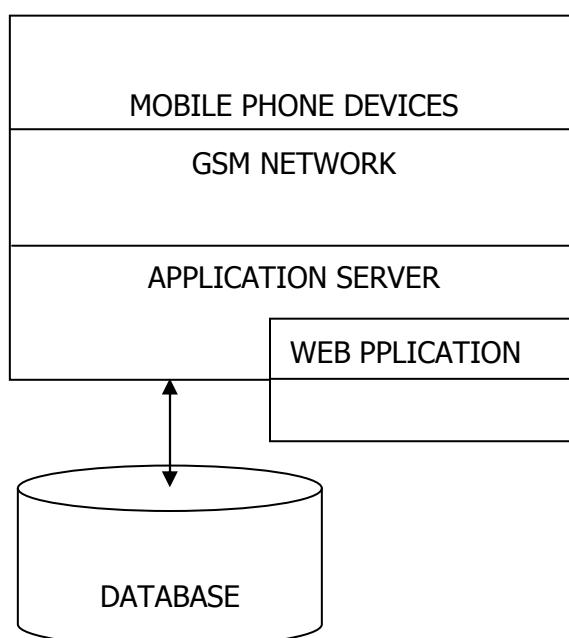
The new system is considered to be successful if it meets the following sets of criteria:

1. **User Interface:** The user interface of the system should be easy to use by each user of the system with little training.
2. **Documentation:** System administrators and other users are provided with proper documentation about the software's features.
3. **Performance:** The system should be able to serve a number of users which are expected to access it concurrently.
4. **Error Handling and Extreme conditions:** The system should be robust enough to handle error conditions and continue with normal operations.

5. **Availability:** The system availability should be available most of the time since it is handling emergency situations.
6. **Security:** The system should prevent the sensitive data from unauthorized access.
7. **Modifiable:** The system should be designed in Object Oriented language so that modification to some part of the system could not affect other parts.

## System Model

This represents the system decomposition and other implementation designs necessary to achieve both the design goals and the functional requirements. The following architecture is considered.



**Figure 10: General Architecture of the System**

At the top of the architecture we have the Mobile Phone Devices. This layer defines any mobile device with SMS functionality that will enable users to make calls and send SMS messages.

At the next layer, we have the Global System for Mobile Communication (GSM) network which is provided by the GSM network service provider. Cell phone calls and SMS messages are sent or received via a GSM network. This serves as a communication link between the application server and the mobile devices.

:

The next layer, the Application Server, accepts the phone call or SMS message from the GSM network either via a wireless GSM modem or a GSM mobile device with a serial port cable connected to the application server. The application server automatically receives the calls or messages and stores it to the database taking necessary action.

### **Program Architecture**

The program architecture of the proposed system is given in figure11 below

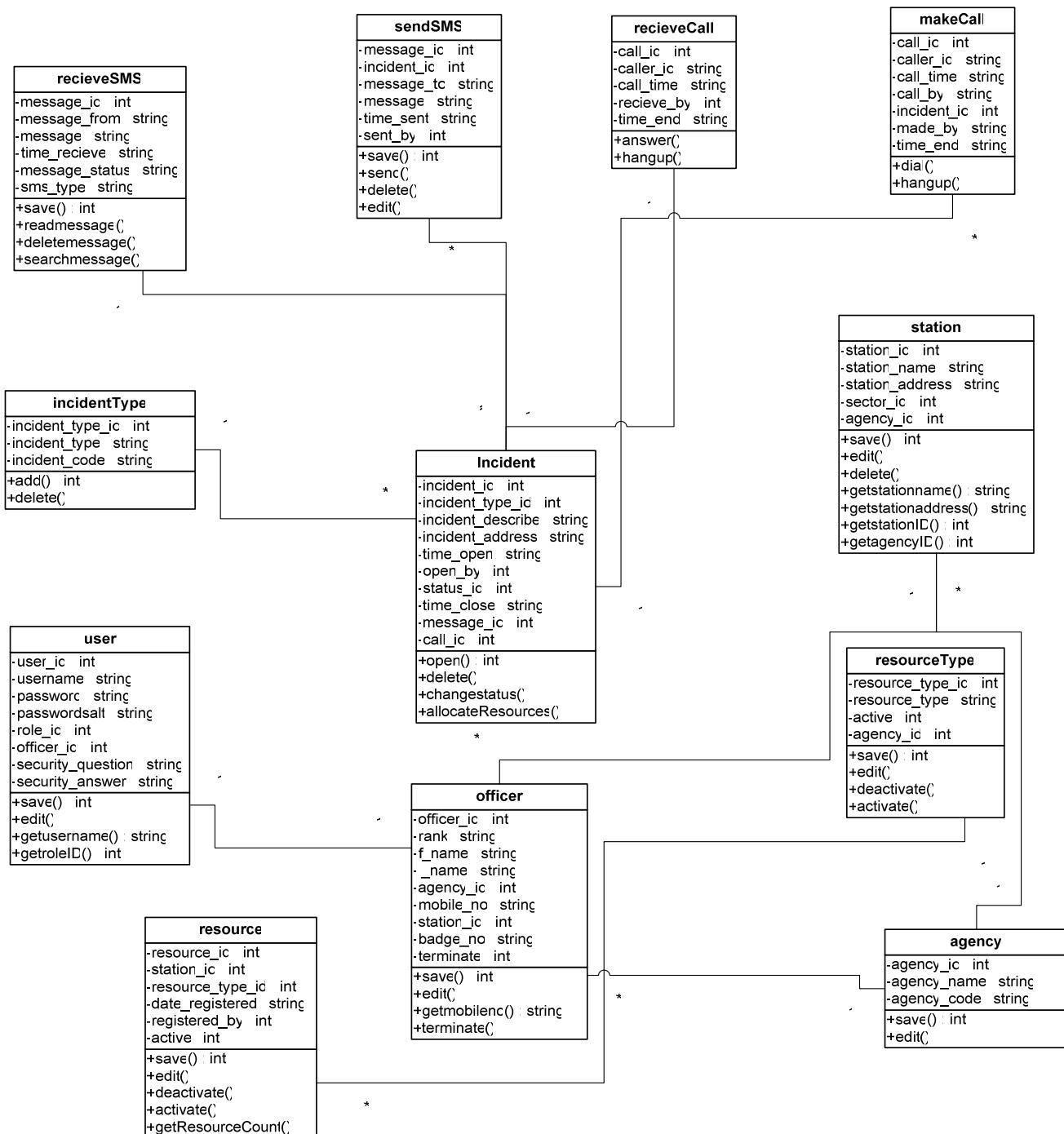


Figure 11: TERMS Class Diagram

The system will use a relational database to keep its persistent data.

The relational database designed is as shown in figure 12.

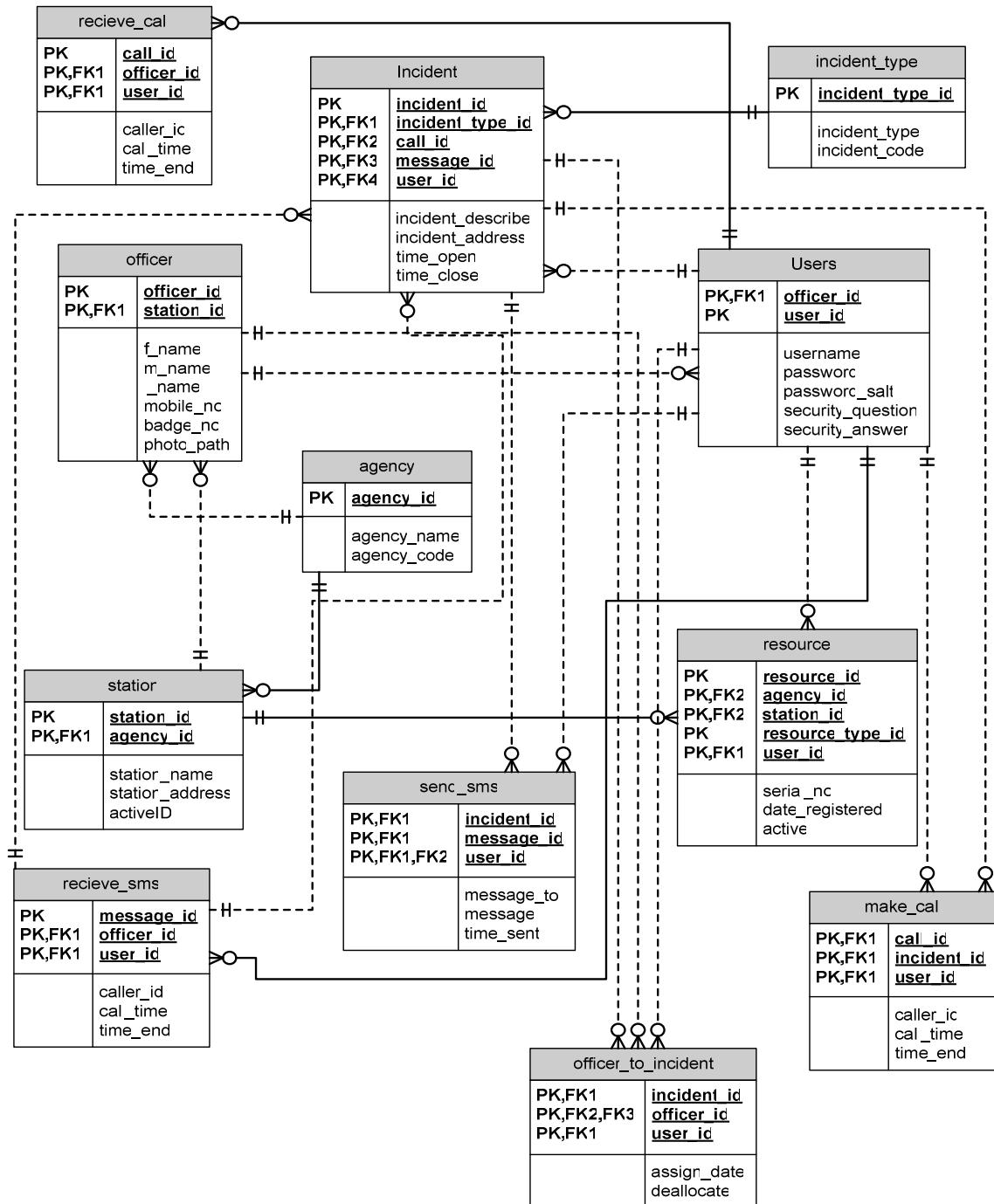


Figure 12: TERMS Database Model

## Deployment Diagram

The system is web-based therefore client nodes should have browser components, whereas the web-server machine will have IIS. The same web-server or an independent machine, will host MSSQL server DBMS

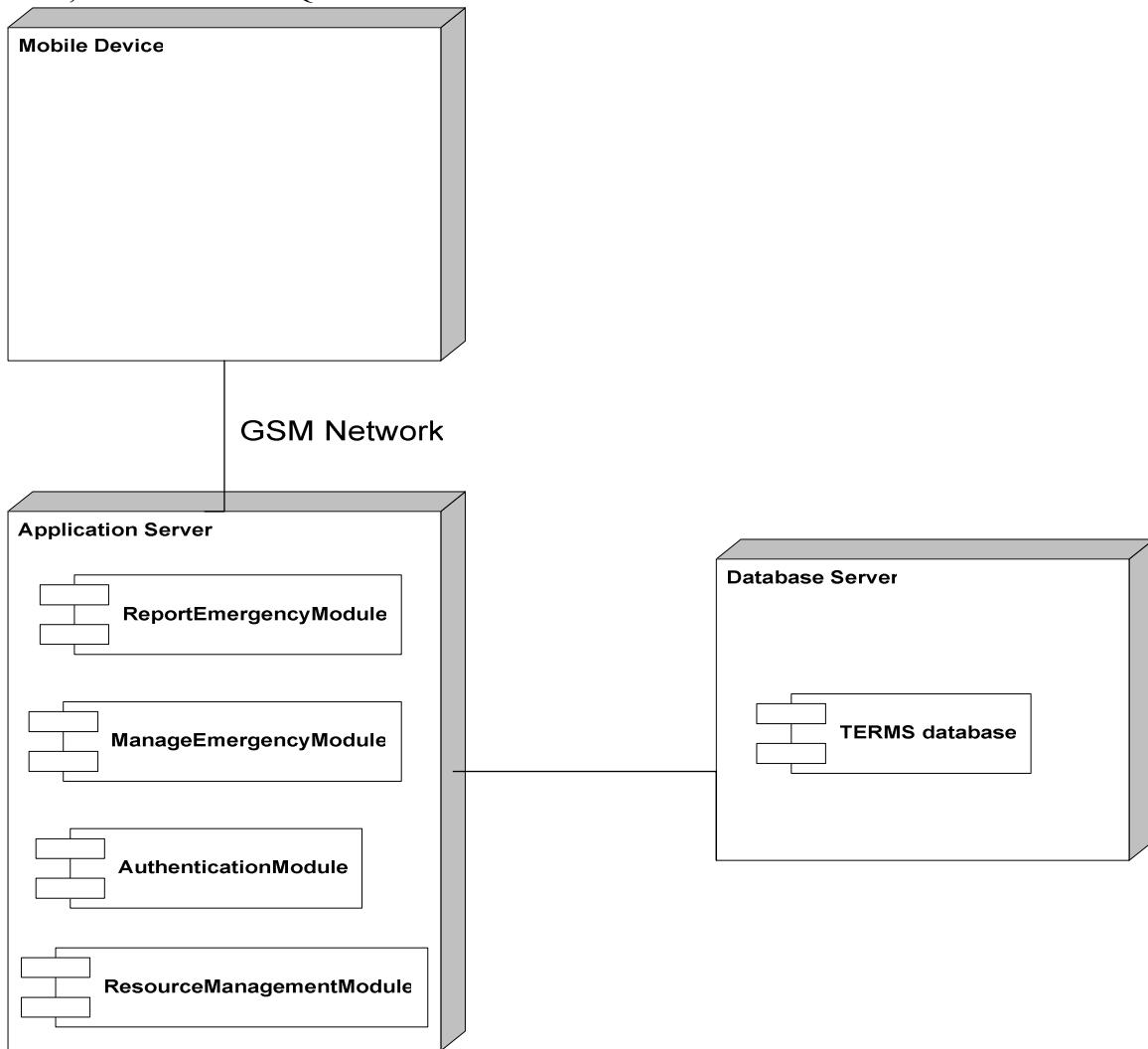


Figure 13: TERMS Deployment Diagram

## Testing

The programming language used is Visual C#.Net, which was chosen because it provides suitable facilities for operating system services and also for its flexibility and simplicity as well as its ability to have

component. Figure 14 shows the deployment diagram which includes the application server where all the business logic functionalities are deployed and the database server. The system will be using client/server architecture

easy access to low level hardware components, and its guarantee for speed or fast application

## Results and Discussion

The System prototype is a web based application that communicates with a GSM modem or GSM mobile phone connected to the server, using the ATSMS library. The system uses the ATSMS library to enable it

send and receive text messages as well as makes and receive phone calls via a mobile network ([www.codeproject.com](http://www.codeproject.com)). Snapshots of some pages in the system and discussions are given below

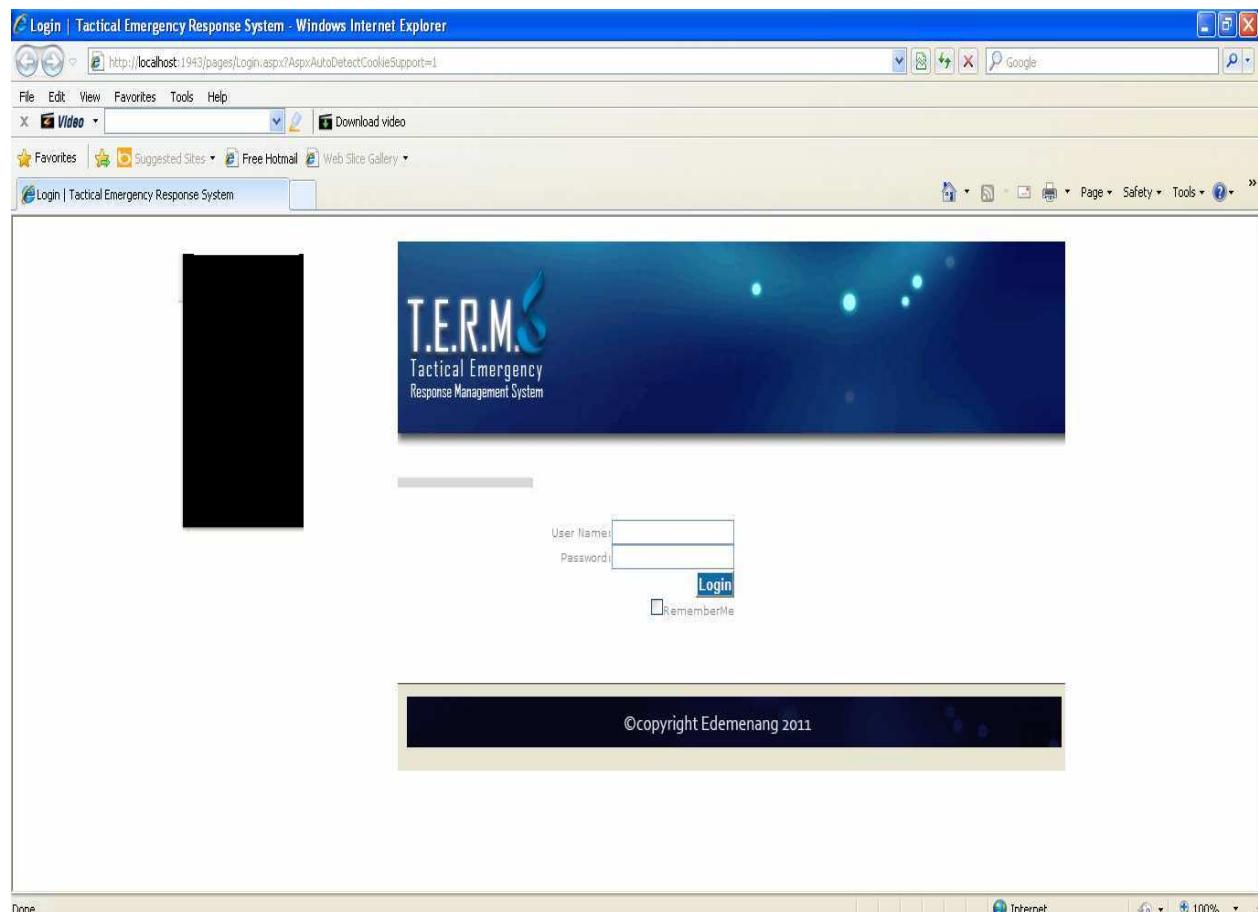
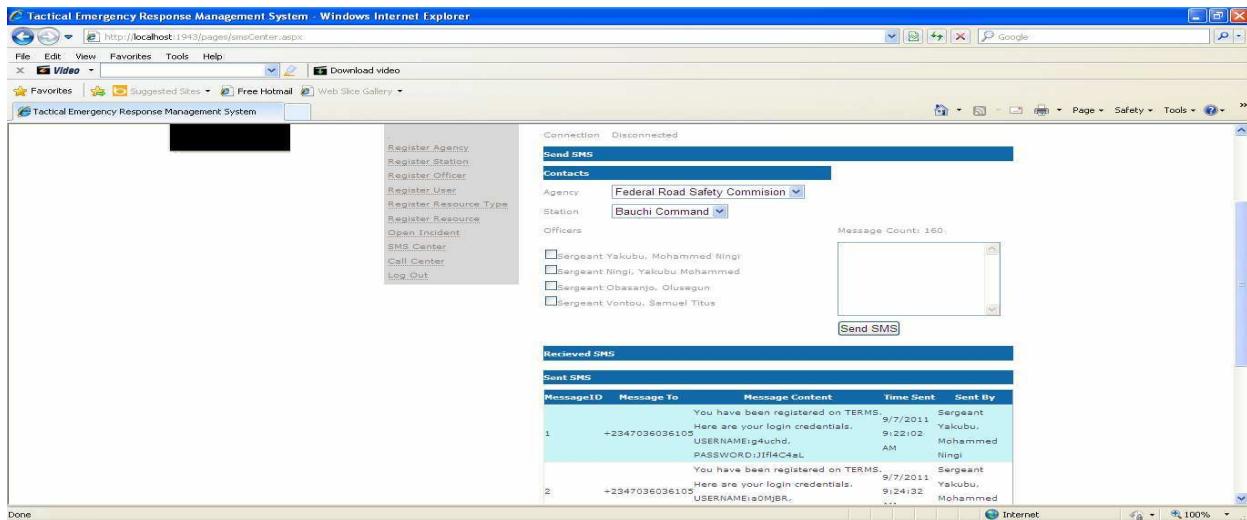


Figure 14: Login Interface for TERMS

The first page that the user sees when he or she accesses the system is the login interface shown in Figure 14 above, every user has a user name and an encrypted password which

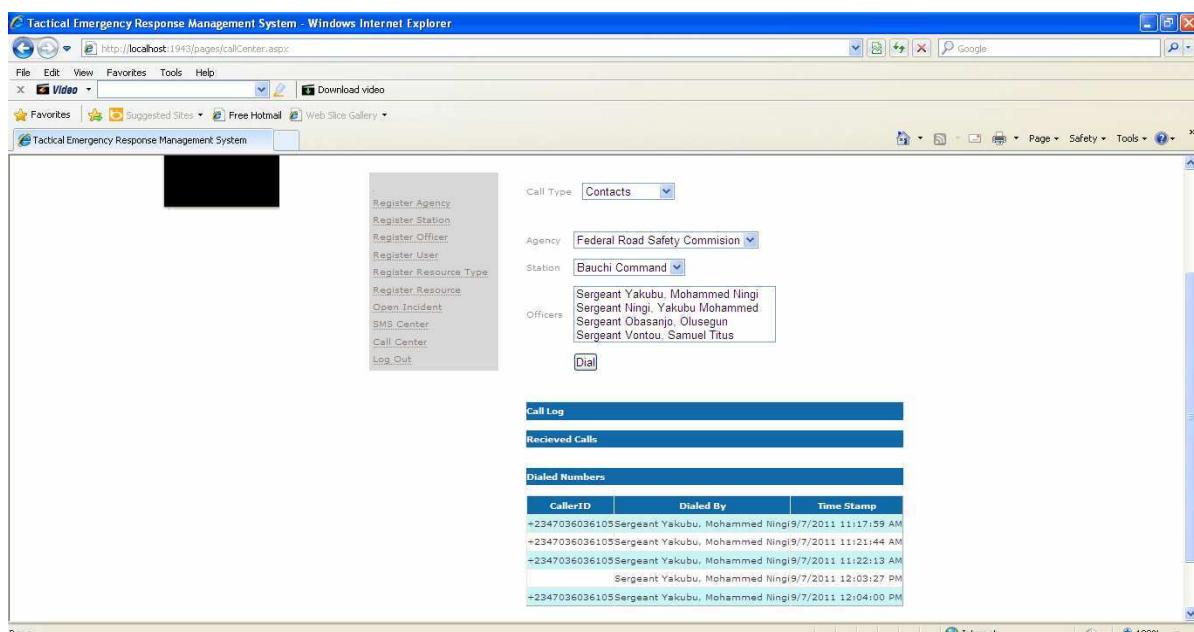
is stored in the TERMS database. After successful login to the system every user will be linked to the SMS Center.



