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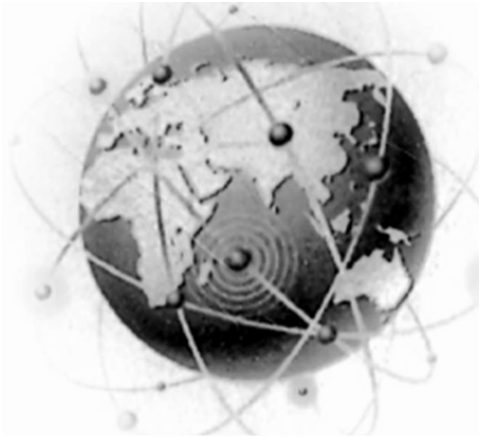

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Analytical Verification of Requirements for Safe and Timely Lay-down of an Offshore S-Lay Pipeline Abandonment Head during Some Pipe-Lay Stops: A case study of Forcados Yokri Integrated Pipeline Project in Nigerian Shallow Offshore.

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Abstract

It is not often planned that an S-lay installation barge will stop operation for longer time than necessary. In some cases, one may think that stoppage will last for some minimal time. In some other time, it could be for an unpredicted number of days, especially when it is an industrial dispute or security crisis. This happens frequently in developing countries. This paper demonstrates the importance to always abandon pipelines on seabed when there are interruption in continuing pipeline construction, especially when such interruption are beyond the control of the engineering team. The result of this paper indicates that consequence of not doing so is very cruel to the structural integrity of the pipeline structure after the first twenty four (24) hours of exposure in West African Nigerian mild offshore weather condition. Environmental pollution and therefore safety of lives and properties may be jeopardized should the pipeline structure be used for oil or gas transport when such limits are ignored. Fracture mechanics approach is used on API 5L X52 of wall thickness of 0.5 inches pipeline structure. The pipeline was failed in a fatigue event due to wave loads in Forcados offshore in the Nigerian Niger Delta area. A 30-days wave data is employed in the analysis and result computations.

1.0 Background

A lay-barge was installing pipeline in theNigeria shallow Forcados offshore. The project was part of the effort of Shell Nigeria to reduce gas flaring in the region. The project of pipe-laying was mobilized in 1999. In March 2004, an industrial problem took place. The pipeline was not abandoned as supposed due to the crisis. The barge was left with the pipeline hanging for six (6) months. On the 180th day, as unfair sea weather hit the area, the pipeline parted from the welded joint just after the Stinger [1].

Ordinarily, one would expect that due to the ductility of the pipe, the pipeline would at its worst undergo excessive twisting, bending and buckling. These were not obvious prior to the parting of the pipeline. The likely reason for the parting is believed to be the cyclic swell/wave loading on the pipeline joint over time, causing yielding of then the eventual failure.

Forcados offshore, similar to the rest of the West African Ocean is mild in nature. Environment of Offshore West Africa lacks locally generated storms, therefore storm surge is minimal and tidal current and swell dominate water level variations [2]

In pipeline installation design practice, static analysis is performed for various configurations of pipe-laying and the worst case is selected to perform the dynamic analysis which will include the Response Amplitude Operators (RAO) for the barge and the hydrodynamic loading on the pipeline itself. The Response Amplitude Operator is simply a measure of the Heave, Surge and Pitch of the barge relative to wave period. In the authors' experience, the static and dynamic computations and analysis do not cover adequately the effect of number of cyclic wave loading on the girth welds.

On long exposure period, specially as certain degree of weld surface and buried imperfections are often allowed during pipeline fabrication.

In a normal practice, stoppage of offshore pipe-lay work mid-way is done by installing an Abandonment-head and then lowering this head to the sea bottom with an attached buoy for easy identification and retrieval. However, in Nigeria and other part of world where military/militant and industrial crisis could emerge at any time during pipe-laying, time is often insufficient to lay-down the pipeline as supposed. It bcomes therefore reasonable to determine the limit of cyclic loading on pipeline that could endanger the integrity of pipeline structure.

The purpose of this presentation is to demonstrate the danger inherent in pipelines when exposed to cyclic loadings over a period of time. The paper reinforces a requirement that pipelines on S-Lay must be abandoned as soon as delay on site is beyond a reasonable period of time

.2.0 Literature review

The crack tip opening displacement (CTOD) of a pipeline segment with an external circumferential surface crack has been investigated by [3] under pure bend loading as well as bending with internal pressure. Though the loading considered in the investigation is not fatigue loading, the result indicated variation of CTOD with strain as approximately a simple linear relationship. The implication of the observation is therefore that CTOD will increase with increasing strain, be it strains from bending, internal pressure or fatigue. Reference [4] agrees that the installation of pipelines under bending may alter the material properties and increasethe weld defects, thus, reducing the fatigue life of the joints under operational loads. The work of [4] was based on cyclic bending processes as it occurs during reeling installation method. Lack of fusion and lack of penetration with varied dimensions in girth weld were considered. The work paid attention to localized deformation that occurs in the vicinity of the defect during reeling

Although, more bending stresses are found on pipeline in the reeling method but more cyclic loadings are encountered on S-lay installations between the over-bend and sag-bend especially at fairly higher depth of water (Figure 1). This is because the rate of pipe-laying is slower with manual welding and the wave action is always active. And when there are technical or industrial relation problems, the line with the girth welds containing defects could be exposed to the loading for longer period. This complicates the problem

3.0 Methodology

A related investigation as was performed by [4] for reel method is now carried out for S-lay installations. The Heave acceleration is of great interest as this is responsible for the rate of change of momentum of the S-part of the pipeline structure in the near-vertical direction, giving rise to the cyclic stresses.

Heave acceleration of the barge, 1 (1)

Examining the vessel at pipe laying condition, the submerged S-part of the pipeline between the Stinger and the sag-bend of the pipeline is tossed up and down in a cyclic manner with respect to the heave. The stress on this S-part is worked out:

Force on S-part as it tosses up and down due to heave = Submerged weight of S-pipeline in water + Net Mass x acceleration of the S-pipeline due to Heave.

$$= (m - \rho v)g + (m - \rho v)\, a_{barge} \qquad (2)$$

Where:

mg = weight of the S-pipeline in air

ρgv= upthrust on the S-pipeline

In attempting to present cyclic loading effect on the girth weld of S-lay pipeline installation, the following analytical approach is proposed:

Heave, H = H (t).

$(m - \rho v)\, a_{barge}$ =acceleration force on the S-pipeline due to heave m=mass of the S-part of the pipeline of the pipeline under consideration

v=outer volume of the s-part of the pipeline under consideration

ρ=density of water

a_{barge} = acceleration of barge stinger carrying the S-pipeline under consideration.

Then:

Stress on the S-pipeline under consideration, in water exposed to heave,

$$\delta = [(m - \rho v)g + (m - \rho v)\, a_{barge}]/A \qquad .(3)$$

Where A is the cross-sectional area of this pipeline under consideration

Equation (3) is related to the work of [5] as further described in the analysis section. The effect of the cyclic loading on girth weld in water exposed to

wave action is then analyzed using typical API 1104 guideline.

4.0 Data

5.0 Aanalysis

The following assumptions are considered in this work:

1. Pitching is minimal
2. Barge heave acceleration, a_{barge} = acceleration of the S-pipeline. (This is a good assumption, since the s-pipeline is assumed fixed by the lay-barge's tensioner).
3. The girth weld is assumed to contain minimum defect similar to the work of [4].
4. The position of the girth weld is mid way prior to the touch-down-point.
5. The cross-sectional area of the cresting or troughing parts of the sea wave is approximately half-ellipsoidal. This is fair assumption since the West African wave can be considered using a 1st order Stoke wave theory [7].
6. Vessel is positioned aft or bowed to the wave front.
7. The West African Swell characteristic applies such that wavelength is longer than the length and breadth characteristic of the lay barge and can be considered to follow the first order linear theory.
8. The pipeline between the over-bend and sag-bend is held by the vessel's tensioner such that forces are transmitted through the axis of the pipeline. See Figure 1.
9. Note that when the vessel undergoes high pitching, depending on subsea bottom condition, reasonable variation exists between barge heave acceleration and pipeline, the pipeline begins to 'bang' on the Stinger rollers causing high stresses on the pipeline. In this work however, it is assumed that this condition does not exist and the interest is on the girth weld lying between the Stinger (over-bend) and the sag-bend as shown in Figure 1.

Generally speaking, pipelines are built with materials of good ductility, but at the welded joints and Heat Affected Zone (HAZ), ductility is lower and can be characterized by J-fracture toughness measure or Crack Tip Opening Displacement (CTOD). CTOD is related to J and following the work of [5]:

Sea State reports for the project in 2004 was unavailable. Wilkens Weather Technologies Weather Report 04 UTC May/June-2008, for a pipeline project in a close location is therefore used in the computation of the results [6].

$$\frac{da}{dN} = c\,(\Delta J)^m$$

Where

$$\Delta J = \frac{\Delta K^2}{E^1} = \frac{(Y\Delta\delta\sqrt{\pi a})^2}{E^1}$$

And

$$E^1 = \frac{E}{1-v^2}$$

E=Modulus of elasticity of the pipeline

v = Poisson ratio

m is the coefficient of model influence and vary between 2 and 4 depending on the magnitude of the stress cycles

C is an empirical crack growth constant that depends on material elasticity, yield stress and fracture strength.

a=imperfection or crack length. (Note that in this paper we are assuming this length to be growing along the thickness).

Y is the imperfection characteristics

N is the cyclic loading

δ is the cyclic stress

K=Fracture toughness.

$$\frac{da}{dN} = c\left[\frac{(Y\Delta\delta\sqrt{\pi a})^2}{E^1}\right]^m \qquad .(5)$$

Observe distinctively that if the initial size of our imperfection, $a_{initial}$ is known, the only critical variable required to identify the number of cycles to failure is $\Delta\delta$.

Consider that the cross-sectional area of the Cresting part of the sea wave is approximately half-ellipsoidal (Figure 2) such that Lay barge moored bow to or Aft of the wave front will have wave crest $r_1/2$ as it heaves the vessel, and simplifying the problem using a simple 1st order Stoke's wave theory, the following derivation is further made

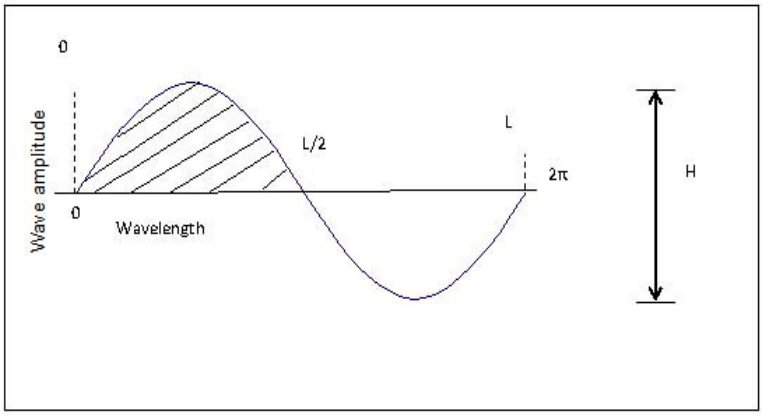

Figure 2. Crest volume of the wave. Crest – Trough Semi elliptical shape assumption.