**Figure 15: TERMS SMS Center**

The sms center can be used at any point in time pass notification to field officers. Figure 16 shows the interface where the user selects the registered field officers by selecting his agency and his station. The

user can then type in the contents of the text message in the given text box and send by clicking the send sms button. A log is also available for the user to view all his sent and received text messages.



**Figure 16: TERMS Call Center**

The call center can be used to contact field officers by placing phone calls via a mobile network. Figure 16 shows the interface where the user selects the registered field officers by selecting his

agency and his station. The user can then place calls by clicking on the dial button. A call log is also available showing all dialed and received calls.



**Figure 17: TERMS Incident Form**

Figure 18 above shows the TERMS incident form. This is the form used by the dispatcher to open reported incidents. After filing all the necessary information, the dispatcher can assign officers to the incident by selecting the appropriate agency as well as

their station. The dispatcher then selects a team leader as well as other officers. By clicking on the open incident button, a new incident is opened in the database and text messages are sent to all selected field officers

Role	Officer Name	Assigned Date
Team Leader	Sergeant Ningi, Yakubu Mohammed	9/3/2011 3:30:47 PM
Team Member	Sergeant Ningi, Yakubu, Mohammed Ningi	9/3/2011 3:30:44 PM

**Figure 18: TERMS Incident Form**

## Conclusion

A framework towards creating an emergency response system fitted for the Nigerian environment was provided. The system was developed using .NET framework, mobile technologies which include mobile telephony as well as short messaging service. This provided a proof of concept to illustrate the capabilities of an

emergency response system in the Nigerian environment, displaying how much such a system could improve emergency response activities of the various agencies. Implementing this work will greatly improve the activities of the various emergency response agencies in Nigeria, providing them with cheap and effective means of communication.

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# **Biometric Authentication Systems: Religious Ideology and Implications For Human Capital Development**

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## **Abstract**

*The Internet is a connection of millions of computers all over the world and a pool of information resource. Internet is a source of large number of electronic services (e-services). This implies that, almost every human Endeavour can be carried out electronically on the internet: e-mail, e-commerce, e-banking, e-relationship, e-money, e-learning, in short e-life is all products supported by the Internet. Thus, information and communication technology (ICT) has transformed the society, time is collapsing, and distance is no longer an obstacle. Crossing the ocean only takes a mouse click, people are connected 24/7. "Instantaneous" has a new meaning. Internet has actually changed everything; as a result, life generally has been redefined and so means of securing life. With e-life came e-crimes, subsequently, e-security. Biometric Authentication Systems (BAS) is one of the latest e-security measures but poses serious threat to some religious and traditional beliefs. This study investigates the degree of understanding of practitioners about BAS, the beliefs that discourages its use and the implications of refusal to learn or use new technology on the human capital development.*

**Key words:** Biometric Authentication systems, Information Communications Technology, e-commerce, e-security, internet, networking

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## **Introduction**

Security is a word that is synonymous with freedom. The Merriam Webster's dictionary defines security as a quality or state of being secure, freedom from danger; freedom from fear or anxiety; and freedom from the prospect of being defrauded. The issue of

security is one predominant factor that takes the highest priority of mankind.

Computer networking involved the integration of two or more computers so that they can seamlessly communicate and share information and other resources, Okonta et al [8]. Networking facilitates fast sharing and transfer of files, multi-user, cost management,

promotes data security and ultimately centralizes software management. Computer networking gave birth to the internet in the mid 20<sup>th</sup> century; it is a connection of international network of computers, a pool of information resource. The internet subsequently led to electronic services such as e-services: e-mail, e-commerce, e-banking, e-relationship, e-money, e-learning, etc.

Ezeagu (2011) declared that internet has transformed the society, time is collapsing and distance is no longer an obstacle. 'Instantaneous' now has a new meaning. As a result, criminals now step up their trade by hacking into every electronic activity to perpetrate fraud and theft, so the emergence of e-crime. "E-banking just opened various other ways to conduct financial crime" [9]. Osuagwu went further to say that so much robbery and kidnapping was recorded worldwide as a result of e-commerce that the word "cyber-crime" has entered the English dictionary. E-crime is so fast and deep that it requires a special kind of force to prevent or catch its perpetrators.

According to industry analysts, there are over 800 million people online worldwide as at 2009. An FBI survey cited in Harby, Qahwaji & Kamala [9] showed that in 2010, over 234 billion dollars commercial sales was made over the net while over 12% of US citizens reported a computer crime of one type or another the same year. Furthermore, in 2002/2003, British crime survey showed that 18% of households with internet access reported a form of computer crime; this increased to 27% in 2003/2004 and exploded to 62% in 2006. A pandemic level of 80% was hit in 2009/2010, Harby et al (2012).

#### Types of crime

- Credit card fraud

- Misuse of non credit card accounts (bank account debit)
- Identity theft for unauthorized access
- Corporate espionage
- Ransom opportunity (sell my information back to me)
- Malicious software (malware)
- Virus, Trojans, worms, spyware, spams, e. t. c

#### Some e-security measures

The electronic nature of conducting commerce requires also that electronic means of securing those systems be developed - e security. E-security is the application and use of electronic means to prevent unauthorized access to valuables and properties, Yerokun (2012). With the alarming spread of e crime, programmers and organizations are working tirelessly to develop measures to curb this surge:

- Firewalls
- Software solutions (antivirus)
- Authenticating system passwords
- Hardware cryptography
- Patches and lately
- Biometric authentication system (BAS)

#### Biometric Authentication System (BAS)

According Osuagwu [9], BAS refers to brand new technology to reliably indicate whether people are who they say they are using traits unique to them. DNA, finger print patterns, iris – arrangement of tissue in the eye's iris, timbre of a person's voice, are some of the examples of a peculiar biometric data in humans which can be used to identify a person. It is an automatic method for identifying a person on the basis of some biological or behavioral characteristics of the person, Khusial & McKegney [ (2005). Even

though researchers claim BAS has been around since 29000BC when cavemen would sign their drawings with hand prints, the first official record of BAS was in 1880's when Alphonsus Bertillon, Chief of the Criminal Investigation Department used a number of bodily measurements (Bertillon System) to identify and arrest a criminal. It has since then gone through series of modifications to arrive at the sophisticated BAS of today.

### **Human Capital Development**

According to the United Nations Development Programme (UNDP) [10], human capital development is an approach to economic growth that emphasizes improving the quality of life of all citizens while conserving the environment and natural resources for future generations. It means the use of every available technology to eliminate poverty and achieve sustainable human development in the country. ICT has brought unlimited opportunities to the Nigerian populace and it will not be an overstatement to say that the acceptance and use of BAS will definitely impact positively the human capital base of this country.

### **Religious and Traditional Beliefs**

Webster's dictionary defined religion as the service and worship of God or the supernatural; commitment or devotion to religious faith, or observance; a set of institutionalized system of religious attitude, beliefs and practices; and a scrupulous conformity to a set of beliefs. Religion is a very volatile aspect of human existence. In an attempt to uphold their belief in a system, attitude, and in conformity to a set of beliefs, people have bled, died and perished. Lagay (2005) claimed that some parents endanger their unborn children's life and are willing to

sacrifice their adult lives for their religious beliefs. Akilaya [2] stated that Nigerian culture and traditional beliefs has been greatly affected by westernization, but westernization in turn brought another set of beliefs. Bello in Agogo [1] said it has been observed that African attitude to issues and situations today has been influenced by what he called "the view point cultivated as a result of slavery as well as colonial education".

However the emergence of computer and its subsequent innovations made Aminu [3] to say that the impact of information technology revolution goes beyond information and pervades all different aspect of globalization. The power of computer information technology has changed the nature of finances and trade, putting an end to geography, creating a borderless world. He went further to say that development in commerce and transportation technology has given rise to the new form of cultural production, consumption and exchange. He cited Pickering (2001) and Giddens (1999) as saying that ICT has 'claimed the invisible overthrown of old pattern of living'.

The volatility of religion has raised a lot of issues in the past, preventing the acceptability and subsequent further development of various machines. In the early 19<sup>th</sup> century, various ethnic groups fought wars to prevent the 'white men' from invading their lands. Agogo [1] mentioned the resistance of the Igese tribe towards removal of certain traditional practices, to the extent that it affects the teaching of science subjects in schools. Sa'adu and Wasagu (2011) said that science and technology are both developed as human endeavors seeking to understand nature, predict nature, control nature and solve human problems. But several factors such as religious beliefs which has led to

misunderstanding the purpose and intent of new technologies, have prevented Nigerians from utilizing and partaking in new technology. Most financial and security & defense organizations in several countries - Britain, US, Malaysia, Australia, India, Saudi Arabia, and others – have resulted to the use of biometric methods to secure their nations, people, migration, transactions, and every of their international and internal affairs. The fight against terrorism has given wings to BAS and most multinational corporations are joining the league of BAS in securing their assets, Harby et al (2012).

### **Problem definition**

The emergence of Biometric Authentication systems as a form of securing conglomerates, databases and systems has begun to generate questions, reactions and controversies among staff, users, clients and customers worldwide. The study is aimed at:

1. To find out the understanding and acceptance level of BAS;
2. To find out the aspects of religious beliefs that clash with the use of BAS;
3. To determine the extent to which practitioners are willing to defend their beliefs; and
4. To find out how this affects human capital development in Nigeria.

### **1. What is the degree of knowledge and Research Questions**

1. understanding of the people about BAS?
2. What areas or aspects of Religion or traditional beliefs clash with the use of BAS?
3. To what extent are religious practitioners willing to consider, accept and practice the use of BAS?
4. What are the implications of rejection or acceptance of BAS in human capital development?

### **Methodology**

The study employed a survey research design. The population of the study consists of all the worship centers in Asaba metropolis. Stratified sampling technique was used to select a sample of two hundred and five (205) worshippers at ten (10) worship centers comprising of: six (6) Christian worship centers; two (2) Islamic worship centers; and two (2) traditional worship centers. Questionnaire was used for data collection. The questionnaire was a 20-item piece designed by the authors and validated by two computer science educators, senior colleagues of the authors.

### **Results**

**Research Question One:** *What is the degree of knowledge and understanding of the people about BAS?*

**Table1:** Percentage distribution of people's knowledge and understanding of BAS

<b>Peoples level of understanding</b>	<b>frequency</b>	<b>Percentage</b>
Very well	126	61.5
Well	46	22.4
Not well	21	10.2
Not at all	12	05.9
Total	205	100

126 persons representing 61.5% of the population interviewed claimed to have good understanding of BAS, 46 (22.4%) respondents know just well enough, while the

remaining 21 persons (10.2%) have heard but do not understand, but 12 respondents (5.9%) claim not to have any knowledge of BAS.

**Research Question Two: *What areas or aspects of religion and traditional beliefs clash with the use of BAS?***

**Table 2:** Various religious beliefs and their percentage distribution of peoples conviction

	Religious / Traditional Beliefs	Frequency	Percent
1.	Blood is sacred, should not be tampered with for any reasons	205	100
2.	Only God has the right to gather data through blood (DNA)	205	100
3.	Quality of individual blood (DNA) can be endangered or destroyed while taking BAS tests	180	87.8
4.	Worldwide database will lead to emergence of the Antichrist	182	88.8
5.	Biometric data can be used to foretell the future	145	70.7
6.	Personal information which only God should have will be exposed to man.	201	98.0
7.	Unintended identification and exposures	205	100
8.	Exposure of body (for scanning) is forbidden	195	95.1
9.	Removal of clothing and personal handling by strangers (data collection officers) is an abomination	195	95.1

Over seventy percent of the entire population is strongly convinced about their beliefs as listed.

**Research Question Three: *To what extent are religious practitioners willing to consider, accept and practice the use of BAS?***

A total of one ninety two (44.9%) respondents bluntly refuse to submit to bas for the reasons of their beliefs, while thirty five respondents (17.1%) agree to use bas if left with no options. only fifty six respondents (27.3%) are willing to reconsider if they get further information that can lead to better understanding of bas while only twenty two

respondents (10.7%) are ready to accept and use bas despite their convictions.

**Research question four: *what are the implications of rejection / acceptance of bas in human capital development?***

The answer to research question four can only be deduced from the three preceding

research questions, especially three. despite the literacy level of the respondents, it is pertinent to note that about half of the sample population is willing to lose whatever is necessary to stand for their religious or traditional beliefs. This can only point to the fact that they are equally willing to refuse training or to train others in the use of bas. yerkun (2009) cited the united states department for education declaring that "*the age of technology, information and communication rewards those nations whose people learn new skills*". fifty six (27.3%) of the respondents are however willing to reconsider their stand if they get further information to lead to a better understanding of bas. invariably, if the nigerian populace is not willing to follow the pace of other nations in the use of technological advancements, then the human capital development in this area will for a long time to come remain a mirage.

### **Summary**

Nigerians are very religious people. they are willing to hold on to what is known for as long as possible. in other words, they do not easily accept change as it can be seen in the popular saying "this is how we have been doing it". but the study has also proved that Nigerians are willing exploit new frontiers, even though from a safe distance, to move in the global direction. with adequate public awareness, orientation and campaign, Nigerians are willing to participate and enjoy the full benefits of the internet by building and developing the human capital base in that direction. Hhuman capital development in

Nigeria cannot be achieved in this era of e-everything without sufficient level of acceptance of e-security-bas and other paraphernalia of the e -highway.

### **Recommendations**

1. Religious leaders should be enlightened on the benefits of e commerce. This will go a long way in calming the followers on the safety of BAS.
2. The federal government should take a Step further by sponsoring campaign and orientation agencies in teaching the populace more about bas.
3. The school curriculum should be revised to include the use of latest technological advancements in the teaching and learning of all subjects at all level of the education in nigeria. this will inculcate understanding in the people from lower level. practice should come after theory for better acceptance.
4. Use of bas should be restricted to computer networks and buildings or infrastructures requiring high level security.
5. Use of bas should be the end of a sequence of security measures, not the only security measure.
6. BAS should be limited to only those that need it.
7. Users should be well warned and informed about the privacy risks before its installation.

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# Bridging Information and Communication Technology and Staff Professional Development: Case Study of Delta State Tertiary Institutions

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## Abstract

*The reinvention of knowledge with the advent of computers is exponentially changing our life options as well as the kind of educational processes (teaching/learning) required for students to succeed in this new knowledge environment. To thrive therefore in such in a changing world where science and technology have made changes to the way we live and so forth, teachers and students alike must also try to learn and adapt to new ways to teach/learn, how to think and be creative as well as understand how these technologies works. With the advent of these new technology, our schools are populated today, with students who have better understanding of the performance capabilities of these information and communication technologies (ICT) than the many adult teachers charged with the duty to impact knowledge and teach them. Teachers are therefore faced with the formidable task of reinventing schools/classroom for a society and world transformed by ICT – because most of these children have grown with this technology as a natural part of their landscape. The forceful impact of technology which is related to the shift in power structures in schools alongside changing the teacher/student roles have brought about great widespread access to electronic information and knowledge.*

**Keywords:** Constructivism, Rationale, informatics, productivity, meida literacy, lifelong.

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### 1. Introduction

Technology is today, an integral part of our culture because actualizing our current societal goals and those of our generations ahead will be a

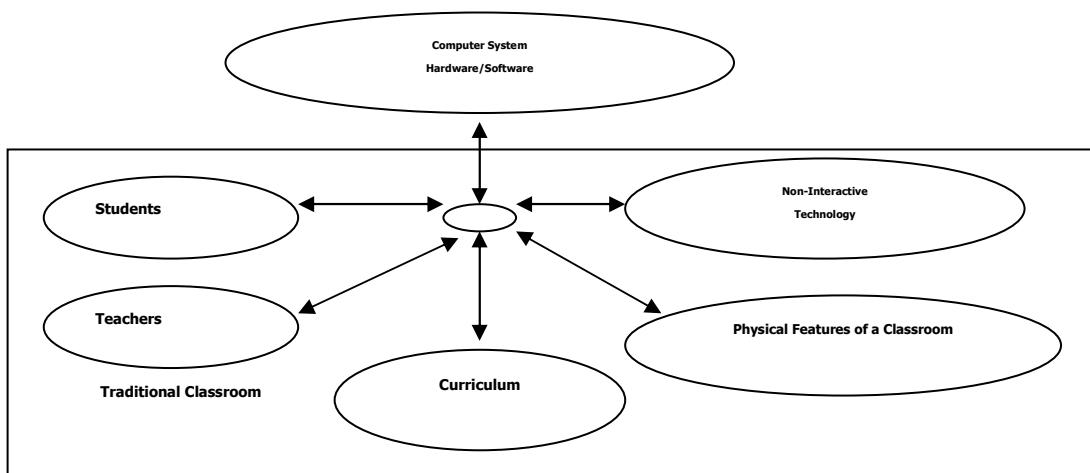
mirage unless we have excellent understanding of it. [1] notes that science and technology have become our heritage and mankind's hope. Thus, the mission of today's

education must ensure students are scientifically literate to cope with technological changes of the *data* age. [2] notes goals of science and technology as:

- (a) to provide preparation for training in science and mathematics,
- (b) to provide basic mathematics and science literacy for everyday living,
- (c) to provide basic skills and attitude to prepare us for technological growth and developments, and
- (d) to help stimulate and enhances creativity.

Education is the art of transferring knowledge from a teacher to learner within a physical environ (called *school with classroom*) and interrelationship that [3] calls a *system* of factors, which jointly affect learning individuals of cultural differences. The classroom

provides the structure in which learning is organized and the school has three major components namely: learner, teacher and administrator. There are basically two styles of education delivery namely ***Traditional*** (a teacher employs face-to-face, oral method in which the teachers pass knowledge to a learner), and ***Alternative Delivery*** (learners can construct new knowledge and meaning from previous concept/beliefs with methods and strategies that involves media literacy. Thus, Alternative delivery is more concerned with what a learner understands as well as does with what he understands rather than the teacher's input; and the use of equipment becomes *focus* of study (technology education) and the educational *support* (educational technology) as seen in figure 1 [2,4].



**Figure 1: a demonstration of constructivist-class model**

The awareness of Information and Communications Technology (ICT) and its integration into education is increasing. Despite the availability of such technological infrastructures and online resources, there is no professional development adopted by the government for teachers, as many teachers have not yet adapted to these new educational reforms for effective learning and teaching in Nigeria.

This key objective of this investigation is to uncover the compelling reasons why technology integration have become a desired goal as well as consider its impact on student learning with teachers taking advantage of these new technologies for their teaching tasks. The teachers concern is not whether integration will yield better teaching results than the traditional processes – because, many research have focused and outlined that even though e-Education is still at its infancy with a few side effects, its benefits can never be overestimated [11].

The intent of ICT learning outcomes is that students should have a knowledge skill and attitude that will serve themwell for entry level, further studies and lifelong learning that will aid them to strive to become inquisitive, discerning and caring persons [Alberta Learning, 2005]. Students must be prepared to understand, use and apply ICT in effective, efficient and ethical ways because technology integration into the Nigerian Educational System

must be cross-curricular and not to be treated as an introductory course, topic in and of itself, since the role of ICT in schools at its best in practice – is receiving a great deal of attention (Ojugo, Aghware and Abala-Odibo, 2006).

ICT requires a considerable change that will enable students take advantage of unregulated online resources, which they can to contribute and extend they share their knowledge with the rest of the society. Leaping into the *knowledge* age is not all about technology integration; but more about changes made in the teaching/learning methods as enabled and required by the new medium – ICT. It also requires thoughtful teachers to face fundamental issues and ask questions such as: nature of literacy and awareness of these teachers in this new hypermedia environment, how do teachers negotiate this new technology and what are their expectations.

The integration of ICT into the educational system has brought about power shift in teacher/student structures equipping students to become the producers of knowledge instead of knowledge-consumers. The issue as for teachers is not whether or not ICT offers a better way of teaching and learning – because ICT integration questions the traditional method of education. ICT has changed forever how people manage

process and share information (Goldman-Segall, 1998). Its integration does not eradicate the presence of classroom teachers – but rather stresses an ever increasing, importance of teachers to take advantages of the unique capabilities of ICT to help enfranchise and emancipate their students, because the framework for measuring the quality of engaged student's learning is grouped into eight categories namely: vision of learning, tasks, assessment, teacher roles, instruction, grouping, learning context and students' roles (Jonassen, Peck and Wilson, 2000; Males, 2006; Ojugo et al, 2006).

For more than a century now and in 2003, Nigeria launched the *CANi* (computer for all Nigerian initiative) project. Then Microsoft and Intel in the same year were to establish five hundred (500) e-schools in Africa. A result of the societal shift/changes made in response to such new medium as it has become a fast emerging force for leveraging educational reforms. Hence, knowledge and learning in the current past share dominant characteristics making it sequential, hierarchical, externally determined and controlled, and compulsory for all (IT digest, 2006; Jonassen et al 2000; Males, 2006). This integration will allow students access to a wide range of information and expertise via the Internet – such that the only for school boards to regain control over the kind and amount of information that students access is via the use of security software. But this on the

other hand, makes the Internet access useless to students and teachers (Clifford, Friessen and Jacobsen, 2007).

## 2. ICT Framework In Education

The provision of modern technological equipment at all school levels varies due to their various levels of preparedness – both by teachers and students. A look at students' ability in obtaining the necessary flexibility in an information age correlates amongst others, level of information setting of schools. This helps to provide schools with various expanse of data in printed and electronic forms via updates, networks and via experts in the informatics field.

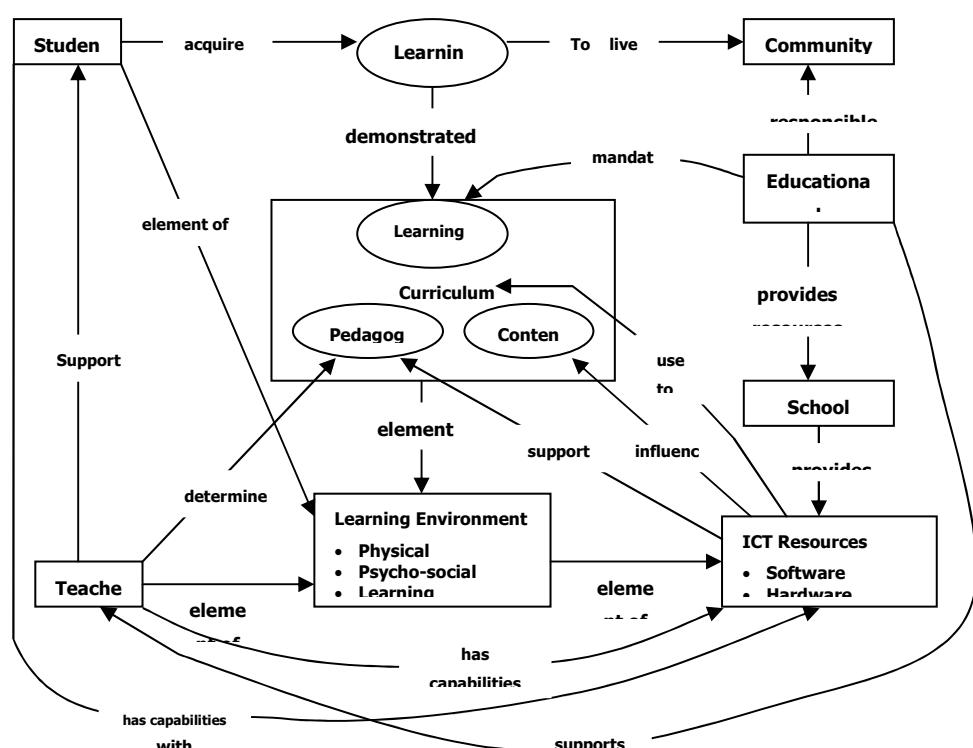
ICT integration into education results in great reforms to the learning process; and educators who advocate such reforms, opines that such learning is informed by constructivism [6]. Constructivism pleads the need for students to develop high thinking skill as opposed to the failure of the current schooling methods to provide such opportunities [7-8]. Thus, a critical factor to ICT integration is **constructivism**, so that learning takes place as the learner completes tasks for which *media support* is required and used to maintain such learning environment and learners [9].

Technology creates ideal learning. Thus, [10] notes it has been ignored or its past implementation has failed widely as it creates a learner-

centered, learning environment with a belief that they learn more from what they do/think rather the teacher's input. We must take care, not to allow the dynamic nature of technology overshadow the enduring nature of learning and ever-increasing knowledge base about learning [7, 4].

[11] notes the concept of **constructivism** as one in which a learner has the ability to actively construct knowledge as he learns. It also emphasizes knowledge as a construction of reality in the learner's mind because knowledge is a dynamic adaptation towards an interpretation of experience. It supports many interpretations to

reality based on knowledge constructed from experience and media-rich class. It focuses on knowledge ***construction*** rather than ***consumption*** – as the learner constructs data from experiences and mental beliefs, interpreting events accomplished outside the mind. We thus see the world we describe rather than describing the world we see. When integrated across curriculum, it provides appropriate level of difficulty due to its tasks that are of real world relevance with engaged-learning and teachers becoming knowledge guides [12] as seen in figure 2.



**Figure 2 shows the concept map indicating the relationship between the learning**

Today's education is transformed by new technologies that provide large amount of data to learners, coupled with the fact that knowledge doubles at increasing speed requiring a transformative method to education. Its challenge is that educators and learners are *suspicious* of the educational practices as it differs from what they are used – as constructivism removes *statewide* assessment, which traditional model promotes by *aligning* tests. The issues of fund shortage, unclear vision to keep the change from occurring rapidly as well as teachers not having a good understanding of how ICT works as they are charged with the duty of emancipating students, are in continual resolution.

This paradigm shift will require teachers to be retraining, role redefinition as well as acculturation to put this systemic change in place – even though it may be slow [13].

[14] presents some known constructivist principles which include:

- Learning is *active* and consists of meaning construction and constructing system for meanings.
- *Language* influences greatly what we learn.
- Learning is a social activity associated with connections the learner makes with others.
- Learning is *contextual* – as learner cannot learn isolated facts or theories in abstract ethereal land, separate from real world situations.
- *Motivation* is a key in learning to help us know how the acquired knowledge can be put to use.
- *Knowledge* is important – as we cannot comprehend new ideas without some structure developed from prior knowledge to build on.

learning is not *instantaneous* but takes time – as the learners must revisit principles, reflect on them and using them as often as possible.

- Knowledge construction is *mental* – since it happens in the mind of the learner.

### 3. New Paradigms: A Constructivism Class

Education, transformed yields the following:

- Shift from whole class to smaller groups
- Teachers coach weaker students rather than all.
- Students become actively engaged, cooperative and less competitive
- Students learn differently than simultaneously.
- Integrate visual/verbal thinking rather than primacy of verbal thinking as in traditional class.

Stakeholders may become *suspicious* of the educational practices as it differs from what they know – because constructivist learning removes *statewide*, *aligned* assessment. Thus, learners will take *standardized* tests, which does not assess *what* they are learning but what new meaning they derive of concept. Class structure will become more *fragmented* and problems will abound due to lack of funds and unclear vision to keep this systematic change from occurring as rapidly as possible.

#### b. Statement of Problem

This investigation seeks to uncover the reasons for technology integration in schools, which has become a desired goal

as well as consider its impact on student learning as teachers take advantage of these new technologies for their teaching task.

### c. Research Questions

The research question developed to guide the researcher is as follows:

#### **Research Question 1**

Is there adequate facilities and funding by the government to aid ICT integration?

**Research Question 3:** Are there educational reforms as well as curricular restructuring to cater for these changes?

**Research Question 4:** Are there technological roadblock towards the achievement of ICT integration?

**Research Question 5:** What professional development programs are put in place to equip teachers of the vast advantages of ICT media when integrated?

### d. Methodology

The research methodology adopted will be viewed under the following headings namely:

#### **1. Sample Population**

For understandability and reliability of information retrieved from the respondents, the investigation was limited to the twelve (12) tertiary institutions in Delta state. From this entire total population, samples were randomly selected from science, social science, business and arts related fields or courses. Two hundred and forty (240) **teachers** and **administrators** were selected for the study, to help alleviate falsehood of results obtained as well as be able to give a fair picture of the entire population.

### **2. Instrument**

Interview and questionnaires were administered to help with collection of data. This was analyzed using a simple majority – to give the investigation true and clear picture.

### **e. Data Analysis And Findings**

Below we discuss the following research questions:

**Research Question 1:** Is there adequate facilities and funding provided by the government to aid and cater for ICT integration?

**Table1:Technology Integration and Educational Reforms**

**Table 1**

Items	Yes
Awareness of ICT projects (NEPAD, CANi) by government alongside introducing e-schools in Nigeria and/or Africa at large with her launch in 2003.	40%
Teachers awareness of technology integration's expectations	45%
Willingness and adaptation to the new scheme by teachers	88%

From respondents made up of teachers and administrators, result findings in Table 1 shows that 40% of the respondents are aware of such ICT introduction of e-schools in Nigeria and Africa at large. 45% claimed to have knowledge of what government expectations are on them with the technology integration in schools; while project plans for technology integration into schools launched in 2003 as well as 88% indicated willingness to adapt to the new scheme.

**Research question 2:** Are there educational reforms and curricular restructuring are in place to cater for these changes and ICT integration?

**Table 2: Curricular-restructuring**

Items	Yes
Awareness of the educational reforms to aid ICT integration	40%
Development of informatics lessons to meet with new scheme	92%
School board, administrators, teachers and IT experts responsible for curricular restructuring	90%
Alternative to site breakdown	38%

Result findings showed that 40% of the respondents are aware of educational reforms (this proceeded from the introduction of ICT projects for technology integration into the Nigerian educational system and introduction of e-schools launched in 2003). 92% made their observations clear of their awareness that government must develop new lessons on informatics to be restructured into the curricular to meet specifications by the new scheme and technology integration. 90% indicated that ICT experts, teachers, school board and administrators must be involved in the restructuring of school curricular; while 38% stated the need for alternative measures in case the sites crash.

**Research Question 3:** What staff professional development programs are put in place to equip teachers of the vast advantages of ICT media when integrated?

**Table 3: Staff Professional Development Plans**

Items	Yes
Teacher's Role awareness with technology integration.	44%
Computer Awareness and appreciation by teachers in the aspects of programming and other concepts/applications.	93%
Professional in-service time and funding	87%
Job satisfaction with the new scheme	75%
Quality of learning	90%

Result findings showed that 44% of the respondents are aware of teachers' role with the new educational reforms and they are aware of what the government/society expects from them – especially with the misrepresentation/misunderstanding of them that they taught technology integration into educational system will make their roles as teacher insignificant. For this reason, 93% of the respondents have undergone computer literacy and awareness training, which has prepared them towards the integration of technology into education. 87% have already made plans towards purchasing of new computers equipment amongst other facilities to aid them fully harness and integrate fully into the new scheme – as government has also started training teachers to aid with the scheme. 75% noted their assurance in that the new scheme will grant better job satisfaction than the traditional method of teaching/learning – though it is a little-bit more tasking than the conventional, traditional approach of education. 90% also indicated that technology integration into education assures a more engaged quality of students learning.

**Hypothesis 4:** Are there technological roadblocks to be expected during this transition?

**Table 4: Technological Roadblocks.**

Items	Yes
Enough time for planning and development of informatics lessons with the integration of ICT in schools	92%
Adequate technical support for ICT integration	54%
Expertise level required for integration and expert's expectations	94%

Result findings showed that 92% of the respondents agreed that there was always time for planning and development of informatics lessons to aid the technology integration. 54% stated that there are adequate technical supports to aid this integration; while 94% responded that they were aware of the expectation on the part of experts that will be required. In addition, respondent were asked to rate which were of utmost importance and their result were:

- (1) Staff professional development,
- (2) alleviation of technological roadblocks,
- (3) Curricular restructuring, and
- (4) Educational reforms. Most of the respondent indicated that the fact that that government has provided the equipment to aid technology integration does not bring about reforms in educational policies.

### Summary

A growing number of teachers are very enthusiastic about adopting ICT, though not all of them are aware of its implication but they are quite sure it will

equip them well enough with the will-power required to help emancipate their students academically, due to the potentials of these ICT tools. The type of professional development available for teachers who wish to develop their technology integration capacity has undergone some changes overtime. The **first** effort is to focus on machine and learning technology skills, which will equip the teachers to move to the next stage.

The **second** effort is the realization that technology integration has less to do with technology itself; but deals rather much more, with the approaches to education. Hence, workshops on teaching with technology will help bring about skills development and also account for large-scale transformation in teaching practices – bearing in mind that teachers are being asked to risk two major changes to their practices of teaching and learning namely:

- (1) Reformed traditional teaching approaches and roles, and
- (2) Technology integration.

The **Third** effort is in staff professional development consisting of online mentorship and support that responds to teachers' individual needs as focused on the present case study, the Nigerian educational system.

### f. Conclusion

This study contributes to knowledge in four broad ways namely:

- (1) its outcome gives a full description of individual, group and organizational adoption patterns of technology for teaching and learning across disciplines at the various school and educational levels, showing the way it can be implemented

- (2) it shows some case histories of adoption decisions and experiences of individual teachers,
- (3) it pictures exemplary practices for teaching, learning and research; and (4) shows evidences linking technology integration, engaged students learning and staff professional development.

The significant contribution to knowledge by this investigative study is both theoretical and practical as follows:

- It increases the understanding and diffusion of ICT innovations as well as the application of its theories and conceptual models in education – showing its potential challenges with the encouraging of widespread adoption of ICT integration for teaching/learning to implement technology outcome curricular across subject areas in schools.
- It highlights a systematic documentation of adoption pattern and characteristics of administrators and teachers willing to integrated ICT with the support of network facilities. The result of the investigation shows that the use of shared instrument for access of widespread information by both teachers and students alike based on the scale of engaged student learning and the stages of technology adoption, will form the foundation for the next step in the planning and implementation processes at each school. This information is useful to all stakeholders in education.

This mode of teaching and learning in its best practices provides the much-

needed images of how ICT integration will be used efficaciously in education for meaningful students learning outcomes – because knowledge of this kind will be useful at the organizational and individual level for the staff professional development in technology integration as well as for further research in such areas.

### **Recommendations**

During the course of this research, some recommendations that were observed and made by the researchers are as follows:

- Government should develop strategies to help fund ICT integration in the Nigerian educational system such as **CANI** as well as provide information and infrastructures of these new technologies – bearing in mind that educational reforms do not come about with just the provision of ICT equipments such as computers in schools.
- Staff professional development programs should be organized as we are often and sometimes caught up in “blame the teacher” syndrome – even when adequate schemes for professional development have not been put in place to help equip these teachers as well as redirect their steps towards the emancipation of these students.

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# **Automated Information Systems for Evaluation of Social Service in Nigeria**

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## **ABSTRACT**

*This research developed information systems for evaluation of social services in Nigeria. The system is to be used by social workers in the long term care of children in the motherless babies' homes. The research has developed a system that evaluates the activities and operation of the motherless babies homes thereby eliminating the problems encountered in the home. The system is capable of detecting the problems with view to modifying the operations and developing a new computerized evaluation system that will be more efficient and accurate. The system will be used to record, store and retrieve a large volume of data. The system developed will reduce duplication of efforts due to inconsistency in activities and time that it takes in search of files when it is required for processing. The system can be used by individual staff to plot their caseload activities and by management in considering problems of resource deployment. The system consists of Assessment Document, Periodic Case Reviews, an Evaluation Chart and Costing information. This study also provides guidance on all stages of the design and implementation of an evaluation system for social services in Nigeria and presents the main options with respect to scope, key research issues and organization. The unique contribution of the study is to solve the problems involved on approaches and operations in the field of social service work. It has been implemented using an internet web-based system that helps in evaluation of various activities and operations of the social service workers in the motherless babies homes,*

**Key words:** information systems, social services, social workers, resource deployment, internet web-based system

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## **Introduction**

The need for an effective evaluation system care service has become inevitable for any social service related sector and will be able to take challenges coming from the dynamic nature of information technology. To

decrease these challenges in the social service sector where paper work and waiting lines are increasing, it demands team work of all social service personnel to help them in immeasurable ways. Record keeping is

the principal repository for information concerning motherless babies home. It affects, in some way, virtually everyone associated with providing, receiving, or reimbursing social care services. Despite many technological advances in social service centers over the past few decades, the typical orphan record of today is remarkably similar to the orphan record of 50 years ago[1]. This failure of orphan records to evolve is now creating additional stress within the already burdened Social service care system as the information needs of practitioners, social service workers, administrators, third-party payers, researchers, and policymakers often go unmet. An institution like motherless babies home encounter problem in the area of documentation and evaluation of documents which include misplacement of vital information or cases as a result of the services that are available or rendered.

This study presents the steps necessary to manage data gathering, data analysis and data use which focus on the wellbeing of the children in the motherless babies home. When such information about an orphan or record about the activities of the home is needed, duplication of efforts due to inconsistency in activities and a lot of time is taken in search of file or reported cases. The problems that exist in the motherless babies' home can be summarized thus: Usually for manual filing system, there is no limitation on who can access the files. Anyone can change the record and this may cause trouble in the future. Using manual filing system, data are kept in file according to the year or may be randomly scattered. This may take time to search for information needed in time as the staff may have to look for the one by one and other related files just to search for single information. In manual file system, usually there are data redundancy and inconsistency. This is

because some data may be stored in various files as they are related with each other. This also causes data anomalies because redundant data are changed/updated in one file but not in the others. Manual file system has no backup and if a file that contains vital information is lost or damaged due to fire, the motherless babies home will lose her valuable information. There have been numerous reports of funds being misused or mislabeled especially in state owned motherless babies homes so as to be channeled into private pockets.

The biggest issue with the mismanagement of fund is unequal distribution of workers salaries and wages[2]. Due to poor documentation of an orphan record, children are being reported to be missing without trace from the motherless babies home. These are actually the problems that are discovered in the existing system that promoted for this research work for the system development for social service and motherless babies homes to work more effectively and also help the social welfare services to monitor and evaluate the activities and operations of the motherless babies home. The system developed will help social service workers and motherless babies home to implement and evaluate best practice approaches for existing and new intervention programs which will use information will use information technology to improve the social condition health, development and quality of life of vulnerable children and orphans. The new system will also give support and guide to adopting families as they go through the pre and post adoption processes.