Volume of the Cresting wave, V_w = (0.5) (b_L/0.5L)(π (0.5r_1)r_2 b_b) .(6)

r_1 = wave height

r_2 = quarter wavelength (i.e. 0.25L)

b_b= barge characteristic breath along the water line and

b_L= barge characteristic length along the water line

L= wavelength

The factors (b_L/0.5L) is the relative dimension factor as the crest volumes are formed by a particular wave traveling crest to trough from the bow to the aft of the barge or vice versa through the length of the barge bottom, so that the shorter the wavelength relative to the barge length characteristic, the more the wave crest is peaked, the more the effect. The rest part of the equation is half the area of the ellipsoidal wave form. The equation then is the total volume of water crested as it heaves through.

Equation (6) can be re-written:

V_w = 0.125 π b_L b_bH (7)

Mass of this wave volume acting underneath the lay-barge, M_w= ρ V_w (8)

Wave vertical acceleration for a linearized wave formulation, as given by [8] is:

a_w= -ϵ_0gκ Sinh κ (z+d) Sin (ωt-κx)/Cosh (κd) (9)

ϵ_0=1/2 maximum wave height.

κ =wave number

z =depth variation (z = 0 at mean level, z = -d at sea bottom)

d= depth at sea bottom.

Therefore, wave-upward force under the barge due to the wave cresting volume= $M_w a_w$

From Newton's second law:

M_b' a_{barge} - $M_w a_w$ = 0 (10)

Where

M_b'= mass of the lay barge plus added mass in water

a_{barge} = barge acceleration

Giving:

M_b' a_{barge}=$M_w a_w$

a_{barge}= $M_w a_w$/ M_b' (11)

Observe that barge acceleration increases with reduction in mass of barge.

The time of the barge acceleration from trough to crest = 0.5 wave period =T/2.

Then, from Newton's first law;

Heave max = H_{max}= 1/2 a_{barge} $(T_c/2)^2$ (12)

T_c = Time within a period to reach crest from trough.

Equation 11 shows that a_{barge} can be used to determine the magnitude of the Heave as the barge tosses from trough to crest.

Equation 11, can be re-written as

$$a_{barge} = -(0.125\ \rho\ \pi\ B_B B_L H)(\epsilon_0 g \kappa \operatorname{Sinh} \kappa (z+d) \operatorname{Sin}(\omega t - \kappa x)/\operatorname{Cosh}(\kappa d))/ M_b' \quad \ldots\ldots\ldots\ldots(13)$$

Utilizing equation (13) into known variables of equation (3) and equation (7), it is possible to estimate the stresses induced by various sea state for given size of pipeline and barge characteristic in a girth joint.

Date of Record		Period T/sec	Sig.H Hs/m	Hmax Hmax/m	Mean T/day Tmean	Avg.Hs/day Hs(mean)	Avg Hmax/day Hmax(mean)	Max Stress KN/m^2	Min Stress KN/m^2
31/05/2008	00hr	13	1.8	3	13.5	1.85	3.025	512	464
	0600hrs	13	1.8	2.9					
	12hrs	14	1.9	3.1					
	1800hr	14	1.9	3.1					
1/6/2008	00hr	13	1.9	3.1	13	1.8	2.95	510	465
	0600hrs	13	1.8	3					
	12hrs	13	1.8	2.9					
	1800hr	13	1.7	2.8					
2/6/2008	00hr	13	1.7	2.7	12.25	1.7	2.825	511	464
	0600hrs	12	1.7	2.8					
	12hrs	12	1.7	2.9					
	1800hr	12	1.7	2.9					
3/6/2008	00hr	12	1.6	2.7	11.25	1.6	2.625	512	463
	0600hrs	11	1.6	2.6					
	12hrs	11	1.6	2.6					
	1800hr	11	1.6	2.6					
4/6/2008	00hr	11	1.5	2.5	10.5	1.5	2.5	513	463
	0600hrs	11	1.5	2.5					
	12hrs	10	1.5	2.5					
	1800hr	10	1.5	2.5					
5/6/2008	00hr	10	1.3	2.2	9.75	1.3	2.15	509	467
	0600hrs	10	1.3	2.2					
	12hrs	10	1.3	2.1					
	1800hr	9	1.3	2.1					
6/6/2008	00hr	9	1.3	2.1	8.75	1.3	2.1	513	463
	0600hrs	9	1.3	2.1					
	12hrs	9	1.3	2.1					
	1800hr	8	1.3	2.1					
7/6/2008	00hr	8	13	2.1	12.75	4.375	2.4	503	472
	0600hrs	13	1.5	2.5					
	12hrs	15	1.5	2.5					
	1800hr	15	1.5	2.5					
8/6/2008	00hr	15	1.6	2.7	14.25	1.625	2.7	504	471
	0600hrs	14	1.7	2.7					
	12hrs	14	1.6	2.7					
	1800hr	14	1.6	2.7					
9/6/2008	00hr	14	1.6	2.7	13.25	1.525	2.65	507	470
	0600hrs	13	1.5	2.7					
	12hrs	13	1.5	2.6					
	1800hr	13	1.5	2.6					
10/6/2008	00hr	13	1.4	2.3	13	1.525	2.5	504	470
	0600hrs	13	1.6	2.6					
	12hrs	13	1.6	2.6					
	1800hr	13	1.5	2.5					

Date of Record		Period T/sec	Sig.H Hs/m	Hmax Hmax/m	Mean T/day Tmean	Avg.Hs/day Hs(mean)	Avg Hmax/day Hmax(mean)	Max Stress KN/m^2	Min Stress KN/m^2
11/6/2008	00hr	13	1.5	2.5	13	1.5	2.5	504	470
	0600hrs	13	1.5	2.5					
	12hrs	13	1.5	2.5					
	1800hr	13	1.5	2.5					
12/6/2008	00hr	12	1.4	2.4	11.5	1.35	2.25	504	471
	0600hrs	12	1.4	2.4					
	12hrs	11	1.3	2.1					
	1800hr	11	1.3	2.1					
13/6/2008	00hr	10	1.3	2.1	10	1.3	2.1	507	469
	0600hrs	10	1.3	2.2					
	12hrs	10	1.3	2.1					
	1800hr	10	1.3	2					
14/6/2008	00hr	9	1.3	2.1	11	1.3	2.125	504	471
	0600hrs	9	1.3	2.1					
	12hrs	13	1.3	2.1					
	1800hr	13	1.3	2.2					
15-06-08	00hr	12	1.3	2.2	12	1.35	2.25	503	473
	0600hrs	12	1.3	2.1					
	12hrs	12	1.4	2.3					
	1800hr	12	1.4	2.4					
16-06-08	00hr	11	1.4	2.4	8.6	1.55	2.55	525	450
	0600hrs	11	1.6	2.6					
	12hrs	11	1.6	2.6					
	1800hr	1.4	1.6	2.6					
17-06-08	00hr	14	1.6	2.6	13.75	1.65	2.7	505	470
	0600hrs	14	1.7	2.7					
	12hrs	14	1.7	2.8					
	1800hr	13	1.6	2.7					
18-06-08	00hr	13	1.6	2.7	12.25	1.45	2.45	505	470
	0600hrs	12	1.5	2.5					
	12hrs	12	1.4	2.4					
	1800hr	12	1.3	2.2					
19-06-08	00hr	11	1.3	2.2	11	1.3	2.2	505	471
	0600hrs	11	1.3	2.2					
	12hrs	11	1.3	2.2					
	1800hr	11	1.3	2.2					
		Mean Period over 30days-			12.2				
		Average Maximum & Minimum Stress Over the 30days						508.8387	466.6452

Planar Surface imperfection
Acceptable height
0-0.153in (0-3.9mm)
0.154-0.31in (3.9-7.9mm)

7.0 Discussion of the results

About 5 stress cycles are made within a minute for the pipeline lay stop. Lay-stop means that pipeline fabrication and pipe-laying activities have come to a halt and have been left on the Stinger. On a quick look, it could be found that the stresses caused by the exposed wave conditions are quite low compared to

the yield strength of the pipeline in question. The long time effect however is dangerous.

The relevance of this result can be found when one considers a related case as illustrated in [9], API 1104 (2005) section A7.3 Table A6.

For the purpose of this paper, it is assumed that during the welding of the joint, an initial acceptable defect, a_i = 3mm was introduced, due to lack of weld

Planar buried imperfection
Acceptable height
0-0.153in (0-3.9mm)
0.154-0.354in (3.9-9mm)

Taking the work of [10], and noting that the stress variations within cycles relative to the yield strength of the pipeline is small,C and M are taken as 5 and 2 respectively.

Also considering the work of [11];
Y can be taken as 1.1.

a= $a_{initial}$= 3mm (acceptable depth of imperfection according to Table 1).

$$E^1 = \frac{E}{1-v^2}$$

Given:
E=207X10^9 pa
v=0.3
E^1=2.27x 10^{11}pa
Equation 5 becomes

$$da = cY^{2m}\left[7.32X10^{-5}\right]^m dN$$

Further computation gives the results shown in Table 2
.

Table 2. Showing the imperfection depth growth as days of pipeline exposure is increased at five (5) stress cycles per minute.

Days exposed	Stress cycles	Difference, da (mm)	Final height (mm)
1	7200	0.282419971	3.282419971
30	216000	8.472599119	11.47259912
60	432000	16.94519824	19.94519824
90	648000	25.41779736	28.41779736
120	864000	33.89039647	36.89039647
150	1080000	42.36299559	45.36299559
180	1296000	50.83559471	53.83559471

Table 2 shows that the structure has lost its fatigue life just during installation almost after the first day of exposure. The wall thickness of the pipeline is 12.7 mm and nearly used up within the first 30 days.

Checking vessel natural period T_0,

Stiffness K = $\rho g A_{wl}$ =1025x9.81x22x75=16.6x10^6 N/m

Total mass of vessel M_T =2541600kg

$$T_0 = \frac{2\pi}{\sqrt{\frac{K}{M_T}}} = 2.5\text{sec}$$

Mean wave period. T = 12.2sec

The vessel is unlikely to pick on resonance.

The relative frequency relation $\beta = \frac{\omega}{\omega_0} = \frac{T_0}{T} = 0.2 << 1$

If λ =damping ratio is assumed to be 1%

Checking on the phase angle between the wave condition and the vessel response,

$$\theta = \text{arctg}\ {2\lambda\beta}/{(1-\beta^2)} = 240^0$$

The vessel is Stiffness controlled and responds nearly in opposite behavior to the wave conditions.

$$\text{Dynamic amplification D} = \frac{1}{\sqrt{[(1-\beta^2)^2 + (2\lambda\beta)^2]}}$$

D=1.04

The vessel is stiff enough to resist motion amplification due to the wave loadings.

Therefore resonance or wave loading amplification did not happen within this period under consideration and the result of the damage is purely due to fatigue caused by the wave loadings.