## **Background Of Study**

Clearly the use of evaluation system in social service practice is highly contingent upon local policy implementation, the local arrangements of services and everyday practices of busy and skeptical practitioners when it comes to their role in critical and creative thinking, Obadare, E.[3]. Even so, it seem that the introduction and application of ICT and evaluation information system in child welfare has been driven by attempts to improve management information system and to increase the accountability and surveillance of both practitioners and children, young people and families with whom they work. At the moment, there is no unique evaluation information system or IT management system for evidence of social services beneficiaries and social services. It should be noted that although the systems being used now are very similar, there is also no standardized procedure or organizational hierarchy that can be find among the Social Work Centres (SWCs). SWCs currently use simplified desktop based system for keeping analytical records needed by the Institute for social activities.

The operational work is mainly managed by hand or via standard office application tools. None of these databases are connected across SWCs. Patel, L.[4]. The lack of a centralized database creates many operational problems. Most significant operational problems are: Lack of validation on offered services allows for the possibility of multiple requests for services in behalf of recipients in multiple locations around the country. Lack of high-level security measurements on local databases allows for illegal database modifications without the possibility for tracing these changes. Current database structure does not allow any data queries for analytical, budgeting and forecasting reporting. The need for a common repository for Business rules is needed to control indiscriminately

approvals/denials of services and easy system maintenance and system updates with new policies and procedures. In many ways, the current literatures on the use of ICT in child Social service is in sharp contrast with the rapid and creative use of ICT where increasingly people seem to find it more satisfying and preferable to discuss some of the most difficult and intimate part of their lives via computer mediated communications rather than through face to face discussion. Most of the discussions and researches made on the development of evaluation system for social services especially in the motherless babies homes end up theoretically and some ended up in the use of general purpose computer programs in the social service welfare or the development of a stand-alone system without access to the internet or cannot be shared on a network,[5].

This research focuses on the design and development of a web-based evaluation system that can be viewed from any part of the world by whoever can have access to internet facility but certain areas of the portal will be accessed by only authorized persons. This system will offer opportunity to change communication in ways that will have direct and very positive possibilities for child social welfare. What seen particular attractive is that such services offer the possibility for a greater degree of confidentiality, something which is very important if children and young people are going to access services provided by the system,[6]. This social service evaluation system will create opportunities that will enable people in a socially disadvantaged situation an access to all services provided by the institution possibly to live in the own home environment to maintain meaningful relations with other people. Computer evaluation provides a judgment based on assessments of relevance, appropriateness,

effectiveness, efficiency, impact and sustainability of development efforts. It involves a rigorous and systematic process in the design, analysis and interpretation of information to answer specific questions. It highlights both intended and unintended results, and provides strategic lessons to guide decision-makers and inform stakeholders. Though evaluation can provide critical inputs to evaluation by way of systematic collection of data and information, yet an evaluation system serves a complementary but distinct function from that of a evaluation system within a performance management framework[7].

## Materials and Methods

Structured systems analysis is used in this study for the development of social service evaluation system because it is a more methodological approach to software design and it proposes structural methods which are sets of notations and guidelines for software design. It involves the specification of procedures and methods for collecting and analyzing data necessary to define or solve the problem for which the research is embarked upon. The scope of the research covers the activities and operation of the motherless babies home as well as the well being of the orphans. This research focus on the pursuit for truth with the help of study, observation, comparison and experiments i.e. systematic method of finding solution to a research problem identified. The process of this research work is a systematic method that includes the following in logical sequence: Enunciating or defining the research problem, Formulating the hypothesis/research question from the research problem, Designing the appropriate research process, Collecting facts or data to help answer the research question, Analyzing the data, Reading certain conclusions from the analyzed data hence

answering the research question. To achieve the objectives for this study, system analysis was carried out on the case study (Motherless babies home).

The System analysis carried out on the case study provides a contextual overview of a particular condition of social service work at a given point in time. Structured system analysis covers all the processes of gathering, analyzing and using information to guide, plan and mobilize action. It can also provide an objective measure of the well being of children in the motherless babies home because it is directly tied to the programming objectives or indicators and it is based on independent methodology and a participatory approach. A cross sectional research study was adopted because the research project dealt with a case study. A case study was used as a means of research because it helped with a focused analysis and steady. In cross sectional studies, subject variables are measured at a single point in time to study information. The advantages which arise from cross sectional studies include short duration, relatively in expenses, subject dropout, not a problem; can study several outcomes, better control over subject selection and measurement. A system analysis using the systematic approach examines a business situation with the intent of improving it through better procedures and methods. The systematic approach used in this study was the system development life cycle (SDLC) which is a phased approach to analysis and design that hold that systems are best developed through the use of a specific cycle of analysis and uses activities,[9].

In the study of the children living and the activities to the motherless babies home, documentation, internet, interviews and observation were mainly used as fact-finding methods. In a bid to ensure correctness of the collections and to better

understand the constraints of the traditional libraries, the researcher reviewed various methods used to avail collections to users, with the intention of discovering strength and weakness of the system. Challenges met when using the manual system were reviewed and steps were taken to ensure that they are either eliminated or reduced in the proposed new system. To obtain quality data, a situation analysis is used and it requires attention to details and procedures. The techniques and tools presented in this research work are based on a process that uses the data gathering methods. However, not all of these methods are appropriate for all analysis. The most critical consideration is to determine which combination of data gathering techniques will ensure that the analysis collects enough and the right kind of information to mobilize action.

### **System Design**

To examine understand and interprets the magnitude and nature of the problem in the motherless babies home, potential support system and care, and the social conditions of the children in the motherless babies home, this study draws a qualitative research approach. This approach contributes to the process of reconstructing research knowledge as the researcher observes records, describes, interprets and appraise settings as they are[10]. Within the context, qualitative researchers interacts with participants such as orphans and their careers as they attempt to understand and make sense of the social world/natural setting and activities being carried out on the existing system from the perspective of the targeted participants. Because of the setbacks of the existing system, a new system is proposed that will eliminate or reduce the problems encountered in the current system. From investigation and analysis, the new system will provide users

with all the relevant information about the new system and adequate security of the data stored and data in transit and also the data stored will be incomprehensible to unauthorized persons. The new system will be computerized using a web portal service and it is aimed to improve the speed, integrity, quality and accuracy of services.

However it is good to note that many roles of human in the manual system could be automated. The justification for the new system includes; Timely staff and child record registration, Timely processing of information, Error free processing of data, It is inexpensive to administrators, Transaction is secure (Authentication), protects records/documents using password, It is cost effective, Easy decision making, Easy backup or duplication of data in disk in case of data loss. At the moment, there is no unique evaluation system or IT management system for evidence of social services works in the motherless babies home. Motherless babies' homes currently use simplified desktop based system for keeping analytical records needed by the Institute for social activities. The operational work is mainly managed by hand or via standard office application tools. None of these databases are connected across different SSCs or with the Institute for social activities in Nigeria. The Motherless babies home and Centres for Social Service Work will use the evaluation system for Social Service for their everyday work. They will be mainly concerned with the input of operational and analytical data regarding to the social welfare service beneficiaries. Since they operate with private and sensible data, there is need for the security policies and user roles for accessing and manipulation with that data is obvious.

The newly developed communication infrastructure within the social service is based on IP protocol, and on the basis of

that choice, all sites will be supported by appropriate TCP/IP connection. The network infrastructure will ensure the connection between the components provided in the various domains and the other systems that need to interface to the Social Service evaluation Information System. In order to achieve the objectives of this development of Social Service evaluation system, the System must be based on the Web based System Architecture. This approach typically include: Web Server – for rendering the client presentation, Application Server – for support the service logic, Database Server – for supporting data management: Security and/or user domain server – for integration of various security policies. The only necessity for the evaluation system to run is a JavaScript enabled browser. Applications are designed to use XML as a data interchange methodology[11].

The social service evaluation system will implement XML as a data interchange process and the use of XML would provide the following advantages: A standard means to exchange information between different systems and A standard way to query data from different systems. The system XML must state the standards and protocols deployed for the purpose of electronic data exchange. The evaluation system for Social Service incorporates informative website to the web portal explaining the available Social Services and documents they need in order to apply, view services and general activities of the home. The web site will also enable sign on for all functionalities of the system. At access level, Social service network information system will have two users: external users using web based access over https enabled internet connection, and internal users using web based access over intranet. It should be noted that there might be more than one system that will be access

using the same client machines. Thus, the security enabled web based access is recommended for the intranet users as well[12].

There are three important processes that must be considered within Social service Network system: e-request processing for external users, e-forms processing and communication with Social welfare service system. The reporting tool for the evaluation system for Social Service provides OLAP or OLAP like functionality. OLAP Stands for "Online Analytical Processing." OLAP allows users to analyze database information from multiple database systems at one time. While relational databases are considered to be two-dimensional, OLAP data is multidimensional, meaning the information can be compared in many different ways. The system will be developed to take into account the following considerations: it is currently anticipated that the evaluation system will permanently store the multimedia data; and databases will have to provide the storage needed for auditing logs. The high criticality and confidentiality of the data in the evaluation system requires a high level of safety. It is essential that all aspects of security are considered, evaluated and integrated in the provided solution. The requirements are based on the ISO 17799 standard, Information Security Management System and Regulative for technical and organizational means for providing security and confidentiality for personal data manipulation.

## Network security

The control of passwords, installation and management of firewall systems should be provided. It is also recommendable to provide a complement to traditional firewall protection, in form of mechanisms to detect attacks, intrusion and strong authentication.

## **Logging and evaluation**

Actions that have to be logged are:

- All database modification requests (Creation/Update/Deletion);
- All queries; and all answers to queries, including no Hits;
- Data dumps, database restorations and repairs;
- All communications between the SoSNIS and the other systems;
- All User and logons and performed actions, as well as failed or unauthorized logons.

## **Confidentiality of communications**

All communications between the SoSNIS to the end user workstations and other systems will be confidential and protected. It is therefore necessary that this traffic is encrypted so that, even if intercepted messages, which cannot be accurately interpreted

## **Implementation**

The requirements of the development of Social Service evaluation system for motherless babies home website system demands that a capable programming language can be used for its implementation. Hence PHP was chosen.

## **User Interface and Mark up**

There are several technical areas to consider with regard to a site's interface. Obviously the site's visual appearance is important. It is also important that

information is presented in a logical manner[3]. As such it is vital that web pages are produced using valid HTML mark-up, and that the HTML code accurately describes the content. Cascading Style Sheets (CSS) are used to control the styling of your site. This enables presentation to be separated from content, and also allows you to have control over the presentation of all pages within your site from one central point. The web portal evaluation system for social service is developed to function correctly in range of browsers across all platforms like (IE6 and above? Safari? Firefox? Netscape Navigator 4?). The range of screen sizes is also considered in the site's design to all the site work in different screen resolution.

## **Results and Discussion**

Changing from paper-based to computer-based systems can be challenging for social service agencies. This has to do with the complexities of using these systems in conjunction with the helping professions. For instance, technology vendors are used to working in the corporate world and the programs they sell may not fully take into account the intricacies necessary to ensuring confidentiality and streamlining client information. Similarly, the cost of new technologies may be beyond the budget of many social service organizations, particularly those that operate not-for-profit.

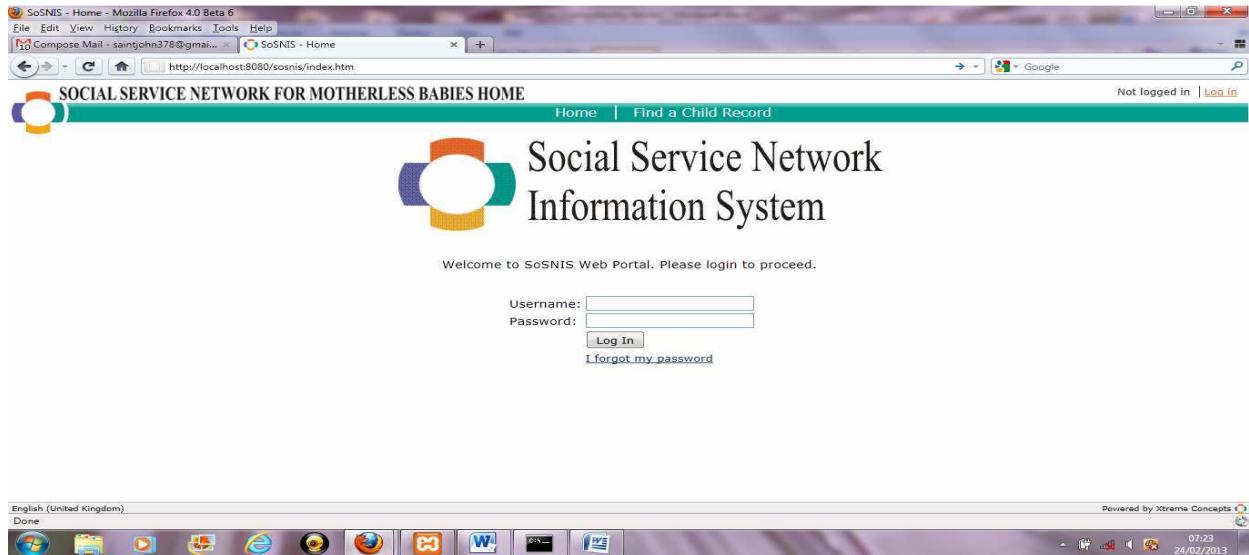


Fig. 1:

However, when organizations find the right fit, these transitions can be successful and beneficial overall for both the organization as well as the clients. The field of social work faces a critical need to incorporate ICTs into training social workers, delivering social work services,

and the conduct of social work research. It is clear that ICTs, when thoughtfully and effectively used, can improve the various practice methods of social work (i.e., delivery of services, education, and research).

SoSNIS - Find Child - Mozilla Firefox 4.0 Beta 6

File Edit View History Bookmarks Tools Help

Compose Mail - saintjohn378@gmail.com SoSNIS - Find Child http://localhost:8080/sosnis/findChild.htm

Home | Find/Create a child Record | Dictionary | Administration

**SOCIAL SERVICE NETWORK FOR MOTHERLESS BABIES HOME**

**Child Search**

**Find child(s)**

Child Identifier or Child Name: Enter the child's name or id

or

**Create child's record**

To create a new child's record, enter the child's name and other information below first to double-check that they don't already have a record in the system.

Person Name:

Birthdate:  or Age:   
(Format: dd/mm/yyyy)

Gender:  Male  Female

English (United Kingdom) Powered by Xtreme Concepts Done

07:29 24/02/2013

Fig. 2

SoSNIS - Child Dashboard - Mozilla Firefox 4.0 Beta 6

File Edit View History Bookmarks Tools Help

Compose Mail - saintjohn378@gmail.com SoSNIS - Child Dashboard http://localhost:8080/sosnis/childDashboard.form?childId=4&phrase=john

Currently logged in as John Ezeafulukwe | Log out | My Profile

**SOCIAL SERVICE NETWORK FOR MOTHERLESS BABIES HOME**

**John Ezeafulukwe** Old Identification Number: **10135**

27 yrs (~ 01-Jan-1986)

BMI: ? ( weight: , Height: ) CD4: | Regimen:

**Child Actions**

**Programs**

Program	Enrollment Date	Location	Completion Date	State	Outcome
MDR program	07-Jan-2013	Unknown Location	Still enrolled		(None)
<a href="#">Add a new program</a>					

**Relationships**

None

[Add a new relationship](#)

**Allergies**

Done

Fig. 3

The system developed and presented in this study will serve as a Web based record keeping/document management system which is an electronic system used by organizations to keep a track record of their electronic documents. The programs are designed in such a way that storing, management, retrieval and archiving of documents can be done in an easy manner. These are seen as the benefits of internet web portal which this new system presents:

- It saves a lot of space as this system ensures paperless office and workstations. The files and documents are saved in electronic format, thus depleting the need of physical record keeping system.
- Since many people just keep one file or record in their office which increases its risk of getting lost, web based document system allows saving of files and records online, thereby reducing the possibilities of data theft or misplaced.
- Since document management is done electronically and there are no physical files or records, the electronic documents will not get lost or damaged.
- There is no need for any type of technical support, up gradation, maintenance and other services because most of the document management systems have these in-built features.
- This system allows better control over record keeping and files.
- Various departments of the social service can coordinate and communicate while accessing the data and important records from anywhere and anytime.
- This system allows faster retrieval of documents and records.
- This system reduces the operational and administrative costs of the social service centers and the productivity of the employees increase because of the hassle free paper work job.
- This system allows access and control of document based processes like invoice making, salary sheets, debt collection charts, pay slips and many other documents.
- The social service evaluation systems is an online program and so is well equipped that it takes a back up of the document in multiple ways by the time the document is saved. So there are absolutely no chances of losing any data record or file because of the data recovery system featured in-built in these programs.
- The documents can be secured by conducting timely audits and giving a password account to those employees who have the authority to access and update any document in the program.
- Any document can be locked easily by the administrator if he or she does not want other employees to make any changes in the file.

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# **Enhancing Cooperative Loan Scheme Through Automated Loan Management System.**

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## **Abstract**

*The concept of automation has been variously applied in most computing fields. This involves utilization of computing or electronic devices to undertake the tasks that are being handled by people. It is a pertinent factor in a profitable and soundly run financial institution. Financial transactions through manual system of operation are prone to errors and unimagined complexities, making it so difficult a task maintaining all entries of users account, search records of activities, handle loan deduction errors and generate reports. Computers running automated system are targeted towards eradicating the menace – hence making the underlying activities efficient and providing the fast response needed. This underscores our interest in deploying a dynamic system that will effectively manage the loan scheme of a named organization. The system essentially manages both short-term and long-term loans, and keeps track of cash inflow and outflow of a cooperative society among others. It utilized SQL Server database architecture at the back end and Visual Basic.Net framework at the front end. This makes it user-friendly and highly interactive. The Object Modeling Technique (OMT) is adopted for the analysis and design of the Loan Software. Interactions with operators and stakeholders and thorough observation of records of activities/events of time, aided the gathering of the required information. Auto-LMS is an innovation, which is bound to bring swift changes in routine cultural loan practices of cooperative societies as it promotes efficiency and productivity. A pragmatic system bundles with several competent capabilities to eliminate data inconsistency and redundancy as well as ensuring data integrity and security, with guaranteed fast retrieval response time.*

**Keywords:** Status Concept, Ledger, Automation, Amortization schedules. Mortgages, Collateral.

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## **Introduction**

The advent of computer technology has salvaged mankind from the dark ages imposed by non-availability of technological know-how and requisite skills for undertaking tasks. Today, technological dynamics can be applied in virtually all facet of human endeavor to beat down complexities with relative ease and achieve maximum productivity even faster. According to Mbam<sup>[1]</sup>, the application of computers to the various facets of human endeavors has improved

those professions by reducing the time needed to accomplish a given task and hence maximizing productivity and throughput therein.

Hence, the need for an automated system that is competent to harness and manage the operation of any cooperative society with same or similar features.

## **Background of study**

An automated system therefore, is a system designed to take in data and process it using a predefined format, thereby generating the expected result. Loan management system is being designed to automate the back office activities of financial institutions offering different types of loans.

Depending on a company's requirements, loan transactions can be subdivided into product types, which can define specific forms of loan or business areas. You define the product types in customizing for loans according to your individual requirements. Also, assign each product type to a product category and condition group.

The inherent risks, inconsistencies and errors associated with manual financial transactions and computations demands the use of automated system for simplicity of operation, accuracy and proven results.

Information technology era provided gateways to streamline the daily financial transactions of various financial institutions. Therefore, such contentious issues as:

- Time/speed of data operations (i.e. processing and transmission);
- Errors in computation;
- Menace of excess deduction of loan repayment;
- Difficulty in maintaining all entries;
- Difficulty in searching a particular record or group of records;
- Poor and irregular report generation for all transactions are adequately addressed.

These factors have indeed hindered effectiveness, efficiency and overall performance of the scheme. But the system in focus took on these factors - enthroned the desired flexibility, ensured that credibility and integrity of data is highly maintained.

According to Wayne [2], to truly manage or operate effectively, you need the requisite skills that

make for attainment of established objectives. Therefore, as a loan manager, it is critical for you to possess industry expertise to assist your chief executive officer and staff in planning. It is equally as important to maintain the technical expertise needed to design and administer systems and controls to carry out policies and required compliance with laws and regulations.

## **Methodology**

The Object Modeling Technique (OMT) is considered most suitable form of methodology in automating the system in question. Osuagwu [3] posits that this methodology deals with object oriented development in terms of analysis and design of a given system . It enhances clarity of the problem and brings out definite concepts associated with this problem domain. The problem in view has to further reflect object, dynamic and functional models which represents system architecture, interactions (creating events) and methods of data operation respectively. OMT helps to model a system in such a way that one can easily manipulate the objects to interact appropriately. It encompasses the structured, information and object-oriented analysis and design.

Moreover, it enhances adequate representation of the system architecture, extracts the objects and gives rise to a design based on these objects. This helps to define concisely the problem in focus, develop solution strategies, identifies and extracts each of the modules and objects (which now form the data structures) in its reasonable smallest comprehensible unit. And finally, the model specifies the appropriate operation to be carried on each module and perform the detailed design.

## **Structural Analysis**

Ideally, any cooperative society would basically draw her income from membership registration fee and routine savings contribution of the members over the months. This savings are separated into

project and ordinary savings. The ordinary savings which is a fixed amount is mandatory for every member and it is non refundable, while the project savings is according to the varying salary capabilities of members which can be re-embossed as condition applies.

These contributions are however traded with through giving of loans and stocking goods so as to enhance the financial income of the society and from whence they calculate the benefit of an individual based on the amount so contributed on a monthly or yearly basis.

#### **Conditions/ Modus Operandi of Loan Scheme**

Beneficiaries of the loan scheme must be permanent staff of the parent establishment.

Also, the beneficiary must be a registered member of the society who must have saved not less than thirty five percent (35%) of the loan amount being

sought for. Products offered in the scheme include short term and long term or project loan. While the short term loans run on a maximum of three months, the later runs a maximum of 24 calendar months with a definite percentage interest respectively. Loan repayment is evenly or equally distributed to span through the number of months allowed. Deduction is effected through standing order from the society's coordinator to the accounts department of staff employer.

#### **Data Flow Diagram Analysis**

Data Flow Diagram (DFD) shows the way data is moving within the system. It essentially helps users to understand how the system works and probably suggest necessary modification(s). The system operation is summarized in DFDs level 0 and level 1 thus:

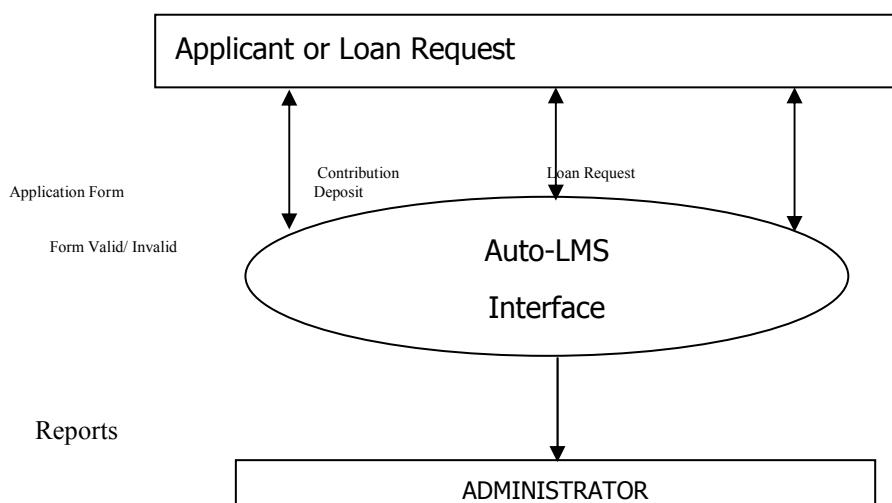
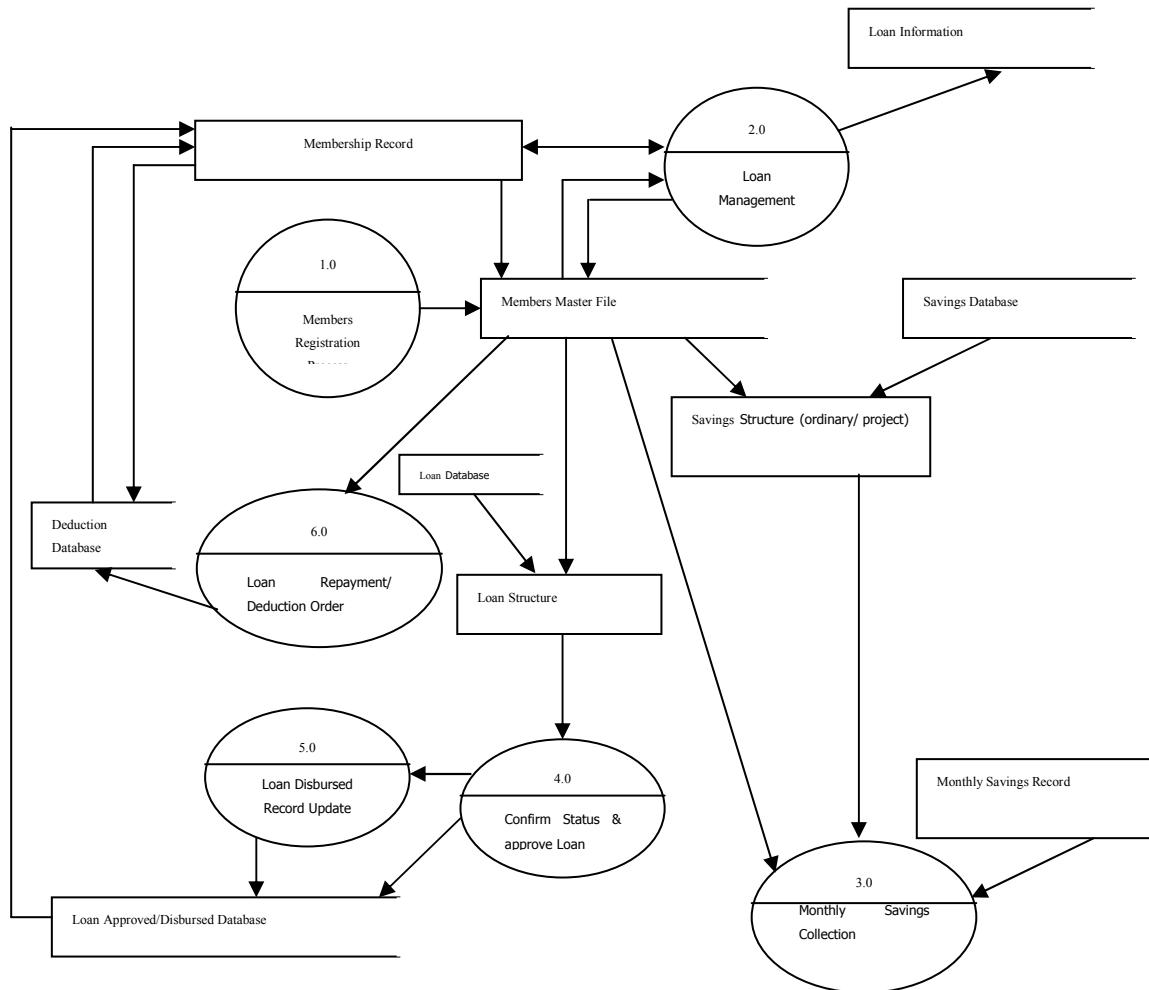


Figure 1: DFD of the model

This DFD is the block summarization of the steps of action involved in the system

showcasing the LMS interface as the central controller.



**Fig.2: Data Flow Diagram Level 1**

The level 1 DFD elaborately described the stages of transaction processes involved in managing a loan facility. In detail, it undertakes the entire task of loan processing utilizing information contained in the member master file. Prospective benefiting member contribution (saving) status and product type being sort are ascertained before loan approval and disbursement is accordingly effected. Each complete and or waiting transaction(s) is captured and validated through appropriate module.

## Discussions

### ***Basic Principles of Loan Scheme Operation***

- a). Contract conditions form the basis for the contractual relationship. The conditions are used to generate planned records, which are required for processing loan receivables and payables later on.
- b). Loans Management uses the status concept to reflect the various stages of the contract process (prospective customer through to conclusion of a contract).
- c). In the loans area, central business partner management offers functions for assigning business partners to loans in specific roles (for example, main borrower or lender, guarantor, issuer). You maintain the business partners in the same way as for the other Treasury areas.
- d). Enter details for important real estate objects and other collateral in the system, including guarantees, pledged securities and encumbrances.

## **Integrated Financial Accounting**

The accounting processes for loans are supported within Loans Management. There are manual and automatic functions for generating debit items, and functions for transfer postings and portfolio valuation. In addition to keeping the sub-ledger, the component offers open item management. The relevant posting information is transferred to Financial Accounting via an interface. Incoming payments to the system is unable to assign to an appropriate

customer account are posted to rejection accounts, while advance payments and overpayments are posted to the relevant customer account. You can then process these payments manually using the incoming payment post-processing functions.

## **Transaction Management**

You can enter rudimentary data from prospective customers or concrete inquiries for specific contract conditions. The flexible condition structure allows you represent complex interest and repayment terms. The task of drawing up standard contracts is supported with predefined condition tables and reference loans. Once you have calculated the credit standing, assigned collateral and objects, and where appropriate, calculated the collateral value, you can add any missing information before you conclude the contract. Thereafter, you disburse the contract or consignment fully. Additional process security can be incorporated by linking release requirements to the process steps. A filed documents facility is available for managing all the documents relating to a loan.

## **Implementation Resources**

For proper system integration and alignment, the front end/GUI tool is **Visual Basic.net** framework ideal due to its object-oriented nature which uses event-driven concepts:

- To avail easy creation of graphical and user-friendly interface as a window-based system.
- To bring about interactivity by exploring the key features of Microsoft windows - Multiple Document Interface (MDI), Object Linking & Embedding (OLE) and Dynamic Data Exchange (DDE).

Also, **SQL Server 2005** database architecture is used at the back end as a Relational Data Base Management System (RDBMS) used in primary data model for commercial data processing applications.

It runs on Windows OS (2000, XP, Vista, Win. 7) environment at minimum and hardware requirement of any Pentium Processor, 128MB RAM with 40GB HDD at minimum.

### User Interface

Usability of an application is greatly dependent on the interface. It is the link between the system

and users. Onu [4] asserts that the effectiveness of any system depends partly on how it relates with the user and partly on how robust it carries out all computations accurately. User interface is perhaps the most important aspect of an application and certainly the most visible, presenting the entire system at a glance.

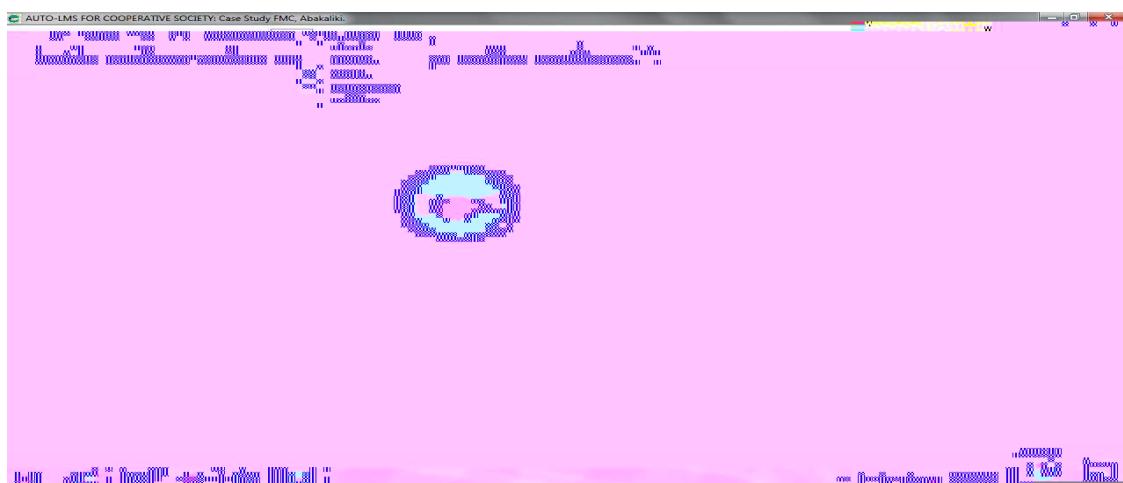


Fig4: Auto-LMS Menu Interface

Fig. 4 above is a menu-driven highly interactive and user-friendly interface that insulates the user from the underlying technology.

### Results

The system is bundled with enormous benefits outlined thus:

1). **Manages Loans More Effectively:** Loan Management System tracks loans payable or receivable from the application phase through daily processing and reporting. An Integrated system that allows you to accrue interest, make or receive payments and manage your loan portfolio.

#### 2). *Find and search records of information with ease:*

The system has the capacity of reporting information for decision making about members of the society, savings status and loan scheme facility among others. It accesses the data you need with an intuitive graphical user interface similar to the standard Microsoft Dynamics SL interface. Transactions are seamlessly integrated and posted to the accounting system under your control. It enables you to create your own reports or use one of the many standard report formats that come with the system.

3). **put your information to work:** Track loans from the application process, through approval and processing with high efficiency.

**View Loan Schedules**

Membership ID	1001	Surname:	Ude	Department:	Clinical
Loan Number	100	Firstname:	Joe	Phone No:	08075875757
		Middle Name:	O	File No:	67676

Payment No	Monthly Payment	Cumulative Payment	Balance	Date Due	Status
1	41667	41667	958333	Apr 03, 2012	UNCLEARED
2	41667	83333	916667	May 03, 2012	UNCLEARED
3	41667	125000	875000	Jun 03, 2012	UNCLEARED
4	41667	166667	833333	Jul 03, 2012	UNCLEARED
5	41667	208333	791667	Aug 03, 2012	UNCLEARED
6	41667	250000	750000	Sep 03, 2012	UNCLEARED
7	41667	291667	708333	Oct 03, 2012	UNCLEARED
8	41667	333333	666667	Nov 03, 2012	UNCLEARED
9	41667	375000	625000	Dec 03, 2012	UNCLEARED
10	41667	416667	583333	Jan 03, 2013	UNCLEARED
11	41667	458333	541667	Feb 03, 2013	UNCLEARED

Total Amount Paid: 0.00      Balance: 1,000,008.00      **Print**      **Reset**

Fig.1: Loan Repayment Schedule Report for a Beneficiary

Assess fees for late payment or write off balances as necessary. Loan Management System will generate amortization schedules; automatically allocate payments between principal and interest, and print checks, payment receipts, or statements.

4). **Integrate powerfully:** Highly dynamic in terms of exchanging records of members. Empower your business by combining the Loan Management System with the general ledger, personal ledger and accounts repayment or deduction modules, ensuring accuracy while reducing redundant data entry.

### Performance and Capacity Planning

Ensuring optimal performance of automated systems is critical to customer satisfaction and profit maximization. Achieving optimal

performance is not one-time event, since automation creates on-going, shifting loads on your computing infrastructure.

Therefore, to be proactive, it requires a means to both measure performance and plan sufficiently for the future so that your computing infrastructure will meet the demand of automation. Effective performance management and capacity planning for an automated system depends greatly on the ability to understand the system in terms customer orders received per day/week/month/year as well time spent processing an order.

Moreover, understanding an existing business activity trends, as well as the timing of new products launches or sales and marketing promotions, will help in anticipating plans for increased computing workloads. For a better insight, evaluate such critical questions as:

- Do your performance management and capacity planning processes enable you to identify if performance problems are rooted in unanticipated business activity (i.e. demand for product, new product launch, and sales promotion)?
- Can you correlate your business activity to both computing resource requirements and response time requirements?

### **Security Support**

Security is a critical component of not only an automated system but for all applications, either software or hardware. This is primarily driven by these reasons:

- To make the users and other customers believe that they can transact with you on trust on a reliable system.
- Ensure that the use of automated system must not by any means compromise their financial or social relevance.

Suitable security policies and practice should be based on the drivers for the automation, regulatory requirements that must be adhered to and other level of risk acceptable to the society. So, where automated applications are critical to financial and or business corporations, security violations will tantamount to loss of millions of funds. Hence, the obvious need for an end-to-end security that will be consistent with the demands of an automation process so as to avert security breach. Security system covers all layers of the automation environment especially the database.

Apparently, automated system security can be considered in the perspectives of authentication, access control, data integrity and confidentiality. Unauthorized users are avoided through authentication process of both internal and external users. It is also vital to create enforceable access control across the automated system architecture. Modify access control from both a user and administrator perspective considering controls on legacy system on which the automated device relies upon.

Accuracy of data, relevance and timely delivery characterize data integrity. Virus protections using firewalls technologies create adequate measure for securing and validating data from malicious mix.

### **Conclusion**

With utmost amazement, the realities of ICTs, the rich potentials of VB.net and SQL Server-2005, created a credible and viable alternative for managing loan scheme facility. Auto-LMS is indeed a concept of the now, a swift change in routine cultural loan practices.

A pragmatic system bundled with several competent capabilities. The underlying technologies and software engineering principles created a broad door of transition to a world of accurate and/or error-free computations, error-proof operations, onscreen transactions/report generation, and fast retrieval of records.

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## **Section C**

# **Management, Social Science Research and Production**

# **Financial Intermediation and the Nigerian Economy: A Time Series Analysis.**

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## **Abstract**

*This paper examines the level of development of financial intermediation and how it impacts on economic growth of Nigeria. Using a time series data covering a period of 40 years (1970 – 2009) and employing the econometric tool of Ordinary Least Squares (OLS) and cointegration analysis based on Engle Granger cointegration theory and error correction methodology, we tested both short and long run relationships between financial intermediation and economic growth in Nigeria. The result revealed that a long-run relationship exists between financial intermediation and growth during the period of study, the result further showed that credit to the private sector, and money supply deviated from *a priori* use case while the other regressors (financial deepening, interest rate, credit to public sector ) conforms to *a priori* since they appeared with correct signs. On the whole only 48 percent variation in growth of the Nigerian economy is determined by financial intermediation during the period of study implying that financial intermediation is weak in stimulating investment and growth of the Nigerian economy during the period of study. However, the weak correlation between the dependent and the independent variables could be attributed to the high level of instability witnessed in the financial sector with its attendant consequences on the domestic economy within the period of this study. Based on the findings, the study recommends a reduction in lending rate, increased volume of credit to private sector, reduction of credit to public sector (to crowd in credit for the private sector), sustenance of on-going reforms, eradication of corruption, evolving measures to boost deposit mobilization and improvement in infrastructures which would spur investment and engender growth in the Nigerian economy.*

**Key Words:** Financial intermediation, Financial Deepening, Economic Growth, Growth Model.

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### **1.1 Introduction**

Recently the phenomenal development of financial intermediation nationally and internationally has led to a wealth of

literature on the interaction between the financial sector and the real sector. In macroeconomics, one of the basic relationships is that foreign plus domestic

savings is equal to investment. Traditionally, the neo-classical approach did not question the mechanisms relating savings to investment. However, the development of the literature on asymmetric information and risk in the 1970s led to a growing body of knowledge on the behaviour of financial intermediaries, the credit market and credit rationing in particular. The financial sector channels funds into savings and from savings into investment. It is quite clear that both can have major implications for economic development. In most markets, efficient allocation is reached through the price system alone as prices are assumed to convey all the necessary information to "clear" the market.

The financial market is one exception since prices that is interest rates alone do not lead to efficient allocation of capital. This is the case because of financial operations involve risk due in part to informational asymmetries between the lender and the borrower. Hence, higher interest rates that would cover financial institutions for risk would also price out the creditworthy clients and induce other clients to undertake riskier projects. While the role of prices in the determination of savings and investment should not be undermined, it is clear that, in practice, it is financial intermediaries that mainly determine the allocation of capital by diminishing (but not eliminating) the level of risk through information gathering and special contract designs. The fact that imperfect information dominates financial markets and that the usual clearing process through prices does no follow also implies that there is scope for government intervention. Historically, policies have aimed at influencing the allocation of resources (economic regulation) as well as at

protecting lenders and savers against risky behavior (prudential regulation).

The balance between efficiency and market regulation is extremely difficult to achieve and not surprisingly, the subject has been extensively researched with major developments in the literature on savings, investment and the real sector. Since risk cannot be fully eliminated and also because the state of macroeconomic environment can increase the perceived risk, the market has been far from good at creating the wide spectrum of financial institutions and services necessary to meet demand. In particular, financial institutions tend to be specialized in services and most of the time, not all segments of the economy and population are seen as attractive. As a consequence, different intermediaries will lead to different financial allocations and income as well as employment distribution effects follow. Also, in the same way the types of institutions matter, the range of services each of them offers does affect the distribution of investments and has consequences for economic growth, poverty and inequality. To minimize the risk of growing inequalities, Western governments, for example, often have intervened with various schemes to induce financial intermediation in neglected areas of activities. As new knowledge about the role of perceived risk grew, so did the interest in policies that compensate for these market imperfections and, the question and how to foster the development of financial intermediation came to the centre of the debate. Therefore the main objective of this research is to determine the impact of financial intermediation on Nigerian economy.