8.0 Conclusion

The work demonstrates that the effect of the cyclic loading imposed by sea condition in the circumstance under consideration cannot be ignored. Though, simple assumptions were made to ease the calculations, it is a pointer that girth welds at positions considered in this project stand structurally jeopardized if exposed beyond 24 hours.

An interesting parameter identified and used in this work is the vessel heave acceleration. This parameter has been observed to be dependent on the wave condition, weight of the barge and the vessel dimensional characteristics.

An interesting parameter identified and used in this work is the vessel heave acceleration. This parameter has been observed to be dependent on the wave condition, weight of the barge and the vessel dimensional characteristics.

It is suggested that further work be carried out to define the effective wave-crest volume value which is the function of actual weight of crest water above the mean water-line that acts on the vessel bottom against the vessel's weight at a given time. It is also necessary to test the validity of this model using direct measurements and nite Element Methods

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Effect of Moisture on Natural Fibre Reinforced Plastics.

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Abstract

In this research, the rate of moisture absorption of the composites reinforced with natural fibres – Ukam plant fibres (chochlostermum placoni) were studied and determined.Composite cubes and plates of different sizes were prepared, then immersed in water for 24 hours at room temperature in order to determine the extent of moisture absorbtion. This was found to be relatively lower for longitudinal arrangement of fibres compared to transverse arrangement. It was observed that the Longitudinal and transverse moisture expansion coefficients were 0.496 and 0.644 respectively.

Keywords: Composites, Natural Fibre, Matrix, Absorption, Moisture Expansion Coefficients.

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1.0 introduction

Composite materials are defined as a mixture of two or more relatively homogeneous materials which have been bonded together to produce a material with properties that are superior to the ones exhibited by the individual component materials[1]. In practice, most composites consist of two or more discrete physical phases, in which a fibrous phase is dispersed within a continuous matrix phase, and the fibrous phase must retain its physical identity, such that it conceivably can be removed from the matrix intact [2]. In the world of technology today, attention is on Natural fibres as reinforcement for resin matrices.

For centuries, mankind has used natural fibres for various types of applications including building materials, making of ropes, spacecraft applications, and the automobile industries have also come up as some of their main beneficiaries [3]. In most countries, users have explored the possibilities of using natural fibres from different plants, which include bagasse, cereal straw, corn stalk, cotton stalk, banana fibres, rice husk / rice straw [4]. The renewed interest resulted in new ways of natural fibre modifications and use and brought them to be superior to synthetic fibres. Composites (reinforced with natural fibres) – the wonder material, with light-weight, high strength to weight ratio and stiffness properties have come a long way in replacing the conventional materials like metals, woods and non-renewable (synthetic) fibres which are more expensive [5]. The natural and wood fibres derived from annually renewable resources, as reinforcing fibres, in both thermoplastic and thermoset matrix composites provide positive environmental benefits with respect to ultimate disposability and raw material utilization [6].

2.0 Materials And Methods

The materials used in this work include:

i. Ukam plant fibres (chochlostermum placoni)
ii. Polyester resin.
iii. Catalyst (methyl ethyl ketone)
iv. Accelerator (cobalt)
v. Gell coat

Specimens were prepared and grouped into specimens “P” and “Q”. Specimen ‘P’ comprises of composite cubes of different sizes (i.e. A, B & C) and different V_f. Specimen ‘Q’ comprises of composite plates of different sizes and

different V_f. (I.e. D & E) the weights of the specimens were taken dry, they were then immersed in water for 24 hours at room temperature. After 24 hours, the specimens were brought out, dried with towel and weighed again. The summary of these processes are tabulated below

2.1 Observations

Table 1 Moisture Intake of the composite of Ukam Plant Fibres

Specimen	Mass of dry specimen (g)	Mass of moist specimen in (g)	Mass of water absorbed (g)	Percent moisture content "C" (%)	Volume of specimen (Cm^3)
SPECIMEN 'P'- COMPOSITE CUBES (20x20x20) mm^3					
A (control)	13.55	13.57	0.02	0.148	9.261
B – 10% V_f	10.16	10.20	0.04	0.394	7.600
C – 30% V_f	12.38	12.46	0.08	0.646	8.379
Specimen 'Q'- Composite Plates					
D – 30% V_f	15.05	15.17	0.12	0.797	11.040
E – 10% V_f	10.12	10.16	0.04	0.395	5.75

2.2 Densities of polyester resin and ukam plant fibres

$$C = \frac{m}{v} \quad - \quad - \quad - \quad - \quad - \quad - \quad - \quad (1)$$

Where m = mass, v = volume and ρ = density.

Table 2 properties of Ukam plant fibres and polyester resin.

Property	Polyester Resin	Ukam Plant Fibres
Mass (kg)	0.747	0.036
Volume (m^3)	5.98×10^{-4}	2.73×10^{-5}
Density (kg/m^3)	1.25×10^3	1.32×10^3

2.3 Moisture expansion coefficients

Moisture absorption by a body (e.g., resin matrix) in composite materials causes a volumetric change in the body. Because of this, coefficient of moisture expansion becomes a composite property that should be studied andDetermined [7].

The percent moisture content, C, in a body is defined as

$$C = \frac{\text{Weight of moist material} - \text{Weight of dry material}}{Weight of dry material} \times 100 \quad (2)$$

A coefficient of moisture expansion, **β**, can be defined as the change in linear dimension of the body per unit initial length per unit change in moisture concentration, and moisture concentration may be defined as the weight of moisture present per unit weight of the body [8].

By converting the weight of moisture content to its volume and considering that linear strain is only one third of the volumetric strain, the expression for **β** of a body can be expressed thus:

$$\beta = \frac{1}{3}\frac{\rho}{\rho w} \quad (3)$$

Where ρ = density of the body

ρ_w = density of water.

Equation (3) is applicable when there are no voids in the body. When voids are present, the actual expansion of the body due to moisture will be less than that indicated by equation (3)

Moisture absorbed by the matrix results in a volume change of the composite. However, the expansion of unidirectional composites in the longitudinal direction is negligible because of the much higher stiffness of the fibres. Therefore, the longitudinal coefficient of moisture expansion, β_L of a unidirectional composite is taken to be zero. The transverse coefficient of moisture expansion, β_T, of the unidirectional composite, is related to the moisture expansion coefficient of the matrix, β_m, as follows:

$$\beta_T = \frac{\rho_c}{\rho_m}(1 + \nu_m)\beta_m \quad (4)$$

Where ρ_c = density of the composite.

ρ_m = density of matrix materia

ν_m = Poisson's ratio of the matrix.

Using equation (3) and the data obtained from the experiment performed, the moisture expansion coefficient of the matrix, composite and Ukam plant fibres are calculated thus:

Given that:

ρ_c = 1.34 x10^3 kg/m^3 (for 10% V_f)

ρ_m = 1.25 x10^3 kg/m^3

ρ_f = 1.32 x10^3 kg/m^3

From Eq. (3),

$$\beta_c \text{ 10\% } v_f = \frac{1}{3}\left\{\frac{1.340}{1.000}\right\} = 0.447$$

$$\beta_c \text{ 30\% } v_f = \frac{1}{3}\left\{\frac{1.487}{1.000}\right\} = 0.496$$

$$\beta_m = \frac{1}{3}\left\{\frac{1.249}{1.000}\right\} = 0.416$$

$$\beta_m = \frac{1}{3}\left\{\frac{1.320}{1.000}\right\} = 0.44$$

Similarly, given that

ρ_c = 1.34 x10^3 kg/m^3

ρ_m = 1.25 x10^3 kg/m^3

β_m = 0.416 x10^3 kg/m^3

ν_m = 0.3

And recalling Equation (4), the transverse coefficient of moisture expansion (β_T) is calculated thus:

$$\beta_T = \frac{1.340}{1.249}(1 + 0.3)0.416$$

= 0.58 (for 10% V_f);

$$\beta_T = \frac{1.487}{1.249}(1 + 0.3)^{0.416}$$

= 0.644 (for 30% V_f)

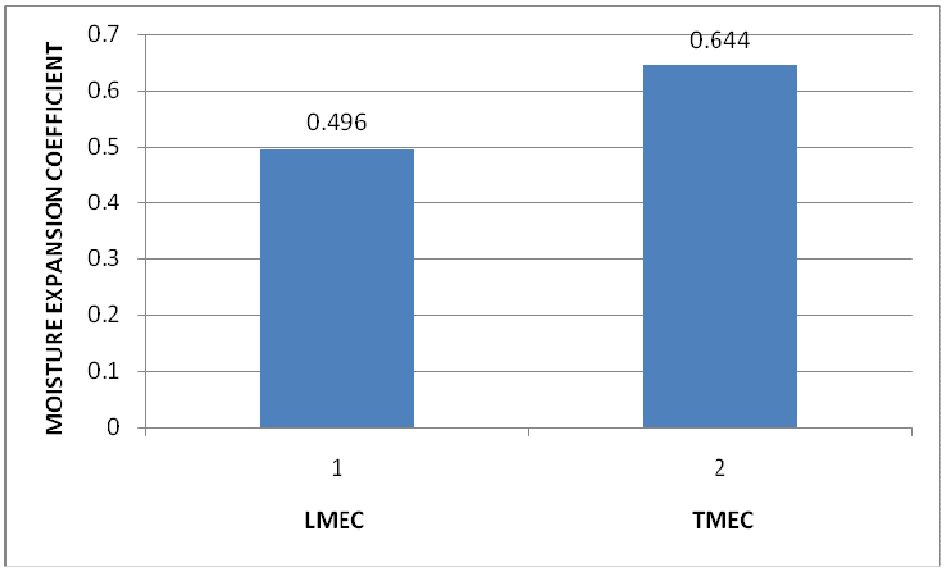

Fig. 1 Effect of V_f on transverse and longitudinal moisture expansion coefficient

(For V_f = 30%)
Key: LMEC – Longitudinal moisture expansion coefficient
TMEC – Transverse moisture expansion coefficient

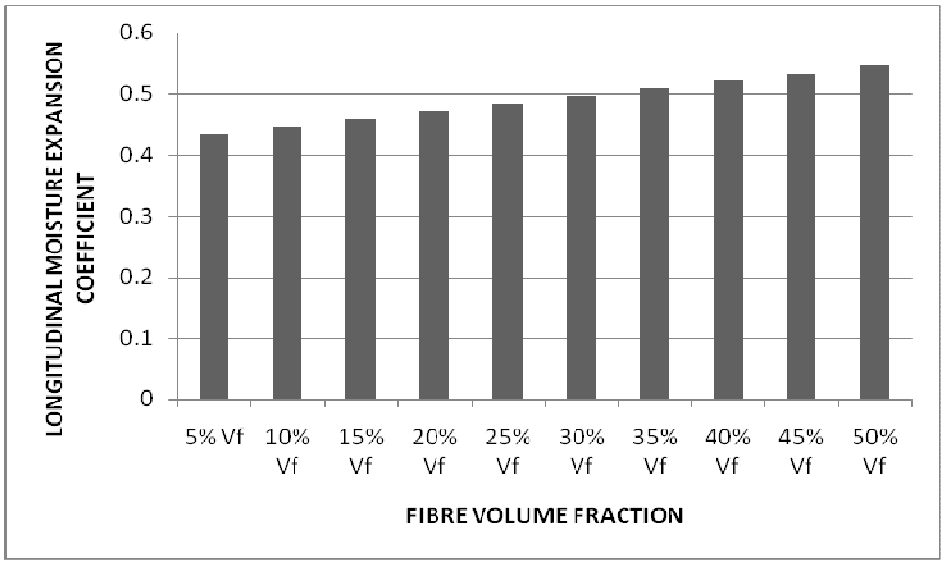

Fig. 2 Effect of volume fraction (V_f) on longitudinal moisture expansion coefficient

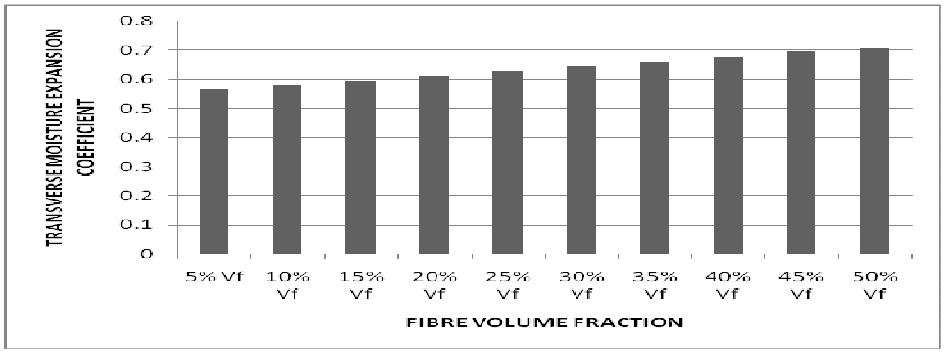

Fig. 3 Effect of volume fraction (V_f) on longitudinal moisture expansion coefficient

2.4 Discussion/Conclusion

From the results above, it could be seen that:

- Transverse moisture expansion coefficient β_T of the composite is higher than the longitudinal moisture expansion coefficient (β_L).
- The moisture resistance capacity of ukam plant fibres can be improved through: (i) Fibre treatment (i.e. changing the hydrophilic nature of the cellulosic fibres to hydrophobic. (ii)Fibrillation – splitting the fibre bundle into smaller filaments, leading to increasing surface area available for wetting by the polymer matrix.
- From the experimental data in table 1, it can be seen that moisture uptake was relatively low, which will turn out not to be such a problem.
- It was observed that the Longitudinal and tranverse moisture expansion coefficients were found to be 0.496 and 0.644 respectively

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Directional Well Trajectory Design: The Effect of Change of Azimuth Builds and Turns On Build-&-Hold And Continuous Build Trajectories.

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Abstract

Across several texts dealing on the issue of the Build-&-Hold and Continuous Build basic well trajectory designs, it was observed that entire mathematical expressions were based on a direct or straight azimuth departure course. In this work, the effect of a curved bend in azimuth from the kick-off to the target of the well trajectory was considered, therefore slightly altering the entire mathematical expressions from the horizontal departure to the Radius of curvature, as well as the overall angle change. By using WellTIT v. 1.0 (self-developed application using Microsoft Visual Basic), two examples were illustrated using 2-domensional and 3-dimensional plots along with survey records to validate the effectiveness of our mathematical expressions.

Keywords: *Build-and-Hold, Continuous Build, Trajectory, Azimuth, Straight course, Horizontal departure*

Introduction

Directional wells are drilled wells that deviate on purpose from the conventional vertical wells. The act of directional drilling is a process of directing the wellbore along some trajectory to intersect a designated subsurface target [5],[6]. Directional wells are drilled mainly for economic and technical reasons so as to achieve maximum results at minimal cost. Some of the practical reasons are;

a) Relief Wells: Such kind of directional wells are drilled to kill an existing well that has a subsurface challenge (like subsurface blowouts), by pumping in either cement or kill fluid to seal-off the existing well.

b) Surface Inaccessible location: Directional wells are drilled when the surface to drill a conventional vertical poses a challenge of a certain degree like; a city where there are existing structures, a swamp or shoreline (it's more expensive to drill on water than on land), Hostile environment/people, etc.

c) Subsurface Obstruction: Directional wells are drilled when subsurface formations pose a potential challenge such as faults (Fault drilling), extra hard or

d) extremely soft/Unstable formations (Salt dome drilling), etc.

e) Reservoir and Production Engineers request: Directional wells are drilled to suit a required well pattern at the reservoir target, so as to ensure maximum production and/or recovery. For example, Horizontal wells. Also to ensure the well doesn't intersect an existing well subsurface.

Directional well trajectory is a planned course for the well to be drilled from the surface to the subsurface target. Planning is an essential part of creating a well trajectory as it is tied to the geological profile of the formation to be drilled [4], [2], management of drilling cost and the available technology.

Directional well trajectory design involves using mathematical tools in creating several well patterns that might achieve a certain purpose [4],[7],[3]. Along with these designs are factors such as the drilling equipment capability to be used, the total length of the well (The longer the trajectory, the more tubulars to be installed, more cementing job), etc. [1]

In a directional well trajectory design pattern, there are some major controlling factors that are applied

mathematically to generate a refined course. These are;

a) Inclination angle/Build angle: This is the angle of deviation of the well course from the initial course.

b) Kick off point (KOP): This is the depth where the inclinational angle build commences

c) Azimuth: This is the horizontal direction of the well with reference to the geologic coordinate system. Which is the North, East, South and West directions.

d) True Vertical Depth: As the name implies, it is the total vertical distance of the well from the surface to the target.

e) Measured depth: It is the total course length of the well

f) Horizontal departure: It is the horizontal distance of the well end from the kick-off point.

g) Northing: It is the geographical and/or magnetic coordinate direction of the wellbore to either North or South from the point of kick-off. If to the north, the values are positive, to the south the values are negative.

h) Easting: it is also the geographical and/or magnetic coordinate direction of the wellbore to either the East or West from the kick-off point. If the direction is tending toward east, the values are positive, to the west, the values are negative.

i) Dogleg Severity: It is the change in overall angle (both the change in inclination angle and Azimuth angle) per unit course length.

[5], [8], [2] and [6]all gave illustrative techniques on how to derive 2-dimensional basic well trajectories. Such as the Build and Hold, Continuous build, and S-type trajectories. But all the illustrations were expressed using a straight line course azimuth angle and deviation length

.

Methodology

Table 1: *Symbol, respective meaning and identification for Build & Hold Trajectory in figure 1(A&B)*

KOP	Kick-Off point depth	$\overline{AB}$
TVD	True Vertical Depth	$\overline{AG}$
Θ	Inclination Angle, Tangent Angle	$A\hat{O}D$, $B\hat{D}C$
HD	Horizontal Departure	$\overline{GC}$, $\overline{BF}$
R_C	Radius of Curvature	$\overline{BO}$, $\overline{OD}$
LOB	Length of Build	$\overline{BD}$
LOH	Length of Hold	$\overline{DC}$
MD	Measured Depth	$\overline{ABDC}$

Under the basis of our approach, taking an assumed inclination angle along with other given information such as the TVD, KOP and HD, we can determine the radius of curvature, hence the build-up rate. Taking both trajectory conditions (fig.1 A &B), the mathematical expressions will therefore be;

$\overline{JO} = \overline{DO}Cos\theta$

(1)

$\overline{BJ} = \overline{GE} = R_c(1 - Cos\theta) = \overline{BO} - \overline{JO}$

(2)

###

(3)

$\overline{BG} = \overline{AG} - \overline{AB}$

(4)

$\overline{DE} = \overline{BG} \quad \overline{JD}$

(5)

$\overline{EC} = \overline{DE}Tan\theta$

(6)

$HD = \overline{GC} = \overline{GE} + \overline{EC}$

$HD = R_c(1 - Cos\theta) + \overline{DE}Tan\theta$

$HD = R_c(1 - Cos\theta) + (\overline{BG} - \overline{JD})Tan\theta$

$HD = R_c(1 - Cos\theta) + [(\overline{AG} - \overline{AB}) - R_c Sin\theta]Tan\theta$

$HD = R_c(1 - Cos\theta) + [(TVD - KOP) - R_c Sin\theta]Tan\theta$

(7)

Opening the bracket at the left hand side of the equation and making R_C subject of expression,

$$R_c = \frac{HD - [(TVD - KOP)Tan\theta]}{[(1 - Cos\theta) - Sin\theta Tan\theta]}$$

(8)

The Build-up rate with reference to most literatures and therefore its application to our above expression becomes;

$$BR = \frac{180}{\pi \times R_C}$$

(9)

Length of Build becomes,

;

$$MD = KOP + LOB + LOH = KOP + \frac{\theta \times \pi \times R_C}{180} + [HD - R_C(1 - Cos\theta)]/_{Sin\theta}$$

(12)

The effect of Azimuth curved bends

$$LOB - \frac{\theta \times \pi \times R_C}{180}$$

(10)

Length of hold section becomes,

$$LOH = [HD - R_C(1 \quad Cos\theta)]/_{Sin\theta}$$

(11)

Measured Depth becomes

Consider figure 1 (A) for example and assume that an azimuth build is initiated from the Kick-off point at point O in fig. 2 (A) with some azimuth angle S_{AZ}, to the target at point "Tgt". The HD_{STR} is the straight horizontal departure assuming no azimuth curved bend needed for the trajectory, and its equivalent to the HD in equation (7). We then prepared a tabular presentation for variables for easier referencing

Table 2: *Azimuth deviational presentation, meaning, referred figure equivalence and determination*

O	Origin of Azimuth	KOP of trajectory
S_{AZ}	Azimuth deviation	
Tgt	Target Point	"C" in fig. 1 (A)&(B)
HD_{STR}	Straight line Horizontal Departure from origin to target	$\overline{GC}$ of fig.1 (A)&(B) O to Tgt
HD_{CURV}	True Horizontal departure course curve from origin to target	Curve O to Tgt
X_{NE}	Overall angle due to azimuth deviation	$2 \times S_{AZ}$
R_{AZ}	Radius of Curvature for HD_{CURV} and angle X_{NE}	$\overline{OQ}$ *and* $\overline{OT_{gt}}$
TR_{AZ}	Azimuth Turn curve rate	

From figure 2(A), we observed the triangle (ΔOQT_{gt}) as an Isosceles triangle with two sides equal ($\overline{OQ}$ *and* $\overline{OT_{gt}}$) in which the Straight line Horizontal departure from the kick-off point to the target (HD_{STR}) data, along with the target Azimuth (S_{AZ}). The solution becomes;

$$X_{NE} = 2 \times S_{AZ} \qquad (13)$$

For figure_(B), since the curve build is initiated at some degree, S^{*}_{AZ}, to the target azimuth, S^{**}_{AZ}, then;

$$X_{NE} = 2 \times (S^{**}_{AZ} - S^{*}_{AZ}) \qquad (14)$$

$$R_{AZ} = \{2 \times HD_{STR}{}^{2}[1 - Cos(X_{NE})]\}^{1/2} \qquad (15)$$

gotten from standard Cosine rule formula $(c^{\wedge}2 - a^{\wedge}2 + b^{\wedge}2 - 2abCos\theta)$

Using the overall angle, X_{NE}, and Azimuth Radius of curvature, R_{AZ}, the Curved horizontal departure, HD_{CURV} becomes,

$$HD_{CURV} = \frac{X_{NE}}{180} \times \pi \times R_{AZ} \qquad (16)$$

For curved horizontal application, we replace HD in equation (7) with HD_{CURV}. The equation becomes;

$$R_{C[caz]} = \frac{HD_{CURV} - [(TVD - KOP)Tan\theta]}{[(1 - Cos\theta) - Sin\theta Tan\theta]} = \frac{\left\{S_{AZ} \times \pi \times \sqrt{\{2 \times HD_{STR}{}^2[1 - Cos(2S_{AZ})]}\right\} - \{90[(TVD - KOP)Tan\theta]\}}{90 \times [(1 - Cos\theta) - Sin\theta Tan\theta]}$$

here $R_{C[caz]}$ signifies radius of curvature for curved azimuth or horizontal departure. It is then applied into equations (9) to (11), so as to obtain the overall Build rate, Length of Build, Length of Hold and True Measured depth

.