## 1.2 Theoretical Underpinnings

Typically, economic growth has been analyzed within the macroeconomic framework where there is an obvious link between investment, savings and national production. During the past twenty years, these theories have evolved significantly, moving away from the view that growth is exogenously determined and therefore governments cannot influence it to the view that economic growth much depends on the quantity and the quality of national factors and, thus, Institutions and policies matter. At this point, let us offer a brief review of this evolution in the theories with an emphasis on those factors that have implications for financial markets.

### 1.2.1 The Solow Growth Model

One of the earliest models of economic growth was developed in Solow [1]. Economic growth is measured by a steady positive increase in total output produced by a country, and at the theoretical level it is approximated by an aggregate production function. Solow's model is set in a neoclassical framework where it is assumed that all prices have adjusted to clear all the markets (i.e., supply is equal to demand) and incentives have generated efficient outcomes. The model is consistent with long-term adjustments having fully taken place. In the simplest form, three factors determine aggregate output: labour, capital and technology. Growth models concentrate on explaining the behaviour of *potential* output; that is output achieved with a given technology and the full employment use of other factors. Naturally, they focus on the effects, over time, of changes in labour, capital and technology. Next, each factor is considered in turns. Changes in labour can

be induced by changes in the population or in the proportion of the people available for work, namely the participation rate. Changes in existing productive capital depend on net investment that is gross investment minus depreciation of existing capital. As long as net investment is positive, capital grows and production growth follows. However, the size of investment matters. It can be so small that the induced change in capital is marginal and so is the effect on production. Finally, technology combines the other inputs, labour and capital, to produce output. Hence, in the absence of changes in one of the two inputs, growth is assumed to come from change in technology. A "better" technology is one that increases total factor productivity that is increases production with a constant amount of inputs used. Technological changes can take several forms: existing technologies are improved or new technologies appear (improved communications); the organization of work changes (sequence of tasks, learning by doing); the quality and or composition of inputs and or outputs changes (increased education level in workforce, move from production of clothing to computers).

Concretely, the Solow growth model is based on an aggregate production function, which exhibits constant returns to scale and diminishing marginal returns. As a consequence, output per worker ( $y=Y/L$ ) depends only on capital per worker ( $k=K/L$ ). The accumulation of capital is larger than what is necessary to provide each new worker with the quantity of capital existing. In this model, financial markets do not explicitly enter the picture. Nevertheless, in the macroeconomic framework, *gross* capital accumulation is equal to investment and, in a closed economy, investment is

equal to domestic saving. Hence, savings in the economy feeds into investment and *net* capital accumulation ( $k$ ), or the change in capital that will contribute to production growth, is defined as total saving ( $sy$ ) minus compensation for labour force growth ( $nk$ ).

As a result, growth in capital ( $g_k$ ) and growth in Output ( $g_y$ ) are defined as,

$$kyk g = sAk - n \text{ and } g = ag$$

Where  $n$  is the rate of growth of population

The main feature of Solow's model is that in the long run, after all adjustments have taken place, total saving is used to make capital grow exactly at the same rate as population. Each new worker gets the same capital as existing workers and capital per worker is constant ( $g_k=0$ ). Alternatively, it can be said that the rate of growth of capital and labour converge to the same value ( $sAk - n = 0$ ) and there is a steady-state value of the capital labour ratio. In Solow's model, in the long run, once the level of capital per worker is stabilized, output per worker is stabilized and both, capital and output grow at the same rate. This is known as the *balanced growth argument*. From the viewpoint of the role of the financial sector, the surprising implication of this model is that in the long run, the rate of growth of output per worker is equal to that of the labour force, regardless of the savings rate. Hence, improvements in the collection of savings or financial innovations that stimulate savings have no effect on economic growth. There is a transition period during which the difference between capital growth and labour growth is positive and thus, capital per worker and output per worker rise. But, the phenomenon is

temporary and eventually, the steady state prevails as  $k$  and  $y$  reach a new constant level. Therefore, the savings rate affects permanently the *level* of output, not its growth rate.

Finally, in the case of an open economy, some of the increase in capital can be financed by foreign saving through capital inflow and current account deficit. The opening up of the economy will put it on a temporary adjustment path if the domestic interest rate is not equal to the world interest rate and investment (or dis- investment) will take place. Once the capital per worker ratio is such that interest rates are equalized, the economy will resume its growth at the labour force rate,  $n$ , with current account disequilibrium and a level of capital flows just necessary to maintain the new capital labour ratio.

The Solow growth model has been used extensively as a basis for empirical investigations on the sources of growth. Many studies focus on the role of technological changes, the so-called TFP calculation (Total Factor Productivity calculation). The following formula can be derived from Solow's model, Total output growth rate is a weighted average of the growth rates of the three factors: capital ( $g_K$ ), labour ( $g_L$ ) and technology ( $g_A$ ). This equality is known as the *growth accounting framework* or the *source of growth methodology*. Even if an economy has not reached the steady state (i.e., is not in balanced growth), it is possible to determine the contribution of labour, capital and technical changes to economic growth. In industrialized countries 70% of growth is attributed to labour ( $a_L=0.7$ ), 30% to capital ( $a_K=0.3$ ). The residual growth is due to technology. Hence, for given values of the

capital and labour growth rates, it is possible to evaluate the non-measurable contribution of technology. It must be noted that this methodology has been used for developing countries with mixed results.

### **1.2.2 Endogenous Growth Theory**

In the Solow model, growth can arise only through continuous changes in technology and therefore is purely exogenous. Savings by itself does not generate growth. One recent venue of research has been to question the relevance of the ergogeneity assumption in the Solow model. Two broad approaches have been developed, one that sees all inputs as reproducible and the other that is based on externalities. In one particular case, the externalities takes the form of human capital building. In both approaches, the savings rate plays a key role in the growth of capital and output per worker. The first approach is the so-called AK-model. It is based on the hypothesis that all input are reproducible and in particular the state of knowledge through research and development. Therefore, the diminishing marginal productivity of capital, which in the neo-classical model leads to constant steady state values of capital and output per worker, is here compensated by an increasing quality of machinery. It can be then shown that using the same investment and saving hypotheses as in the neo-classical model, the steady state rate of growth of capital per worker in the AK- model is,

$$gsA n, y k = \alpha$$

which implies that, for constant savings rate and population growth, if  $sA > n$ , capital per

worker can grow without bound. Moreover, an increase in the savings rate permanently raises the rate of growth of capital and output per worker. The second approach introduces externalities in the production process such that an increase in the output level by one firm affects positively factor productivity in another firm. Not all types of externalities are, however, necessarily linked to the production process and one type of externalities which is of particular interest concerns labour. In this model, labour is endogenously determined and it is not just the quantity of labour, which is relevant, but its "quality". Households can save by investing in human capital in addition to saving to invest in physical capital In doing so, households produce labour with skills, labour that can create ideas and handle sophisticated technologies. The theoretical set-up is very similar to that of the Solow model but with human capital deliberately accumulated (i.e., endogenous). Production per worker can be represented by, where  $y$  and  $k$  are the same as in the Solow model that is output and capital per worker and  $h$  is human capital per worker. In Solow's model, the quantity of labour available to the economy is determined by population growth and there is no quality of skill effect. In this model, output is consumed and saved as before except that there are two ways to save. Fractions is saved for capital accumulation ( $k=sy$ ) as before and another fraction  $q$  is saved to increase human capital quality ( $h=qy$ ). In that case, in steady state,  $y$ ,  $k$  and  $h$  grow at the same rate which is determined by the two savings rates such that,

$$\begin{aligned} y &= k^{\alpha} h^{1-\alpha}, \\ \kappa_y g &= s \alpha q - \alpha = g \end{aligned}$$

The major implication of this equation is that both savings rates have growth rate effects and not just level effects. As a consequence, growth is no longer determined by arbitrary technological changes but it is endogenous and determined by decision to invest in physical or human capital. Clearly, this conclusion leaves room for policies that stimulate savings in either factor of production to affect the growth of the economy.

The growth models described in the above do not have financial intermediation explicitly modeled. It is simply stated that the share of aggregate output saved by the economy is available for investment. Such assumption is equivalent to having perfect, costless financial intermediation between the agents with a surplus of funds and those with a deficit of funds. While it is true that financial intermediation does increase the transfer of funds across agents it is certainly not costless and several types of leakages can occur between savers and investors. Therefore, the presence of financial intermediaries helps improve efficiency in the distribution of capital but not at zero cost.

Capital market transactions are affected by three categories of problems: uncertainty, information asymmetries and transaction costs. All three can be linked back to information that prices are unable to reflect. However, financial intermediation can reduce some of the inefficiencies resulting from these three sources of imperfect information. First, uncertainty in financial transactions arises on the supply-side of funds through capital allocation and on the demand-side of funds through risk allocation.

Economies of scales allow financial intermediaries to gather information and decrease uncertainty at a relatively low cost. Second, asymmetric information concerns the fact that private information is costly to obtain. Financial intermediaries can set-up special arrangements and contracts, such as the collateralization of credit, to generate the correct incentives. Third, other transaction costs are reduced by financial institutions, which can intermediate between a large number of small savers and big borrowers for example.

### 1.3 Financial Intermediation: An Overview

With advances in computer technology, one can transfer money instantly, anywhere in the world, you can trade your funds across major stock exchanges online, and you can use your credit card across the globe and so on. Lending and borrowing of money is made simple by financial institutions called financial intermediaries. Financial intermediaries such as commercial banks, credit unions and brokerage funds carry out these transactions on your behalf. A financial intermediary is a financial institution that borrows from savers and lend to individuals or firms that need resources for investment. The investments made by financial intermediaries can be in loan and or securities. Basic role of financial intermediaries is transforming financial assets that are less desirable for a large part of the public into other financial asset, which is preferred more by the public.

This transformation involves at least four economical functions: providing maturity intermediation, risk reduction via diversifications, reducing the costs of contracting and information processing and providing a payment mechanism. Without

financial intermediation we must not have seen revolution in financial services in past couple of decades. Financial intermediation is responsible for creation of institutional investors in financial market. Modern world would not have been so modern without financial intermediaries. Financial intermediation has won savers confidence by protecting their asset while providing efficient services to help manage their asset. On the contrary, with pool of household savings from savers, they emerged as one large lender who can lend money to businesses and various other borrowers. Financial intermediaries are vital part of our economic system and they help to maintain constant flow of money in an economy. If there were no intermediaries, individual savers would have to directly purchase the securities of borrowers. There would have been incompatibility of the maturity needs of lenders and borrowers since most savers want to lend funds at short maturity, while borrowers want to borrow at longer maturities. It would have been difficult to match small amounts of individual savings to the larger loan amounts desired by borrowers. This would have caused borrowing more difficult and more tedious. Financial intermediaries perform important function of maturity intermediation to make investment from savers and money borrowing for borrowers seamless. Maturity intermediation involves a financial intermediary issuing liabilities against it that have maturity different from the assets it acquires with the fund raised. An example is a commercial bank that issues certificate of deposit and invests in assets with a longer maturity than those liabilities. Maturity intermediation offers more choice concerning maturity for their investments to

investors and reduces cost of long term borrowing for borrowers. Financial intermediaries issue their own debt claims to the saver in forms more attractive to savers, and in turn, lend to borrowers on terms satisfactory to the borrowers.

Financial intermediary's bears risk on behalf of investors by investigating their savings across various sectors of business. They transform risk-by-risk spreading and risk pooling; they can spread risk across a range of institution. In turn institutions can pool risk by spreading investment across firms and various projects. Diversification allows a financial intermediary to allocate assets and bear risk more efficiently. Financial intermediaries do risk screening, risk monitoring and risk evaluation; it is more efficient for institutions to screen investment opportunity on behalf of individuals than for all individuals to screen the risk. It helps individual saver to save time and money and offers low risk investment opportunity. One of the common example of this function is; a dollar deposited in a chequeing or savings account, it is not redeemed at less than a dollar but in turn one gets paid interest on it over period of time. Therefore, without financial intermediaries it would really have been difficult for individual investors to screen prospective borrower or investment opportunity, which would have discouraged individual savers from lending money and would have affected economic development.

Financial intermediaries provide convenient and safe way to store funds and creates standardized forms of securities. It also facilitates easy exchange of funds. Due to high volume, it is able to bear transaction and information search costs on behalf of savers. Therefore, individual saver enjoys

financial services that enable them to deposit and withdraw funds without negotiation; whereas borrowers avoid having to deal with individual investors. Since it has information available for both lenders and borrowers, it minimizes information cost for analyzing their data. Without financial intermediaries lenders and borrowers would have to pay higher transactional and information costs.

## 2.0 Empirical Literature

Recently, panel and time-series analysis have come to dominate econometric research. Beck provides a review of different econometric methodologies to assess the link between finance and growth. The direction of causality is said to be crucial because it has significantly different implications for development policy [2]. Calderon and Liu [3] analyze a larger number of countries (one hundred and nine countries from 1960 to 1994) and on pooled data employ the Geweke decomposition test. Their results are as follows:

- a) financial development generally leads to economic growth;
- b) the Granger causality from financial development to economic growth and the Granger causality from economic growth to financial development coexist;
- c) financial deepening contributes more to the causal relationship in the developing countries than in the industrial countries;
- d) the longer the sampling interval, the larger the effect of financial development on economic growth;
- e) financial deepening propels economic growth through both rapid capital accumulation and productivity growth, with the latter channel being the strongest. Unlike Calderon and Liu, but on a sample of ten

developing countries from 1970 to 2000, Christopoulos and Tsionas [4] find that long-run causality runs from financial development to economic growth but that there is no evidence of bi-directional causality. However, they did not find any short-run causality between financial deepening and output. The authors stress that an important policy implication is that policies aimed at improving financial markets will have an effect on growth that is delayed but nevertheless significant. Fink et al. [5] obtain the opposite result in terms of the time perspective. They found a strong finance-growth link in eleven transition countries<sup>6</sup> (1990-2001) and the main growth impact runs via the productivity channel. However, financial sector development triggers short run growth effects rather than spurring long term growth. Their financial indicator includes not only bank credit, but also stock market capitalization and value of outstanding debt securities divided by GDP. In summary, most authors reviewed in this study use different econometric methodologies (cross-section, panel analysis, time-series), to observe different time periods, as well as countries, and all conclude that financial intermediation leads economic growth. Should we be skeptical about their conclusion? The answer follows the work of Zhang [6]. The author applies time-series based on Zhang's variance decomposition analysis, there is little evidence that financial development leads to economic growth in the eleven countries in his sample (from 1985 to 1998, quarterly data). Also, no substantial differences were found between eight Western countries that have more developed financial systems and the three Asian countries with less developed financial systems. To the limited

extent that one does find some support for the hypothesis that financial development leads economic growth, it seems clear that financial development is no more than a contributing factor and, almost certainly, not the most important factor. It is clear that whatever causality may exist, it is not uniform in direction or strength, and highlights the inappropriateness of cross-sectional analysis

Levine *et al.* [7] found that there is no evidence of any positive unidirectional causal link from financial development indicators to economic growth. On the contrary, there is substantial indication that economic growth precedes subsequent financial development. The authors emphasize that their result does not imply that the role of financial development is not important, but that the bottom line is that a more balanced approach to studying the relationship between finance and growth needs to be adopted. The motivation for their paper came from the “casual observation that superstar East Asian countries with the world’s highest growth rates for the last four decades, such as Japan, South Korea, and China, could not be classified as more financially developed than their competitors”. This is especially true for South Korea whose financial institutions did not operate under market forces until very recently. When it comes to transition economies, existing research does not show a strong link between finance and growth. Koivu analyzes twenty five countries during 1993-2000 and emphasizes that a large banking sector is not in itself something that promotes Colombia, Costa Rica, Greece, India, Korea, Malaysia, Philippines, Sri Lanka, South Africa, Thailand, Australia, Canada, Denmark,

Finland, Italy, Portugal, UK, USA, 12 China, Japan, South Korea. [8]

Probably, the most important problem in the whole finance-growth literature is that theory and emperics are disconnected. While theory focuses on financial efficiency, data limitations determine the focus of emperics, which is financial depth (share of private sector credit in GDP) or size (share of bank assets in GDP). Basically, theory is not confronted with data [9]. This leads to another important issue: it is possible that, due to data limitations, the role of finance in determining economic growth is exaggerated. Furthermore, there are no clear quantitative lessons to be drawn from the existing literature. Here is a list of the most pronounced problems regarding the proxies used in research: Monetary aggregates, which are often used in the literature, are probably not a good measure of financial intermediation because they show how good the financial system is in providing liquidity. For example, a low level of M1 in GDP can show that the financial system is developed and that individuals need not hold a lot of cash. Fortunately, these proxies are used less and less.

The trend of financial development measured by the credit-to-GDP ratio is itself rising over time across countries. As a result, those countries that did converge have necessarily had a higher measure of financial development over the observed period [9]. It would be necessary to compare countries at a similar stage of economic development, which several papers confirm.

- Research does not differentiate between loans to companies and consumers. A notable exception is a paper by Beck [10].
- Countries for which data are not available (usually undeveloped economies) are

excluded from the sample, and their inclusion would probably change the results. There is thus a selection bias towards the developed economies. In addition, papers that observe a large number of countries mostly exclude former socialist countries. It is recommendable to study groups of similar countries, or each country individually.

- Increasing the share of credit to the private sector need not be a sign of growing financial development. Rather, it can be a sign of a forthcoming financial crisis. This has been ignored by most researchers. Benhabib and Spiegel think that there are indications that the financial development indicators are proxying for broader country characteristics. Namely, they find that indicators of financial development are correlated with both total factor productivity and investment. However, indicators that are correlated with total factor productivity growth differ from those that encourage investment. [11] Research done by Hasan *et al* differs from the “standard” research insofar as they suggest a more direct measure of finance quality rather than quantity (credit to the private sector). They test if bank profit efficiency, estimated at the firm-level (around 7,000 banks in EU-25 between 1997 and 2003) significantly spurs economic growth. The authors established a positive relation between banking quality and economic growth in the EU-25 and find out that the quality channel has approximately three times the effect of the quantity channel. [12]

### 3.0 Methodology

This study is designed in a way that it would be totally an econometric investigation of the impact of financial intermediation on economic growth in Nigeria. Using an econometric technique of Ordinary Least Squares (OLS) and cointegration analysis based on Engle-Granger cointegration theory [13], we tested both short and the long run relationships between financial intermediation and economic growth in Nigeria.

However, in order to really assess how financial intermediation affects economic growth, we extended the scope of our study by incorporating interest rate and inflation rate due to the critical role they play in channeling funds from surplus to deficit economic units. To achieve our objectives we utilized the following data: growth rate of GDP, ratio of banking sector lending to private sector/GDP, ratio of public sectors lending/GDP, ratio of external balance/GDP, financial deepening, interest rate on lending and inflation rate of Nigeria from 1970-2009. All these data are sourced from the Central Bank of Nigeria statistical bulletin and National Bureau of Statistics.

#### 3.1 Model specification

Financial intermediation is concerned mostly with funds mobilization from the surplus to deficit economic units. Hence financial intermediation by the financial sector is influenced by both endogenous and exogenous factors such as level of financial growth, interest rate, and financial sector stability and lending which is determined by lending rates, level of domestic investment, demand for fund by the economic agents and inflation rate. Given this background we shall specify a growth model that incorporates the following variables;

GDPR = f(PGdp, Egdp, Ggdp, Irr, Fid, Inr).....(i)

This model is transformed into a log-linear form as follows;

$\text{LnGDPR} = \alpha_0 + \alpha_1 \text{LnPgdp} + \alpha_2 \text{LnEgdp} + \alpha_3 \text{LnGgdp} + \alpha_4 \text{LnIrr} + \alpha_5 \text{LnFid} + \alpha_6 \text{LnInr} + e$  ... (ii)  
 Apriori expectation:  $\alpha_1 > 0, \alpha_2 > 0, \alpha_3 < 0, \alpha_4 < 0, \alpha_5 > 0, \alpha_6 < 0$  ..... (v)

Where

Ln = Natural Logarithms

$\infty_o$  = Autonomous growth component  
GDPR= Growth rate of GDP  
Pgdp = Commercial bank total lending to  
the private sector/GDP  
Egdp = External reserve/GDP (proxy for  
capital inflow into the banking  
sector)  
Ggdp = Commercial bank total lending to  
the public sector/GDP  
Irr = Interest rate (lending rate) of  
commercial banks  
Fin = financial deepening  
Inr = inflation rate  
e = Random/disturbance term.