Table 3: *Symbol, respective meaning and identification for Continuous Build Trajectory in figure 1(A&B)*

KOP	Kick-Off point depth	$\overline{AB}$
TVD	True Vertical Depth	$\overline{AD}$
Θ	Inclination Angle, Tangent Angle	$B\hat{O}C$
HD	Horizontal Departure	$\overline{DC}$
R_C	Radius of Curvature	$\overline{BO}$, $\overline{OC}$
LOB	Length of Build	Curve $\overset{\frown}{BC}$
MD	Measured Depth	$\overline{ABC}$

Applying necessary information such as the TVD, KOP and HD, we can determine the inclination angle, the radius of curvature, hence the build-up rate.

Taking both trajectory conditions (fig. 3 A&B), the mathematical expressions will therefore be

$$\overline{BD} - \overline{AD} - \overline{AB} - TVD - KOP$$

(18)

$$\theta = 2 \times Tan\, {}^{DC}/_{\overline{BD}} = 2 \times Tan\, {}^{HD}/_{(TVD - KOP)}$$

(19)

$$\overline{BC} = {}^{DC}/_{Sin\left({}^{\theta}/_{2}\right)} = {}^{HD}/_{Sin\left({}^{\theta}/_{2}\right)}$$

(20)

$$R_C = \overline{RO} = \left\{\frac{\overline{BC}^2}{2(1 - Cos\theta)}\right\}^{\frac{1}{2}} = \left\{\frac{\left[{}^{HD}/_{Sin\left({}^{\theta}/_{2}\right)}\right]^2}{2(1 - Cos\theta)}\right\}^{\frac{1}{2}}$$

(21)

Rc in from equation (21) is applied into equation (9) and equation (10) to obtain the inclination build rate and length of build section respectively

Measured Depth becomes;

$$MD = KOP + LOB = KOP + \frac{\theta \times \pi \times R_C}{180}$$

(22)

As for the curved horizontal departure, following necessary procedures as expressed in the build and Hold trajectory, the adjusted radius of curvature for curved azimuth and curved horizontal departure becomes

$$R_{C[caz]} = \left\{\frac{\left[{}^{HD_{CURV}}/_{Sin\left({}^{\theta}/_{2}\right)}\right]^2}{2(1 - Cos\theta)}\right\}^{\frac{1}{2}} = \left\{\frac{\left[\left\{S_{AZ} \times \pi \times \sqrt{\{2 \times HD_{STR}{}^2[1 - Cos(2S_{AZ})]}\right\} / 90Sin\left({}^{\theta}/_{2}\right)\right]^2}{2(1 - Cos\theta)}\right\}^{\frac{1}{2}}$$

(23)

,

Equations (13) to (15) also applies for the continuous build trajectory.

The Effect of survey intervals (stations) and Azimuth build rate

Another fact is that perhaps in drilling practice involving another curve rate for the horizontal departure curve, that is the Azimuth Turn curve rate (TR_{AZ}), which will give;

$$T_{RAZ(Build)} = \frac{180}{2\pi R_{AZ}}$$

(24)

Assuming drilling from the **KOP** to the end of the **Build section**, and thereby having a build rate, **BR**, Radius of curvature for build section, $\mathbf{R_c}$, course interval station, $\mathbf{I_{NT}}$, the radius of curvature for the curved horizontal departure, $\mathbf{R_{AZ}}$, and curved horizontal departure per course interval station, $\mathbf{HD_{CURV(NT)}}$, and the Survey azimuth increment in $\mathbf{S_{AZ1}}$, becomes

Table 4: *Diagrammatic relationship illustration of interval variables between figures 4 and 5*

R_c	$\overline{OB}$	$\overline{OB}$
I_{NT}	Green, Orange and Blue dotted curve along course length from point B (KOP).	
$HD_{CURV(NT)}$	$\overline{GM}, \overline{GU}, \overline{GP}$	$\overline{OM}, \overline{OU}, \overline{OP}$
S_{AZ1}		$N\hat{O}M, N\hat{O}U, N\hat{O}P$

Observing figure 4 (A&B), which consist of the Build and Hold trajectory and Continuous Build trajectory an interval course length is drilled from point B (KOP) along the green curve path to the end of the curve colour, which can be marked as point "M". The curve horizontal departure from this course interval is taken as $\overline{GM}$

. Equation (25) shows the mathematical expression for determining the solution value

$$H_{CURV(NT)} = \frac{R_C}{Cos\left[{(BR \times I_{NT})}/{2}\right]} \times [Sin(BR \times I_{NT})]^2$$

(25)

The interpretation in the azimuth survey, shown in figures 5 (A&B). the value curve OM is the value of $\overline{GM}$, (equation 25). So do the values gotten from $\overline{GU}$ and GP, which is equivalent to line curves OU and OP, respectively.

With the original anticipated azimuth radius of curvature, R_{AZ}, the survey azimuth increment can actually be predicted from the equation (26) below.

$$S_{AZ1} = \frac{H_{CURV(NT)} \times 180}{2\pi R_{AZ}} \qquad (26)$$

PRACTICAL - Application of expressions using WellTIT v. 1.0 (Self developed Application)

In this subsection, we applied the above expressions into our directional well trajectory application, WellTIT v. 1.0 to obtain solutions, survey records and diagrammatic representation of the calculated course trajectory. Table 5, shows the inputed data and figure 6 (A) to (D) for Build-and-Hold trajectoryand Table 6, shows the inputed data and figure 7 (A) to (D) for Continuous Build trajectoryshows the interface of the program and plot results.

.

Table 5: *Build-And-Hold Trajectory*

TVD	*9000 ft*	**KOP**	*3000 ft*	**Azimuth**	*31° NE*
HD_{STR}	*1400 ft*	**Θ**	*18°*	**Bend Direction**	*Clockwise*

Table 6: *Continuous Build Trajectory*

TVD	*8000 ft*	**KOP**	*3000 ft*	**Azimuth**	*27° SE*
HD_{STR}	*800 ft*	**Θ**	-	**Bend Direction**	*AntiClockwise*

Conclusion

The development of azimuth bends came as a result of subsurface challenges and to minimize sharp bends that can yield high dogleg severity. The derived expressions for the curved horizontal departures for both Build-And –Hold trajectory and Continuous build trajectory yielded successful results when applied through WellTIT v. 1.0. This Azimuth curves can be further applied to the other coordinate directions. More so, this approach can play a vital role in other complex well trajectory designs. The development of the Mathematical model and WellTIT application is to guide students on concepts and theories of directional well trajectory plan. The application is continuously developed to increase its efficiency and make it a desired education and industrial tool

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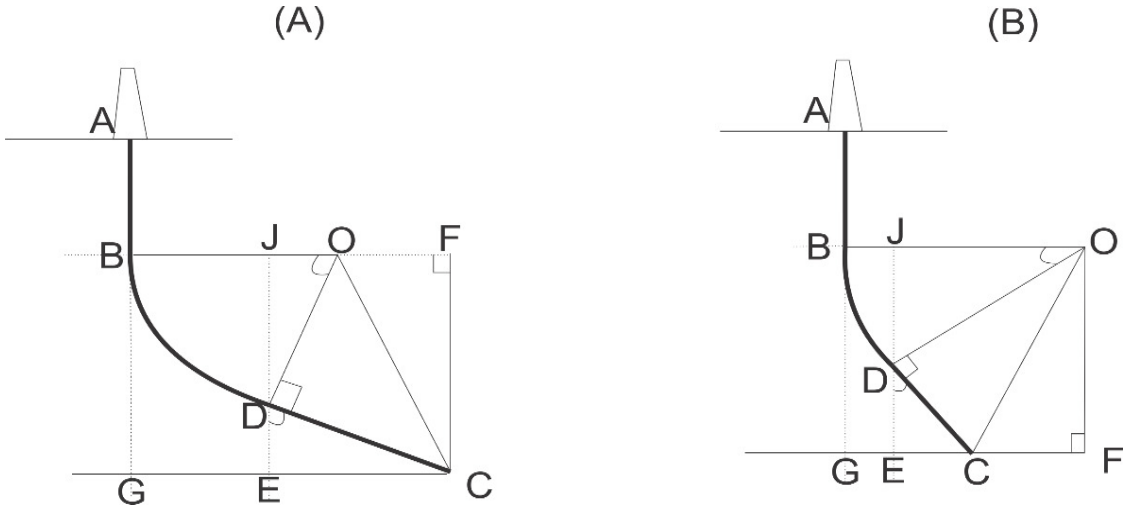

Figure 1: Build and Hold Trajectory presentation

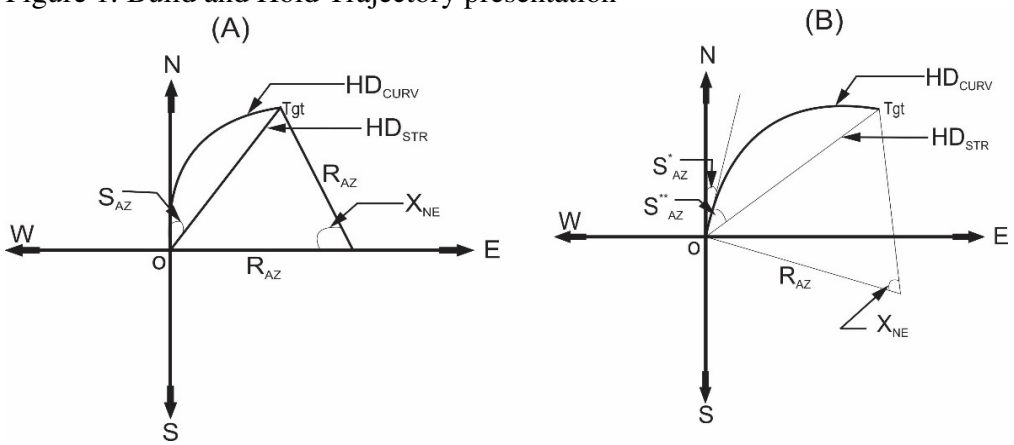

Figure 2: Curved directional Azimuth diagrammatic illustration

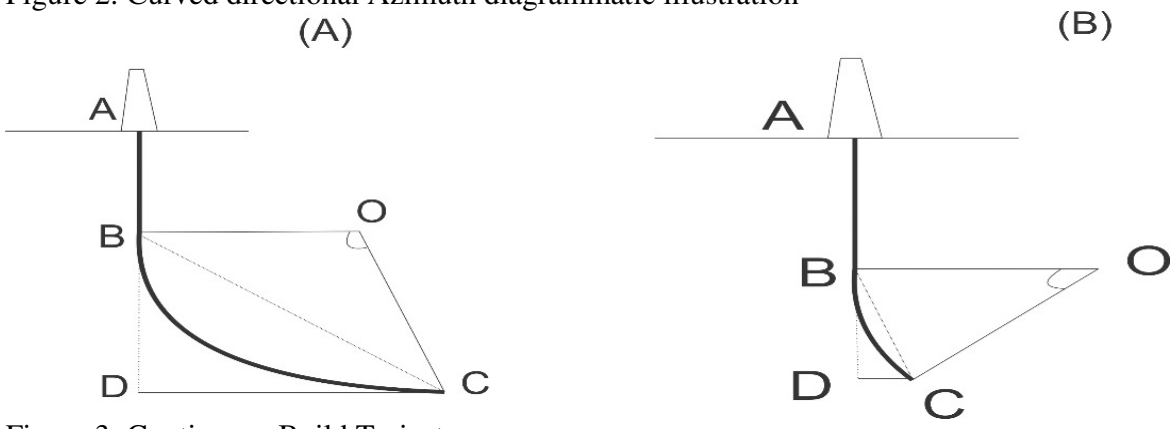

Figure 3: Continuous Build Trajectory

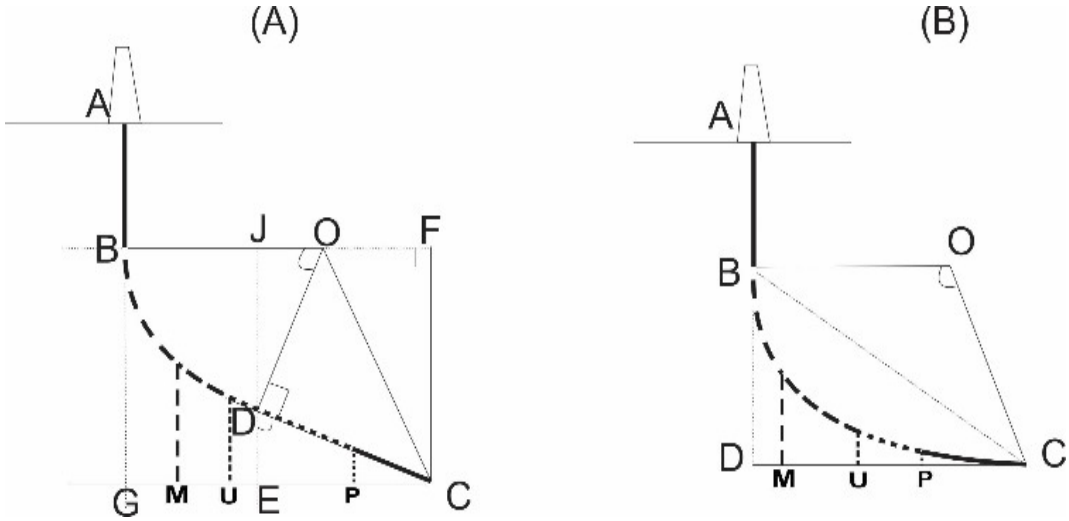

Figure 4: Diagrammatic illustration of interval presentation for (A) Build & Hold (B) Continuous Build
Figure 5: Diagrammatic illustration of interval presentation on curved directional Azimuth
Figure 6: WellTIT program application used for calculating and presenting Build & Hold trajectory example

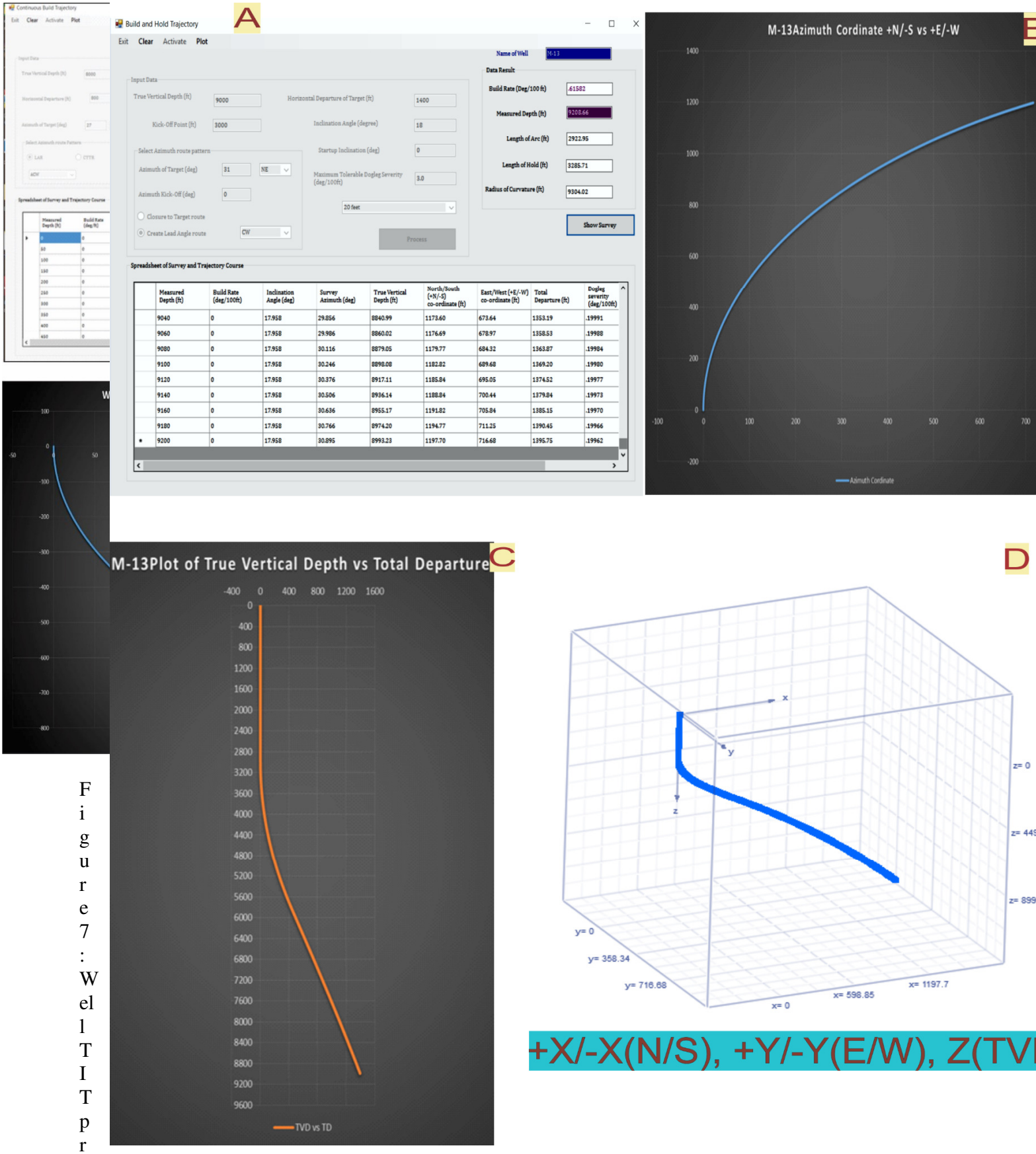

Figure 7: Well TITP

ogram application used for calculating and presenting Continuous build trajectory example

Multi-biometric Liveness Detection – A New Perspective

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Abstract

The problem of securing valuable data stored in databases has been of great concern to organizations and individuals alike. The more worrisome is the increasing complexity of fraud perpetration by cyber criminals which demands that a more secure method be deployed. Basic Multi-biometric Authentication System was thought to have sealed the vulnerabilities and escape route from cyber criminals, but emerging attack patterns have proved us wrong. In spite of their benefits, multi-biometric systems also have peculiar challenges especially circumvention of security strategy, that is, how susceptible the system or the presented biometric modality is to spoof attacks and identity fraud. Liveness detection has been applied as an anti-spoofing mechanism to checkmate circumvention, however its application approach has thrown up more vulnerabilities. In this paper, we introduce our work and adopt the Structured Systems Analysis and Design Methodology (SSADM) to assist us understand the weaknesses and propose a solution which integrates liveness detection to halt spoofing of legitimate subjects, and propose a different approach for performing liveness detection in multi-biometric systems that significantly minimizes the probability of circumvention and strengthens the overall security strategy of the authentication process. The expected output of the research is a prototype software for multi-modal biometrics that detects, in a randomized sequence, the absence of liveness and blocks access to critical infrastructure by fraudsters.

Keywords: *Authentication, biometrics, liveness detection, spoofing, trait.*

1.0 Introduction

The growing sophistication of cyber-attacks by cyber criminals is a global threat that requires a re-definition and strengthening of the biometric authentication process in seeking to advance the proper and beneficial use of biometrics [1]. We are motivated by the idea that the proper application of appropriate technology can curtail the rising spate of cyber criminalities around the globe, specifically by refining the existing biometric liveness detection process into a more secure anti-spoofing mechanism. The goal of this research is to design and develop a software prototype for enhanced liveness detection, capable of performing multiple instances of different trait verifications using alternating traits and modalities from the same person for each successive instance. In this work, we adopt multi-mode biometrics using finger, face and voice modalities.

Human traits that are suitable for biometric purposes in line with the generic qualities specified by [2] and [3] are first captured by a sensor to generate an image which later gets processed through feature extraction into a template. Biometric templates exist in the form of electronic data that can be manipulated in similar ways as any other form of digital data element. Once the templates are captured into the appropriate database (DB) or biometric repository, they become useful for pattern recognition in either the identification or the verification (authentication) mode.

Given the criticality of biometric templates for authentication, it becomes necessary to deploy adequate all-round protective mechanisms and systems to secure them in storage, in process and in transit. Although the security of some of the deployed protective systems is questionable when utilized alone, integration with other technologies such as Identity Based Encryption (IBE), Public Key Infrastructure (PKI) or digital signatures results in cryptographically secure applications of biometrics [4], which gives a reasonable guarantee of an encrypted biometric authentication.

2.0 Securing Biometrics With Cryptography

The concept of encrypted biometrics evolved in the quest to mitigate the effects of compromised biometric template. For a system that uses biometric templates for identification and authentication, there is the issue of what to do when a template has been compromised [5]. For a mere password or token-based system, the solution is straightforward; the user performs a password reset or gets a new physical token. However, in a case of biometric template compromise, user cannot renew his biometrics such as grow a new finger or swap to a spare eyeball. It appears the solution to a compromised biometric template lies in the application of the revocable features of biometric templates.