### 3.2 Presentation of Data

The data for the model specification are presented below.

Table 3.1 : Operational Data on Economic Variables used for the Study (1970-2009).

Year	Ggdp	Irr	Fid	INR	Pgdp	Egdp	GdpR
1970	0.12	8	18.5	13.8	0.083	0.025	23.6
1971	0.06	10	15.7	16	0.107	0.028	10.5
1972	0.08	10	16.9	3.2	0.13	0.039	3.6
1973	0.07	10	17.6	5.4	0.14	0.045	7.9
1974	0.05	10	12.5	13.4	0.061	0.196	66.7
1975	0.03	9	19.7	33.9	0.062	0.124	41.4
1976	0.04	10	22.2	21.2	0.086	0.105	6.77
1977	0.04	6	25.1	15.4	0.121	0.08	7.53
1978	0.03	11	23.1	16.6	0.155	0.043	-7.9
1979	0.07	11	24.4	11.8	0.18	0.102	2.46
1980	0.08	9.5	30.4	9.9	0.236	0.173	5.07
1981	0.009	10	33.9	20.9	0.047	0.077	84.6
1982	0.014	11.75	36.9	7.7	0.058	0.05	-2.77
1983	0.28	11.5	39.3	23.2	0.066	0.003	-7.59
1984	0.05	13	39.2	39.6	0.07	0.006	-1.11
1985	0.05	11.75	38.7	5.5	0.07	0.009	8.69
1986	0.02	12	39.6	5.4	0.089	0.018	2.4
1987	0.04	19.2	32	10.2	0.107	0.023	-0.57
1988	0.03	17.6	32.7	38.3	0.12	0.016	6.85

1989	0.02	24.6	21.7	40.9	0.13	0.06	7.12
1990	0.03	27.7	25.7	7.5	0.13	0.15	11.5
1991	0.03	20.8	28	13	0.159	0.17	-0.82
1992	0.03	31.2	24.2	44.5	0.3	0.25	2.21
1993	0.11	36.09	29	57.2	0.35	0.11	1.26
1994	0.15	21	29.7	57	0.55	0.15	0.22
1995	0.08	20.79	16.5	72.8	0.75	0.62	2.12
1996	0.17	20.86	13.7	29.3	0.89	0.89	4.2
1997	0.14	23.32	15.3	8.5	1.06	0.75	2.74
1998	1.61	21.34	19.4	10	1.2	1.76	2.85
1999	0.61	27.19	21.9	6.6	1.46	3.49	0.41
2000	0.88	21.55	22.6	6.9	1.81	3.59	5.16
2001	0.66	21.34	27.8	18.9	2.4	2.84	7.79
2002	1.12	30.19	23.1	12.9	2.21	2.46	17.6
2003	0.83	22.88	23.4	14	2.54	4.68	9.28
2004	1.2	20.82	19.8	15	2.91	6.92	9.49
2005	1.22	19.49	19.3	17.9	3.57	9.66	6.11
2006	1.8	18.7	21.7	8.2	4.45	10.16	5.69
2007	2.42	18.36	28.1	6.6	7.97	11.08	6.06
2008	3.24	18.7	37.7	15.1	11.99	10.45	6.02
2009	3.94	22.9	43.6	12.1	14.2	8.84	6.24

Sources: CBN Statistical Bulletin; NDIC Quarterly

### 3.3 Data Analysis

In order to correct pitfalls that may occur in the econometric analysis, both stationarity and co-integration tests were conducted to avoid spurious regression results. Basically, testing for unit roots in data always precedes co-integration analysis. In testing for the

stationarity of the variables, Augmented Dicky-Fuller (ADF) test was employed to determine the degree of integration of the variables. That is, how many times a variable should be differenced to attain stationarity (Dickey and Fuller 1981).

## Analysis of Regression Result

Table A

Variable	Coefficient	T-statistic	Probability
C	32.62816	2.476335	0.0186
IRR	-0.705534	-1.549310	0.1308
FID	-0.463905	-1.160810	0.2540
INR	0.041671	0.201986	0.8412
PGDP	1.078828	0.291153	0.7728
EGDP	-0.585637	-0.316693	0.7535
GGDP	-0.687068	-0.050836	0.9598

R<sup>2</sup>=0.11; R<sup>2</sup>-adjusted=-0.05; DW=1.9; F-statistic=0.68

Source: Researchers' Computation (E-view)

The short run result reported above indicates that all the variables under consideration are insignificant at 5 percent level except the dependent variable. Also the low Durbin Watson statistic shows that there is presence of serial correlation. In order to correct these pitfalls in our result above, both stationarity and co-integration tests were conducted to check the possibility of

spurious regression results. Basically, testing for unit roots in data always precedes co-integration analysis. In testing for the stationarity of the variables, Augmented Dicky-Fuller (ADF) test was employed to determine the degree of integration of the variables. That is, how many times a variable should be differenced to attain stationarity (Dickey and Fuller 1981).

Table B:Unit Root Test- Variables at Ordinary level and First Difference

Variables	ADF Test Statistic	1% critical Level	5% critical Level	10% critical Level
D(Gdpr)	-5.352381	-3.610457	-2.938987	-2.607932
D(Pgdp)	7.757817	-3.639407	-2.951125	-2.614300
D(Egdp)	-3.781494	-3.670170	-2.963972	-2.621007
D(Ggdp)	4.061328	-3615588	-2.941145	-2.609066
D(Irr,2)	-7.018770	-3.621023	-2.943427	-2.610263
D(Fid,2)	-5.379732	-3615588	-2.941145	-2.609066
D(inr,2)	-6.097700	-3.621023	-2.943427	-2.610263

Source: Computed Result (E-view 7.1)

The unit root test reported above shows that the variables under consideration were not stationary at ordinary level except GDP growth rate. This is because the ADF statistic is less than their theoretical values at all levels. However, commercial bank

lending to the private sector/GDP, commercial bank credit to the public sector/GDP, external reserve/GDP, lending rate, financial deepening and inflation rate attained stationarity at 1<sup>st</sup> difference.

**Table C: Johansen Co integration Result – Financial Intermediation and Economic Growth:**

Series: D(GDPR) D(PGDP) D(EGDP) D(GGDP) D(INR,2)

D(FID,2)

Lags interval (in first differences): 1 to 1

Eigenvalue	Max-Eigen Statistic	5% Critical level	Probability	Hypothesized no. of CE(s)
0.800060	57.95055	40.07757	0.0002	None *
0.766277	52.33023	33.87687	0.0001	At most 1 *
0.567294	30.15709	27.58434	0.0228	At most 2 *
0.520863	26.48769	21.13162	0.0080	At most 3 *
0.439335	20.83076	14.26460	0.0040	At most 4 *
0.067008	2.496893	3.841466	0.1141	At most 5

Max-Eigenvalue test indicates 5 cointegratingeqn(s) at 0.05 level \*denotes rejection of the hypothesis at 5% significance level \*\* MacKinnon-Haug-Michelis (1999) p-values

Source; Researcher's Computation (E-view)

The result above indicates that there exist five cointegrating equations which satisfies the condition for fitting in a parsimonious error correction model (ECM).

**Table D: Parsimonious Co-integration result; Financial Intermediation and Economic Growth**

Variable	Coefficient	T. Statistic	Probability
C	1.339858	0.411864	0.6837
D(GDPR(-1))	0.583130	2.547972	0.0168
D(GDPR(-2))	0.348842	2.015946	0.0539
D(IRR)	-0.603835	-0.911334	0.3702
D(FID)	0.146604	0.202183	0.8413
D(INR)	0.350875	1.843370	0.0763
D(PGDP)	-1.713549	-0.443119	0.6612
D(EGDP)	-0.388612	-0.104389	0.9176
D(GGDP)	-1.795295	-0.207325	0.8373
ECM(-1)	-1.636643	-5.297576	0.0000

R<sup>2</sup>=0.61; R<sup>2</sup>-adjusted=0.48; Durbin Watson Stat=2.2; F-stat=4.7

Source: Researchers' Computation (E-view)

### 3.4 Result Interpretation/Findings

Financial deepening is positively related to economic growth hence it complies with our expectation and economic theory. This implies that a rise in financial growth promotes growth while a fall in financial

deepening retards growth. However, its insignificance at 5 percent level shows that the level of financial growth is inadequate to spur investment and growth in the country during the period under review. The low level of savings due to high level of poverty

and unemployment and the instability in the banking sector may have accounted for the observed result. The World Bank currently put the poverty level in Nigeria at about 60 percent of the population. Also unemployment rate especially graduate unemployment has been on the high side. These are unhealthy indicators for growth and development of the country.

Interest rate also adheres to our *apriori* expectation and economic theory by bearing negative sign. A fall in interest rate (lending rate) make fund cheaper for investors or borrowers. Reduction in interest rate thereby spur investment and growth since investors are willing to borrow more at lower interest rate. However, the insignificance of interest rate reveals that the current lending rate in Nigeria is still very high to promote rapid and sustainable investment and economic growth in the country. The liberalization of interest rate since the introduction of SAP in 1985 and that myriad of reforms in the financial sector have raised interest rate on lending in Nigeria. Currently, prime lending rate by commercial banks is put at 22-24 percent excluding management and processing charges. This rate has serious negative implication for investment and growth for a developing economy like Nigeria.

Money supply deviated from our expectation by bearing a negative sign. Theoretically, an increase in money supply stimulates growth by making funds available at cheaper rate for investment. The negative relationship of money supply with growth and its insignificance at 5 percent level indicates that money supply is inadequate in promoting investment and growth in Nigeria. The instability in the financial sector especially the banking sector

may have explained this result. Recently, the Central Bank of Nigeria (CBN) took up punitive measures against banks that fail to comply with the prudential guideline on banking operation. For instance the central bank has embarked on restricted monetary policy in order to curb some excesses and indiscriminate lending by most commercial banks in the country.

Commercial banks credit to the public sector is in consonance with our expectation and insignificant at 5 percent level. This implies that bank lending to the public sector significantly retards growth. An increase in bank lending to the public sector crowds out private investment and reduces growth. Over the years, public sector has been the major borrower of funds from the banking sector. This development has had serious negative implication on private investment, a principal ingredient for growth and development.

Bank lending to the private sector deviated from our *apriori* expectation and economic theory. It is also insignificant at 5 percent level. This indicates that lending to the private sector retarded growth during the period of this study. Usually, increased bank lending to private businesses spur domestic investment and growth. However, the deviation of this variable from this position in this study could be traced to the excessive borrowing by the government from the banking sector. The government being a major player in the Nigerian economy remains a major borrower of investment fund. Unfortunately most of these funds borrowed by the government in Nigeria are either diverted into recurrent spending or put into private pockets.

The compliance of the error correction model to our expectation with the required

negative sign and its significance at 5 percent level indicates that a long run relationship exists between financial intermediation and growth during the period of this study. Also the Durbin Watson statistic of 2.10 shows that, serial correlation is minimal in our data.

Our coefficient of determination of 0.48 shows that about 48 percent of the systematic variation in financial intermediation is explained by deposit mobilization, interest rate, money supply, banks' lending to the public and private sectors during the period of this study. Also the tests of significance of the parameter estimates indicate that all the explanatory variables are all insignificant at 5 percent level. This implies that their contribution to growth during the period is not very strong. In like manner the F-statistic of 1.3 shows that, the overall growth model is not statistically significant at 5 percent level.

#### 4.0 Conclusion and Recommendation

In this paper, we examined the impact of financial intermediation on economic growth in Nigeria. Our analyses and results indicate that interest rate, deposit mobilization and deposit money (commercial) banks credit lending to the public sector conform to our expectation by bearing the required negative, positive and negative signs respectively. Money supply and banking sector credit lending to the

private sector deviated from our expectation. Also, all the explanatory variables were insignificant at 5 percent level while the coefficient of determination indicates that only 48 percent of the total variation in growth is determined by financial intermediation during the period of this study. These results revealed that financial intermediation is weak in stimulating investment and growth of the Nigerian economy during the period under review which is a reflection of weak monetary policy trust and or poor implementation as found in Okereke [14]. The financial sector had witnessed one of the highest levels of instability during the period. It has been characterized by distress, corruption and inefficiency. These have led to the introduction of catalogue of reforms in order to reposition the sector for improved performance and growth. Though a lot of reforms have been introduced and some are still on-going, the level of investment fund, interest rate charged by the sector is still very high to stimulate real sector investment and economic growth in the country.

Based on these results and findings, we recommend, a reduction in lending interest rate, increase lending to the private sector, evolve measures to boost deposit mobilization and improvement in infrastructure as possible avenue to spur investment and growth in Nigeria.

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# **Electronic Banking And Bank Performance In Nigeria**

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## **Abstract**

*This study investigated the profitability performance of Nigerian banks following the full adoption of electronic banking system. The study became necessary as a result of increased penetration of electronic banking which has redefined the banking operations in Nigeria and around the world. Judgmental sampling method was adopted by utilizing data collected from four Nigerian banks. These four banks are the only banks in Nigeria that have consistently retained their brand names and remain quoted in the Nigerian Stock Exchange since 1997. The profitability performance of these banks was measured in terms of returns on equity (ROE) and returns on assets (ROA). With the data collected, we tested the pre- and post-adoption of e-banking performance difference between means using a standard statistical technique for independent sample at 5 percent level of significance for performance factors such as ROE and ROA. The study revealed that the adoption of electronic banking has positively and significantly improved the returns on equity (ROE) of Nigerian banks. On the other hand and on the contrary, it also revealed that e-banking has not significantly improved the returns on assets (ROA) of Nigerian banks.. The findings of this study have motivated new recommendations for bank customers, bank management and shareholders with regard to electronic banking adoption for banking operations.*

**Keywords:** Electronic banking, returns on assets (ROA), returns on Equity (ROE), difference between means and Bank profitability performance.

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## **Introduction**

The introduction of Universal banking practice in Nigeria and the adoption of electronic banking by Deposit Money banks have offered increased services to customers with attendant increase in customer risk exposure. The changing environment of bank management in Nigeria has impacted

much on the number of services and risk which Nigerian banks face.

Electronic banking is the conduct of banking business electronically which involves the use of information communication technology to drive banking business for immediate and future goals. Daniel (1999) cited in Alhajri [1] describes

e-banking as the provision of banking services to customers through internet technology. According to Basel Committee on banking supervision<sup>[2]</sup>, electronic banking is defined to include the provision of retail and small value banking products and services through electronic channels as well as a large value electronic payment and other wholesale banking services delivered electronically. Though, Alsmadi and Alwabel<sup>[3]</sup> expressed that the definition of electronic banking varies among researchers partially because electronic banking refers to several types of services through which bank customers can request information and carry out banking services..

However, the revolution in the banking industry in Nigeria started with the advent of electronic devices to assist in the discharge of quality services to bank customers. The introduction of these electronic devices has increased competition in the industry which has gone a long way to reducing customers' waiting time for banking transactions. This innovation is brought in by the use of computers and other networking gadgets. In Nigeria, the networking started with the LAN (Local Area Network) MAN (Metropolitan Area Network) and subsequently the WAN (Wider Area Network).

Generally, the automation of banks makes transaction and data processing very easily accessible for quick management decision making. This led to another level of benefit which ushered in what is today referred to as electronic banking. Electronic banking helps the banks to speed up their retail and wholesale banking services. The banking industry believes that by adopting the new technology – e-banking, the banks will be able to improve customer service

level and tie their customers closer to the bank<sup>[4]</sup>. According to Simpson<sup>[5]</sup>, what actually motivates the investment in electronic banking is largely the prospects of minimizing operating costs and maximizing operating revenue.

Nevertheless, the adoption of electronic banking (e-banking) has brought major challenges to the banking industry in terms of risk exposure. The volume of deposits has increased as well as the fraudulent practices experienced by Nigerian banks since its adoption in the economy. This is the reason why Ovia<sup>[6]</sup> posits that Nigeria's banking scene has witnessed phenomenal changes, especially in the mid 1980s and these have manifested in the enormous volume and complexity in product or service delivery, financial liberalization and business process re-engineering. The effectiveness of deploying information Technology in banks therefore can not be put to doubt. The fact remains that the reality of using IT in banks is necessitated by the huge amount of information being handled by these banks on a daily basis. On the customers' side, cash is withdrawn or deposited, cheques are deposited or cleared, statement of accounts are provided, money transfers etc. At the same time, banks need up-to-date information on accounts, credit facilities and recovery, interest, deposits, charges, income, profitability indices and other control of financial information.

However, researchers have not given much attention to this revolution occasioned by electronic banking with regard to profitability performance of banks.

The revolution in the banking industry in Nigeria occasioned by the adoption of electronic banking has compelled Nigerian banks to invest more in assets to meet up

with competitive positioning. Since much earnings have been retained to meet up this obligation, shareholders have been denied dividend with the expectation that future dividend will be fatter.

The banking software is usually improved on short term basis causing huge financial costs to the banks. To the capital providers, they expect that there would be tremendous returns accruing from the project if information driven technology (e-banking) is adopted. Going through annual financial reports of Nigerian banks in recent years, they reveal that dividend returns are dwindling while other performance indicators seem to be weak contrary to the expectation of the shareholders or investors. Generally, there appears not to be improvement on banks' returns on equity and assets as speculated.

This study tries to fill the gap and to complement previous literature available on electronic and internet banking in Nigeria. Although, there has been vast study on the benefits the banks customers will derive on adoption of electronic banking, there is however less research outputs in the area of returns on assets and returns on equity to investors. This study therefore investigates the pattern of returns on equity and assets of Nigerian banks in this era of e-banking.

## **Review of Related Literature**

In recent times, electronic banking has spread rapidly all over the globe. According to Onay e-t al [7], the increased adoption and penetration of internet has recently redefined the play ground for retail banks. In Nigeria, all banks are making greater use of e-banking facilities to provide better services in order to excel in the competitive Nigerian banking industry. The spread of e-banking

has also greatly benefited the ordinary customer in general and corporate world in particular. Consequently, electronic banking (e-banking) has been the greatest challenge to the banking industry going by the sophistication and volume of fraudulent practices associated with this form of banking.

In the past few years, banking activities in Nigeria have increasingly depended on the deployment of information and communications technology. Customers' insatiable appetite for efficient services has compelled financial institutions to fast track to a more radical transformation of their business systems and models for embracing e-banking<sup>[6]</sup>.

E-banking appeal as well its product development is rapidly growing, and the global acceptance has strongly encouraged its penetration. The success of e-banking is contingent upon reliable and adequate data communication infrastructure. Therefore, it is efficient for banks to invest in online transactions through the creation of networks. However, there has been a mix up between electronic banking and internet banking. The fact is that internet banking is subsumed in electronic banking.

Banking has come a long way from the time of ledger cards and other manual filing systems. Most banks today have electronic systems to handle their daily voluminous tasks of information retrieval, storage and processing. Irrespective of whether they are automated or not, banks by their nature are continually involved in all forms of information management on a continuous basis.

The computer is of course an established tool for achieving a competitive edge and optimal resource allocation. The most

obvious application of computers in the banking industry is in the area of customer services, information management and control. Computerized banks respond immediately to requests from customers for statement of accounts, balance and account activity enquiries. With signature and image verification systems, the time taken to offer typical cashier services like receiving and paying out of cash is minimized<sup>[8]</sup>. Also with the advent of automated Teller machines (ATM), banks are able to serve customers outside the banking hall all round the clock.

### **Types and Delivery Channels of e-banking**

E-banking can be classified into three basic types. These include *Internet banking*, *Smart card banking* and *Mobile/telephone banking*.

**Internet banking:** This is a type of e-banking service where customers' instructions are taken and attended to through the internet. Internet banking offers customers the possibility of enjoying banking services from the comfort of their homes and offices. What this means is that customers can buy goods by placing orders from the net, instruct their banks to pay the vendor the invoice amount involved, and the products are delivered to the destination where the buyer wants.

**Smartcard banking:** This is the conduct of banking transactions through the use of electronic cards (Value Card, ATM Card, Debit Card, Credit Card etc.). The smart card system makes it easy for bank customers to have access to cash, carry out transfers and make enquiries about their accounts without visiting the banking hall. Smart card facility is usually mounted at

strategic places in the cities such as supermarkets, Hotels, Transport terminals, shopping malls etc.