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Revocable templates are biometric templates that have been enhanced through several different cryptographic methods to allow for the revocation and reissuance of the existing biometric token without modifying the underlying biometric [5]. Revocable biometric templates are also called cancellable biometrics. They are the resulting code generated when biometric data has been converted into random strings suitable to apply cryptographic techniques for security. The extraction is usually done by fuzzy extractors [6] or secure sketches. Figure 1 below depicts a typical sequence that generates revocable biometric templates

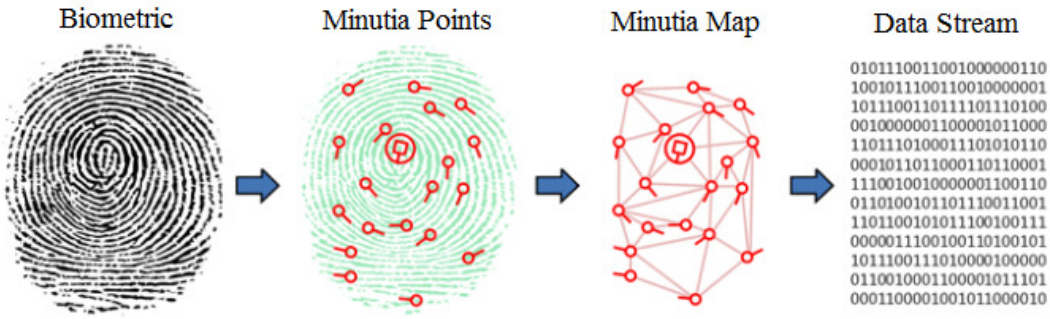

Figure 1: Sequence for the revocable biometric templates process. Adapted from [5]

Two methods commonly used to create cancellable biometric templates are *salting* and *one-way transformations* [5]. Whereas *salting* inserts a known set of fake data into predetermined locations of the template to disguise it and allow compromised biometric template to be recovered, *one-way transformations* distort the biometric template in a revocable but irreversible manner thereby increasing privacy and accuracy. Since it becomes impracticable to reveal information from the cancellable biometrics template, the one-way transformations used to create them is also known as non-invertible transforms [7]. Cancellable biometric templates are essential for biometric authentication systems (BAS), especially for those operated under unattended and/or over networked environments.

3.0 The Liveness Detection (LD) Landscape

Despite the superiority of Biometric Authentication Systems (BAS) over passwords and PINs that can be forgotten or physical tokens that can be damaged, misplaced or stolen, they are still not foolproof. Spoofing (or copy attack) is a fatal threat for BAS [8], and occurs when an impostor attempts to mimic the traits corresponding to legitimately enrolled subjects [9]. The ability to detect spoof attempts is a measure of the performance and security of BAS.

Liveness Detection (LD) is the process of verifying that the biometric modality presented or rendered before a biometric verification system for the purpose of capturing the biometric trait is real and not fake [10]; and that such a presenter is medically alive [11], and physically present at the moment of such capture [12]. LD reads claimant's physiological signs of life [13]. Biometric circumvention describes to what extent a biometric system can be fooled using fraudulent methods [14], and how susceptible the modality is to spoof attacks [3] and identity fraud [2].

The goal of any anti-spoofing approach is to strengthen the security of biometric authentication, and at a basic level, LD is an anti-spoofing mechanism that attempts to answer questions concerning the originality

of the trait presented before the BAS scanner. In our analysis though, we identified that the factors that influence the use and effectiveness of any liveness detection techniques include (i) ease of trait acquisition, (ii) nature of trait in view, (iii) tolerable level of intrusiveness, and (iv) duration of processing. The overall LD goals are better security and sustenance of a reasonable balance between False Accept Rate (*FAR*) and False Reject Rate (*FRR*) incidents. A well-applied *LD* technique should guarantee a *FAR* low enough to ward off the possibility of incorrectly authenticating impostors, and a marginal *FRR* low enough not to reject legitimate users.

3.1 Aspects of LD in Focus

Effectively, LD denotes the methods capable of discriminating real human traits (live or non-live) from synthetic counterfeits made by silicon [15], gelatin [16] or play-doh [17], with the help of appropriate spoof mitigation algorithms [18]. Checking for signs of vitality involves the search for, and measurement of, certain intrinsic properties [11] (such as thermal, optical, mechanical and electrical quantities), involuntary properties [8] (such as blood flow, oxygen saturation and pulse rate), and response to external stimuli (such as eye blinking). These elements must be tested for verification. In this section, we critically analyse some measurable quantities (metric) required for running liveness detection checks on selected traits.

Fingerprint LD

The use of fingerprint recognition for access control and other uses is becoming increasingly common due to its security and ease of use [5]. Despite its broad application, the existing fingerprint recognition systems can be easily deceived, for example, by presenting a well-duplicated synthetic finger [19]. A vital question on fingerprint LD is "*how do we verify that the fingerprint image presented before a thumb scanner or fingerprint reader is not an artificial finger or a fake dummy finger fabricated out of gelatine* [16]*, play-doh* [17]*, silicon* [15] *or any other spoofing tactics* [18]*; or molds made out of latent fingerprints stealthily picked from or left by legitimate users, or from the dismembered thumb* [20] *of the real enrolee?"*

In attempting to answer this question, fingerprint LD tests check for signs of vitality using an analysis of measurement of some or all quantities as shown in Table 1

Table 1: Quantities evaluated in a fingerprint LD test

SN	Quantity	Description
1	Warmth	Test for the presence of normal warmness within acceptable temperature range for a living human body.
2	Pulse	Test for the presence of pulse on the finger as evidence of the presence of a natural heartbeat.
3	Density	Test for the pressure tolerance, elasticity and texture upon contact with the finger.
4	Haemoglobin	Test for the presence of blood flow.
5	Oxymetry	Test for the appropriate saturation of oxygen in the blood inside the finger.
6	Blood pressure [15]	Test for the presence of the force exerted by the heart's action of pumping and circulating blood, in relation to the diameter and elasticity of the arterial walls

		within normal blood pressure range for each given gender.
6	Spectroscopy	Test for the relative absorption or reflection or radiation (eg Infra Red light) on the submitted finger.
7	Perspiration	Test for the presence of secreted sweat from pores only found in real live human finger traits.

Facial print LD

Primarily facial recognition measures the overall facial structure including distances between eyes, nose, mouth, and jaw edges [21]. Generally speaking, there are three ways (also called replay-attacks [22]) to spoof facial recognition [23] as follows: (i) photograph of a valid user, (ii) video of a valid user, and (iii) 3D model of a valid user. After acquiring the facial image [24], face recognition processing [23] in BAS involves four steps:

- Step 1: The face image is enhanced and segmented.
- Step 2: The face boundary and facial features are extracted.
- Step 3: The extracted features are matched against features in the DB.
- Step 4: The classification or recognition of the user is achieved. While all four steps are implemented differently by different vendors [25], a significant question in facialprint LD is *"can we determine, with some degree of certainty, that the facial image presented before a biometric facial camera is not a portrait picture of a legitimate user merely presented as a static paper photograph, or disguised in a facial mould or a mask; or a mere screen/video display of the valid user's picture?"* Table 2 highlights typical quantities measured in a facialprint LD

Table 2: Quantities evaluated in a Facialprint LD test

SN	Quantity	Description
1	Nodal geometry	Test for the conformity of the geometry of nodal points on the face including nose, cheek, jaw, eye, socket, forehead, etc.
2	Facial expression	Test for conformity of trait to involuntary actions and response to stimuli such as smile, frown, wink, etc.
3	Mouth movement	Test for the presence of the natural pattern of human mouth movement during speech.
4	Eye blinking	Test for the presence of a sequence that indicates the pattern of human eye action.
5	Facial thermogram	Test for the presence of radiation only emitted by a living human face.

Voiceprint LD

The voice recognition system uses the unique characteristics of the human voice including measurement of audible frequency, tone, pitch, etc to distinguish the subject and used for confirmation of liveness in authentication. Detecting elements of liveness in the human voice asks the relevant question: *"How can we confirm that the voice image presented before a voice recognition system is not a playback of a pre-recorded audio clip, or a synthesized voice clip of the legitimate user; or from a physically-present impostor who is anonymously mimicking the voice of an authentic user?"*

Vein pattern LD

LD in a vein pattern modality essentially checks for palm vein matching quantities whose measurement connote the presence of life in the subject including blood flow, contour synthesis, geometry of fingers, oxymetry, spectroscopy, pulse rate, blood pressure, etc. A pertinent question regarding vein pattern LD is *"to what extent can we verify that the hand modality presented before a vascular pattern reader or hand geometry scanner is from a valid user and also a living hand naturally attached to a living human body and not a standalone dismembered part or from a cadaver?"*

Eye LD for iris and retina patterns

The focus of eye biometrics is basically to identify vitality signs that show proof of the presence of a live human eye whose iris and retina show measurements indicating liveness. The vital question is *"how do we verify that the eye image presented before a retina scanner or iris sensor is not faked with a mimicking contact lens or other eye image enhancing agents?"*

Measurable quantities for detection of real living iris or retina include a combination of physiological characteristics and involuntary actions such hippus movements, eye blinking, coloration, blood flow, temperature checks, etc.

K eystroke pattern LD Keystroke liveness check tends to ask the question *"How can we truly confirm that the keystroke patterns presented before typing sequence sensor are generated from a real physical keypad and are coming from the typing action of a real physical human being and not from a pattern captured by a key logger attack tool or simulated by other keystroke pattern generators?"*

3.2 One-Time Password (Otp) Security Imperatives

OTP was introduced to provide a pseudo password in form of a one-off access code to deal with one of the major weaknesses of traditional password, reusability. An OTP is a password code used to perform a timed single instance authentication without possibility of reuse in future transactions. OTP is mostly used by online payment systems to provide a one-off password code which is sent to the user's email address or phone number and must be used within a specified limited timeframe beyond which the OTP expires. An expired OTP becomes unusable and a new code must be generated and used to complete the transaction. Apart from its short-lived lifespan, a significant security benefit of an OTP lies in the added association with the user's personal telephone number and/or email address. Figure 2 below shows a sample of an OTP sent as a Short Message Service (SMS) safe token message to a user's phone number for use in the authorization of an online payment transaction

(a) *(b)*

Figure 2: One Time Password implementations showing (a) 6-digit token sent via sms, and (b) online payment authorization portal [26] *where the sent token is entered as secure approval code to complete a pending transaction.*

For example the ComBiom ® Safe ID USB stick [27] offers a multi-functional token with integrated biometric authentication that enables physical access control and logical access control in one token. Figure 3 below shows several hardware tokens that randomly generate fixed length, short-lived, unique codes for access control and authorization of online payment transactions

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(a) (b) (c)

Figure 3: Hardware tokens used to generate random 6-digit OTP security codes for (a) access control [27], and (b), (c) online payment authorization.

To secure the biometric authentication process in a multi-factor environment, we take advantage of the widespread use and reliability of OTPs to introduce an added element of further strength in corroborating identity and forestalling circumvention of the authentication process.

2.3 How Significant Is Multi-Biometric (Mb) Fusion?

No single biometric method to date can guarantee a 100% authentication accuracy and usage by itself. Multi-biometrics evolved in response to the need to build more security into BAS. The combination of multiple biometric sources, modes and more formidable methods of authentication is referred to as multi-biometric fusion, and such a system that operates through any of such combination is often called a multi-biometric system [10]. MB is the concurrent application of more than one biometric source, method or other determining factors as a distinguishing element of authentication.