**Mobile/telephone banking:** This involves the conduct of banking business through the use of mobile phones or fixed wireless phones. It takes the following steps: Instructions are passed via voice or short messages (SMS) to the computer; the computer decrypts the message and executes the instructions through a highly coded device. Then, the response is given back to the customer electronically.

### **Benefits of E-banking**

Rogers<sup>[9]</sup> posits that the rate of adoption of a new innovation is related to (perceived) relative advantage: The greater the perceived related advantage, the faster the adoption. Secondly, the desire to improve organizational performance is seen to be an enabler for technological change. However, the benefits of electronic banking encompass a broad range of functions and include: Electronic mail (e-mail) improves communication between individuals and the bank, within the bank, with the bank and external parties and between banks.

The availability of online information provides bankers and customers with a powerful vehicle for research. Banks can provide information and services online which customers can pay for and receive. Banking processes are made more efficient and cost effective by integrating other aspects of banking operations such as management and financial control. Ovia<sup>[6]</sup> posits that on-line banking services have now become a birth right of the customer as the customer demands the flexibility of operating an account in any branch of a bank irrespective of which branch the account

was domiciled. With internet banking, customers would enjoy sitting in the comfort of their homes and offices and with a Personal Computer, log onto their banks' servers and transact banking activities<sup>[6]</sup>.

### **Electronic Banking Risks and Control**

Each financial institution should apply guidelines based on its scope and level of sophistication in e-banking technology. Typically, electronic banking amplifies the scale of exposure of banks to traditional risks, such as transaction, strategic, reputation and compliance risk, among others. As information systems become more connected and interdependent, the risk of computer intrusion will increase. Arguably, this is the single most challenging aspect of the "new" electronic delivery system. Banks with weak physical and system security substantially increase their exposure to a plethora of risks, many of which could lead to collapse. Potential consequences include direct currency loss, change reputation, improper disclosure, and law suits or regulatory sanction. Bank consolidation as most Central Banks think, may not only be the solution to Bank distress and collapse. But exposure to global risk due to the adoption of electronic banking can in a moment throw a bank into oblivion. The security of payment cards from the view point of the holder is another area of concern. The danger of invasion of the system by fraudsters to corner and divert funds is ever present and a successful invasion could result in jumbo scale diversion of funds<sup>[10]</sup>. Another security problem of payment cards as noted by Okafor<sup>[10]</sup> is the consequence of any break down even momentarily and for whatever reasons, could be devastating. Therefore,

banks deploying this technology should have an eagle eye to monitor occurrence of breakdown and good maintenance culture.

Therefore, e-banking should be consistent with the banks overall strategic and business plans, and adequate expertise should be employed to operate and maintain such systems. It is therefore imperative that e-banking risks be managed as part of a bank's overall risk management process. The level of risks assumed by banks need to be consistent with individual bank's overall risk tolerance, and not its ability to manage and control risk<sup>[11]</sup>.

### **Bank Performance**

By bank performance, generally it implies whether a bank has faired well within a trading period to realize its objectives. The only document that explains this is presumably the published financial statements. According to Rose<sup>[12]</sup>, a fair evaluation of any bank's performance should start by evaluating whether it has been able to achieve the objectives set by management and stockholders. Certainly, many banks have their own unique objectives. Some wish to grow faster and achieve some long-range growth objective, others seem to prefer quiet life, minimizing risk and conveying the image of a sound bank, but with modest rewards to their shareholders<sup>[12]</sup>.

Ordinarily, stock prices and its behaviour are deemed to reflect the performance of a firm. This is a market indicator and may not be reliable always. However, the size of the bank, the volume of deposit and its profitability could be deemed as more reliable performance indicators. For the purpose of this study, profitability indicators, precisely the Return on Equity

Capital (ROE) and the returns on Assets (ROA) are used to assess bank performance. These ratios are indicators of management efficiency, and rate of returns. According to Rose [12], these profitability measures vary substantially over time and from one banking market to another. The ROE and ROA are popularly in use today. Nikolai & Bazley<sup>[13]</sup> posit that the amount of net income earned in relation to total assets is an indicator of how efficiently a company uses its economic resources. They further stressed that when the ROE is higher than the ROA, the company has favourable financial leverage.

### **Research Evidence**

Sullivan<sup>[14]</sup>, in his study took sample of banks that are located in tenth Federal Reserve District that have adopted internet bank and those that have not. Comparing their financial performances and risk positions, he observed that the profitability and risks of these grouped banks were similar.

Hernando and Nieto<sup>[15]</sup> found that the impact of adopting internet on the performance of banks as a delivery channel of e-banking takes time to appear. They hold the view that the adoption of a transactional website has a positive impact on profitability which becomes significant in terms of ROA and ROE three years after adoption. This finding actually conveys that there is a lag period for positive profitability impact to manifest on adoption of electronic banking. However, their study revealed some weaker evidence of an earlier positive impact on adoption of e-banking particularly in terms of ROA.

Siam<sup>[16]</sup> citing the works of Shuqair (2003) on “practical electronic banking

services by the Jordanian banks”, pointed out that one of the most important findings in that study is the high cost of electronic banking services on the short run due to the training of employees, and the cost of the infrastructure. The implication of this finding is that electronic banking services will have a negative effect on the bank’s profitability in the short run.

Onay et al<sup>[7]</sup>, in their study reveal that adoption of online banking and its investment is a gradual process. They posit that electronic banking does not seem to have a significant impact on the performance of Turkish banks measured in terms of ROA, ROE or margin in the year of adoption of the technology. Further, they showed that in the following year, there was significant decrease in profitability which was also attributed to the increase in IT expenditure following the adoption of the new technology.

Also, in a similar study, Malhotra, and Singh<sup>[17]</sup>, found that profitability and experience in offering of internet banking do not have any impact on banks’ performance in the Indian banking context.

Khrawish and Al-sa’di<sup>[18]</sup> studied the impact of e-banking on bank profitability with evidence from Jordan. For banks that applied electronic services for less than two years, they found that there was no significant effect of these electronic services on the return of assets and the returns on equity. The study however, showed that such services made significant impact on the profit margin of the concerned banks. They also found that there was no significant effect of these services on banks profitability after two years of applying it in Jordan.

Alsmadi and Al-wabel<sup>[3]</sup>, while studying e-banking on the performance of Jordanian

banks, found that the adoption of e-banking affects bank performance negatively. In their opinion, they hold that e-banking may eventually become a very important factor affecting performance for many banks. From the research evidence so far, there has not been a research output of related study from Nigeria on electronic banking and banks profitability performance since the adoption of electronic banking. This study therefore makes an insight in this direction to close the gap.

### **Research Methodology**

This study utilizes secondary data extracted from the Nigerian Stock Exchange Fact Books and published annual reports of four sampled banks. With the secondary data collected, returns on assets and equity for the relevant years were computed. These four banks are banks that have continued to

The Return on Equity is given by:

$$\text{ROE} = \frac{\text{Net Income after taxes}}{\text{Total Equity capital}}$$

While Returns on Assets is given by:

$$\text{ROA} = \frac{\text{Net income after taxes}}{\text{Total Assets}}$$

Furthermore,

$$\frac{1}{\sum_{n=4}} \frac{\Sigma \text{ BROE}}{\Sigma N} = \text{Mean for each bank} \quad \text{Eqn. 1}$$

$$\frac{1}{\sum_{n=4}} \frac{\Sigma \text{ BROA}}{\Sigma N} = \text{Mean for each bank} \quad \text{Eqn. 2}$$

retain their brand names and still quoted in the Nigerian Stock Exchange since 1997. The data collected covers the period 1997-2010. Since the objective of the study has been to determine whether e-banking has significantly improved the profitability performance of banks in Nigeria with regards to the returns on equity (ROE) and returns on assets (ROA), the data was grouped into two i.e. pre and post adoption of electronic banking.

The years 1997-2002 covers the pre-adoption period and 2003- 2010 covers the post full adoption period of electronic banking in Nigeria.

Based on the above, the mean returns on assets and equity respectively for each bank was computed for the relevant years of the group data.

.

where:

BROE = Bank Returns on Equity  
 BROA = Bank Returns on Assets  
 N = Number of years

Based on the means computed for each bank, the test for difference between means was conducted to test how significant our results are at five percent (5%) level of significance. The test for difference between

means is a standard statistical technique for testing independent samples.

#### 4.1 Data Presentation and Analysis

**Table 1:ROE (return on equity) Pre Adoption of E-banking**  
 $X_1, X_2, \dots, X_6$  = ROE for all sampled Banks for the relevant years

	<b>X<sub>1</sub></b>	<b>X<sub>2</sub></b>	<b>X<sub>3</sub></b>	<b>X<sub>4</sub></b>	<b>X<sub>5</sub></b>	<b>X<sub>6</sub></b>	<b>MEAN</b>
BANK	1997	1998	1999	2000	2001	2002	
A	0.18	0.20	0.28	0.31	0.28	0.22	0.245
B	0.21	0.21	0.30	0.39	0.37	0.16	0.273
C	0.17	0.04	0.23	0.43	0.14	0.14	0.192
D	0.36	0.33	0.16	0.20	0.24	0.20	0.248
TOTAL							0.958
Mean of Means							0.240

**Source:** Computed from Stock Exchange Fact book (various issues) and Annual reports on sampled banks for the relevant years

**Table 2: ROE (Return on Equity) Post Adoption of E-banking**

	X <sub>1</sub>	X <sub>2</sub>	X <sub>3</sub>	X <sub>4</sub>	X <sub>5</sub>	X <sub>6</sub>	X <sub>7</sub>	X <sub>8</sub>	Mean
BANK	2003	2004	2005	2006	2007	2008	2009	2010	
A	0.41	0.29	0.27	0.26	0.24	0.09	0.10	0.05	0.214
B	0.20	0.22	0.24	0.10	0.13	0.22	0	0	0.139
C	0.22	0.23	0.26	0.24	0.12	0.21	0.07	0.01	0.170
D	0.12	0.03	0.32	0.10	0.11	0	0	.02	0.090
Total									<b>0.613</b>
Mean of Means									<b>0.153</b>

X<sub>1</sub>, X<sub>2</sub>, ..., X<sub>8</sub> = ROE for all sampled Banks for the relevant years

**Source:** Computed from Stock Exchange Fact books (various issues) and Annual reports on banks for the relevant years.

**Table 3:ROA (Return on Assets) Pre Adoption of E-banking**

	<b>X<sub>1</sub></b>	<b>X<sub>2</sub></b>	<b>X<sub>3</sub></b>	<b>X<sub>4</sub></b>	<b>X<sub>5</sub></b>	<b>X<sub>6</sub></b>	<b>Mean</b>
BANK	1997	1998	1999	2000	2001	2002	
A	0.02	0.02	0.02	0.02	0.02	0.01	0.018
B	0.02	0.02	0.02	0.02	0.02	0.02	0.020
C	0.02	0.00	0.01	0.03	0.01	0.01	0.013
D	0.02	0.03	0.02	0.02	0.02	0.02	0.022
Total							<b>0.073</b>
Mean of means							<b>0.018</b>

X<sub>1</sub>, X<sub>2</sub>, ..., X<sub>6</sub> = ROA for all sampled Banks for the relevant years

**Source:** Computed from Stock Exchange Fact book (various issues) and Annual reports on sampled banks.

**Table 4: ROA (Return on Assets) Post Adoption of E-banking**

	<b>X<sub>1</sub></b>	<b>X<sub>2</sub></b>	<b>X<sub>3</sub></b>	<b>X<sub>4</sub></b>	<b>X<sub>5</sub></b>	<b>X<sub>6</sub></b>	<b>X<sub>7</sub></b>	<b>X<sub>8</sub></b>	<b>Mean</b>
BANK	2003	2004	2005	2006	2007	2008	2009	2010	
A	0.03	0.04	0.03	0.03	0.02	0.03	0.02	0.02	0.028
B	0.02	0.02	0.02	0.02	0.02	0.03	0	0.02	0.019
C	0.01	0.02	0.02	0.01	0.02	0.03	.01	0.00	0.015
D	0.01	0.01	0.05	0.02	0.02	0	0	0.08	0.024
Total									0.097
Mean of means									0.024

X<sub>1</sub>, X<sub>2</sub>, ..., X<sub>8</sub> = ROA for all sampled Banks for the relevant years

**Source:** Computed from Stock Exchange Fact books (various issues) and Annual reports of banks.

### Test for Difference Between Means

$$t = \frac{\bar{X}_1 - \bar{X}_2}{s_{\bar{X}_1 - \bar{X}_2}} \quad \text{Eqn. 3}$$

where

$$s_{\bar{X}_1 - \bar{X}_2} = \sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}. \quad \text{Eqn. 4}$$

Here  $s^2$  is the unbiased estimator of the variance of the two samples,  $n_i$  = number of participants in group  $i$ ,  $i=1$  or  $2$ . Note that in this case  $\frac{s_{\bar{X}_1 - \bar{X}_2}^2}{2}$  is not a pooled variance.

$$\text{d.f.} = \frac{(s_1^2/n_1 + s_2^2/n_2)^2}{(s_1^2/n_1)^2/(n_1 - 1) + (s_2^2/n_2)^2/(n_2 - 1)} \quad \text{Eqn. 3}$$

#### 4.2 Empirical Results and Discussion.

The test for difference between means were conducted for pre and post adoption of electronic banking for both returns on equity (ROE) and returns on Assets (ROA) at 5 Percent levels of significance. The results reveal that there is significant difference between pre and post returns on equity on adoption of electronic banking, hence t-calculated  $> t_{0.05}$  i.e.  $2.767 > 2.571$ . The clearer picture of the results is that adoption of e-banking in Nigeria has significantly improved Nigerian banks performance in terms of returns on equity (ROE) only.

On the other hand, the results also reveal that there is no significant difference between pre- and post- returns on assets (ROA) of Nigeria banks on adoption of e-banking. Here, the implication of this result is that electronic banking adoption has not significantly improved the returns on assets of Nigerian banks. These tests for difference of means applied to test pre - and post-returns on adoption of the e-banking technology showed no positive impact of the e-banking technology on the profitability performance indicator measured as ROA, hence the t-calculated  $< t_{\alpha/0.05}$  i.e.  $-946 < 2.571$ .

Going by the activities of banks and their full integration into electronic banking system, the operations costs of banks have

increased rapidly in relation to turnover. It is also a known fact that electronic banking technology is capital intensive which involves huge initial capital spending and associated maintenance costs. Consequently, electronic banking equipment has increased the total cost of assets of banks. As a result of the above, total asset returns being positive in the short run may not be feasible. It is expected that there should be lag period before positive returns on total assets are noticed.

The result of this study above is in line with those of Onay et al [7] that used Turkish banks to test the impact of internet banking on bank profitability. Their study revealed online banking as a gradual process, and further, provided evidence that internet banking variables have had a positive impact on the performance of the banking system in Turkey in terms of ROE only with a lag of two (2) years. Hernando and Nieto [15] in their study that used Spanish banks revealed positive impact of e-banking in the third year of adoption. This also conveys that there is a lag period for recovery of the huge capitalized costs. Siam [16] in a similar study discovered negative effect of electronic banking services using Jordanian banks in the short run. This he attributed to cost of investments by the banks to set up the technical and electronic infrastructure; train their employees to be skilled as well as

competent in this field and prepare what is called an electronic environment where banks can electronically operate smoothly. The result of this study also shares similar opinion of these scholars and hope that profitability level of performance may be better in the long run.

Nevertheless, the result of this study with respect to returns on total assets does not imply that electronic banking is not necessary nor is it an expenditure in futility. E-banking creates more bank products and has come a long way in satisfying customers' quest for improved financial service delivery. Customers can do banking transactions at their convenience; hence 24 hours are available for banking transactions. Electronic banking should increase efficiency and reduce wastage. It has led to expansion of the banking industry, opening new avenues for banking operations. Electronic banking has greatly helped banks to reduce paper work, thus helping them to operate in more reduced paperless environment. It has also discouraged many illegal and illegitimate practices associated with money laundering. E-banking has changed the dimensions of competition in deposit money banking by adding a new distribution channel to deposit money banking.

However, because one of the profitability performance indicators (ROA) examined in this study is yet to be improved, this study cannot conclude that electronic banking has generally improved profitability performance of banks in Nigeria. The unimproved returns on assets meanwhile may have arisen from the high cost of the technology and maintenance cost of software. It is a fact that e-banking facilities are still new with high cost of maintenance

and updating of software as well as human capital. This may be the reason why Nikolai and Bazley<sup>[13]</sup> posited that the returns on company's assets will get higher as the assets become older because the denominator will decrease each year due to the increase in accumulated depreciation. Furthermore, since prices tend to increase arising from inflation, a company that uses recently purchased assets will tend to show relatively lower returns on these assets. As a case, Nigeria is a developing country, if the size of bank customers continues to grow in future; the returns on ROA and ROE will relatively improve significantly. This is to say in simple terms that the improvement expected on profitability will manifest in the long run. Also, Nigeria as a country meanwhile experience poor power supply for operations. The costs of generating energy for about 24 hours daily to operate computers and other electronic machines used in electronic banking activities are enormous. This is because people and corporate organizations resort to own generating set to augment epileptic power supply by the agency in charge of power supply in Nigeria - the PHCN. All these cause the operating costs to rise.

### **5.1 Summary, Conclusion and Recommendations:**

This study investigated the returns on equity and returns on assets of Nigerian banks following the adoption of electronic banking in Nigeria. Nigeria is a developing country advancing in the use of electronic banking for its banking operations in comparison with others in African region. With high level of e-banking fraud, some customers feel discouraged with the use of

Automated Teller Machines (ATM), an electronic banking product.

This study has provided evidence that electronic banking has improved returns on the equity of Nigeria banks significantly but yet to positively improve the returns on assets (ROA) based on the hypotheses tested. As revealed by the empirical result on returns on assets, this study does not suggest that the adoption of e-banking is an investment in futility; rather it helps to satisfy customers' appetite for improved service delivery and convenience. The unimproved returns may have arisen from the high cost of maintenance of equipment, software and training of personnel. Electronic banking is cost intensive and will improve on total profitability performance in future as incidence of banking fraud caused by electronic facilities reduces and as well as the assets get older. The study encourages the use of electronic banking system based on its enormous benefits to the bank management, customers and the regulatory authorities.

This study therefore recommends as follows:

That the banking industry should adjust to full and effective deployment of information technology due to its sophistication since the technology is irreversible with relative perceived advantage.

That Nigerian banks should be able to accept the level of risk that they can cope with in electronic banking system, measurable to the bank's overall strategic and business plans. Though there is inherent risk for not adopting e-banking.

That banks should be able to provide adequate security both physically and electronically to check the incidence of hacking by fraudsters. Network hackers successfully dupe banks of billions of naira at a strike and can send banks into liquidation.

That holder of banking transaction cards should be able to secure them by providing passwords

Those are unimaginable by the most immediate neighbors at intervals but re-collectible at all times.

That shareholders of banks should exercise patience with the banks management in the payment of dividend as perceived future dividends will be fatter after some lag period of cost recovery.

That the banks management should from time to time train customers with regard to electronic banking, its benefits, risk exposure, physical and electronic security to avoid financial loss in the hands of hackers. Also, trainings should be held for bank staff in short periods to acquaint them with modern developments of the sophisticated technology in changing times.

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## Appendices

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 /VARIABLES=ROE  
 /CRITERIA=CI(.9500).

**T-Test**

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**Group Statistics**

GROUP	N	Mean	Std. Deviation	Std. Error Mean
ROE	1	.2395	.03406	.01703
	2	.1533	.05220	.02610

**Independent Samples Test**

	Levene's Test for Equality of Variances		t-test for Equality of Means						95% Confidence Interval of the Difference	
	F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper	
ROE	Equal variances assumed	.796	.407	2.767	6	.033	.08625	.03117	.00999	.16251
	Equal variances not assumed			2.767	5.163	.038	.08625	.03117	.00689	.16581

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► T-Test

[DataSet1]

**Group Statistics**

	GROUP	N	Mean	Std. Deviation	Std. Error Mean
ROA	1	4	.0183	.00386	.00193
	2	4	.0215	.00569	.00284

**Independent Samples Test**

	Levene's Test for Equality of Variances		t Test for Equality of Means						95% Confidence Interval of the Difference	
	F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference			
								Lower	Upper	
ROA	Equal variances assumed	1.205	.314	-.946	6	.381	-.00325	.00344	-.01166	.00516
	Equal variances not assumed			-.946	5.282	.386	-.00325	.00344	-.01194	.00544

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