The uniqueness of the multi-biometric concept lies in its emphasis on multiple application of variables, methods or factors as simplified in Table 3

Table 3: Description of the multi-biometric fusion concept

	Multi-Biometric Fusion Technique	Description Of Technique	Example
	Multi-sample	Multiple presentation of a sample in varying fashions.	4R Fingers + 4L Fingers + 2 thumbs (4-4-2)
	Multi-mode OR Multi-identifier	Multiple presentation of a sample from multiple sources.	Thumb + Face + Voice + …
	Multi-system	Multiple application of different biometric hardware from different OEMs assuming vendor interoperability is guaranteed.	$System_1 + System_2 + System_3 + \ldots$
			Example, using the Lumidigm ® Mercury M301 fingerprint reader together with the Verifi ® P5100 thumb scanner [28].
	Multi-algorithm	Application of multiple matching algorithms to a single trait in sequence. Using different processing and feature extraction methods on the same biometric data.	$PCA_{a1} + ICA_{a2} + LDA_{a3} + \ldots$
			Example, [29] discusses a face recognition system that combines three different global feature extraction schemes (Principal Component Analysis (PCA), Independent Component Analysis (ICA) and Linear Discriminant Analysis (LDA).
	Multi-	Processing of similar	$(Face)_{s1} + (Face)_{s2} + \ldots$

	sensor	samples with multiple sensors. Multi-sensor systems employ multiple sensors to capture a single biometric trait [9] or modality of an individual [10].	Example, a face recognition system may deploy a 2D camera to acquire the face image, and an infrared sensor in conjunction with a visible-light sensor to acquire the subsurface information of a person's face.
	Multi-instance OR Multi-unit	Application of repeated instances and iterations of sources. Here the same modality or trait is recorded in terms of multiple instances or parts.	Li + Ri + … Example, left iris followed by the right iris of an individual.
	Hybrid model	Concurrent utilization of multiple fusion techniques.	A mix of many techniques and sources in one.

4.0 Identified Problems With Current LD Approach

In general, LD is an embedded function of the biometric scanner and different manufacturers implement it in different ways, generally proprietary to each vendor [25], but the problem lies in the way the liveness detection check is currently run in multi-biometric systems by many vendors as a single instance process.

(1) **Deficient technique:** As far as we know from available literature, there appears not to be much research into a single biometric system that performs multiple simultaneous instances of liveness checks on the same person using different traits at each instance prior to authentication. To the best of our knowledge, no such system has been proposed either. Most biometric authentication systems are either limited in the number of instances checked for liveness or are completely unimodal in nature.

(2) **More Vulnerable:** The gap introduced by the deficiency of multiple simultaneous instances of liveness checks using multiple traits from the same subject has serious security implications. The risk is that after a smart attacker has performed reconnaissance, he can launch a spoof attack targeting only a single liveness detection technique on a single trait, concentrating all efforts at achieving this by taking advantage of the system not having a way of associating each single liveness check of a person's trait to another liveness check on a different trait of the same person for consistency. This security glitch is too grievous to be ignored by the global Cybersecurity community.

Intrusiveness: Operationally, the average biometric user becomes uncomfortable if the trait acquisition method tends to be too invasive, restrictive, demanding or time-consuming; for example a theoretical multi-identifier liveness detection process could require a user to recite a pre-written text (*test for voice liveness*), while holding a pulse meter (*test for vein liveness*), and staring at an iris scanner (*test for iris liveness*) either simultaneously or in sequence. In the circumstance, and even where no physical contacts are made with sensors, many users still develop a natural apathy against the entire biometric liveness detection process describing it as grossly intrusive.

(5) **Limited Systems Design:** A good number of existing unimodal biometric systems do not have a built-in liveness detection module and most uninformed users are equally unaware of the implications of this limitations. Economic factors top the list of reasons for the acquisition of low grade systems that are deficient in the liveness detection component. On the part of the Original Equipment Manufacturers (OEM)s and vendors, inadequate Research and Development (R&D) is a major factor militating against the design and development of quality biometric systems with embedded liveness detection component.

4.1 Proposed Mitigation Approaches

The way and manner, hence the approach, in which LD is applied in a biometric authentication system is significant to determining the level of security expected and achieved. Using the Structured Systems Analysis and Design Methodology, we have thoroughly reviewed existing liveness detection techniques focusing on their performance, user acceptance, intrusiveness and security

effectiveness against spoof attacks. We also examined the comments of various classes of biometric system end-users and their expectations from future developments.

Based on our analysis of the current liveness detection landscape, and having identified its inherent technical and operational weaknesses, we have developed a new model of trait vitality checks that is capable of enhancing the effective security of the biometric authentication strategy while remaining non-intrusive and user-friendly. We present an introductory part of our iterative (recursive) trait liveness verification model as a series of three approaches, namely:

Combination approach

Apply one LD method on a particular biometric trait followed by another dissimilar LD method on a different trait, from the same enrolee. The rationale of our approach is based on the fact that physically uncorrelated modalities or traits (E.g. retina and fingerprint) usually yield stronger security and improved performance than correlated modalities or traits (E.g. lip movement and voice) [9].

First assumption (consistency)

In our model, we assume that at any time during the authentication process,

$$\mathbf{LD_{count}} = \mathbf{T_{count}}$$

where $\mathbf{LD_{count}}$ = Number of liveness detection instances, and

$\mathbf{T_{count}}$ = Number of traits prompted for.

The rationale is that, applying *n* separate LD methods (supposing an *n*-factor multi-biometric authentication) on *n* separate traits but from the same subject, defeats the attack purpose since an attacker would naturally be expected to perform *n* separate spoofs, one for each of the liveness detection techniques applicable to the particular trait used or prompted for.

Second assumption (paranoia)

We further assume that the attacker has cleverly produced all possible spoofs applicable to a particular trait in readiness to any liveness detection check applicable to his target trait only.

Therefore prompting for a second, a third, and possibly an nth different instance of liveness detection using a different trait for each instance makes it more difficult for the attacker to successfully circumvent all the options.

The near-intractability of (the attacker) having to spoof each known liveness detection method for each trait used in the biometric authentication system, up to the count of liveness detection instances permissible in the system, decreases the probability of spoofing, discourages the attacker and greatly improves the overall system security. Our approach is illustrated with some tables below

.Table 4: Our LD approach, instance 1 on fingerprint trait

LD Instance 1	Modality	Human thumb/finger
	Trait 1:	Fingerprint
	LD checks applied	Test of warmth (temperature test).
		Test of oxygen saturation in blood (oxymetry test).
		Test of sweat secretion from pores (perspiration test)
	Probability score	**P1**

Table 5: Our LD approach, instance 2 on facialprint trait

LD Instance 2	Modality	Human face
	Trait 2:	Facial print
	LD checks applied	Test for instantaneous radiation (facial thermograph).
		Test for effect of background illumination.
		Test of light absorption (spectroscopy) on skin.
		Test for effect of variable focus.
		Test of eye blinking sequence.
		Test for natural facial expressions (smile, frown, etc.)
	Probability score	**P2**

Table 6: Our LD approach, instance 3 on iris pattern trait

LD Instane 3	Modality	Human eye
	Trait 3:	Iris pattern
	LD checks applied	Test of pupil pulsation (Hippus test).
		Test of infra-red scattering
		Aqua reflection density test.
	Probability score	**P3**

Table 7: Our LD approach, instance 4 on voiceprint trait

LD Instance 4	Modality	Human voice
	Trait 3:	Voiceprint
	LD checks applied	Test for frequency within the audible range.
		Test for concurrency with lip movement.
		Other ancillary tests
	Probability score	**P4**

Probability

Overall probability of liveness is the mean of **P** expressed as a percentage.

$$P_t = \underline{P_1 + P_2 + P_3 + P_4 \ldots + P_n} \qquad (1)$$

$$\sum f(p)n/\,\mathrm{n} \qquad (2)$$

The probability module built into the LD algorithm computes the mean matching score based on a predefined rule-set determined partly by the count of instances and the security criticality required from the system in its area of application, which is the basis for the manual calibration of the system. The system calibration determines its sensitivity in controlling error rates.

System tolerance

To reduce the probability of high False Accept Rates, our system is built to tolerate a low score from not more than one LD instance per subject.

Randomization approach

By randomizing the choice and sequence of the possible liveness detection instances through appropriate algorithm, the attacker faces the unpredictability of guessing which next trait to expect and this situation further reduces his chances of beating the False Accept Rate (FAR) – False Reject Rate (FRR) balance. Randomization is automated as a built-in programme module into the BAS to increase overall security.

By prompting the user for a random set of traits at the point of acquisition [9], our model shows that the multi-biometric activates a challenge-response mechanism, ensuring that the system is interacting with a live user. Furthermore, to maintain the FAR - FRR balance (and sustain a zero tolerance for type-2 errors), the sensitivity of the BAS can be tuned to such a less-sensitive range that False Accept (FA) possibilities are significantly reduced without considerably impacting on False Reject (FR).

Innovativeness of the Proposed Approach

A lot of innovations can be built around this concept of iterative (recursive) Liveness Detection.

Simultaneity

Firstly, the fusion of the combination and randomization approaches constitutes a unique iteration, a sequencing we term recursive liveness detection. Our approach allows for simultaneous liveness checks on multiple traits, thereby minimizing delays and reducing possibility of fatigue-induced user apathy.

Synchronized processing

Secondly, the BAS can run the matching algorithm in synch with the trait supply thereby minimizing delays and overbearing processing time.

5.0 Further Research

Untapped areas exist in MB and LD, including the need to focus research on developing a comprehensive taxonomy of LD necessary to advance further knowledge in the field of biometric securit

6.0 Conclusion

Biometric technology and Biometric Authentication Systems (BAS) have come to stay, at least going by the rate of advancing research and development including innovations in LD techniques. Every LD technique tends to ask "*does the biometric sample being captured represent an actual measurement from an authorized, live person?*" A negative answer connotes circumvention, and all known biometric modalities and traits can be circumvented with varying degrees of ease irrespective of whether physiological or behavioural. Although each trait possesses measurable characteristics that can be used to verify liveness and checkmate spoofing, it is the application of these characteristics that makes all the difference. The way and manner, hence the approach, in which the LD technique itself is applied within the BAS is significant to determining the level of security expected and achieved.

In this paper our biometric liveness detection approach which is based on the appropriate combination of traits from different uncorrelated modalities of the same person in a recursive manner has been presented. The outcome of our study will hopefully assist future development of anti-spoofing countermeasures not only to detect and prevent but also to mitigate effects of successful spoof attacks. The expected Liveness Detection prototype runs on Oracle Relational Database Management System (RDBMS) as the backend engine, the Open Database Connector (ODBC) as Application Programme Interface (API) and in Java as the front engine development language. The High Level Model illustrated in Fig 4 consists of a control centre with the following automation boundaries: housekeeping, biometric inputs, analytics module, metric computation module, report \module

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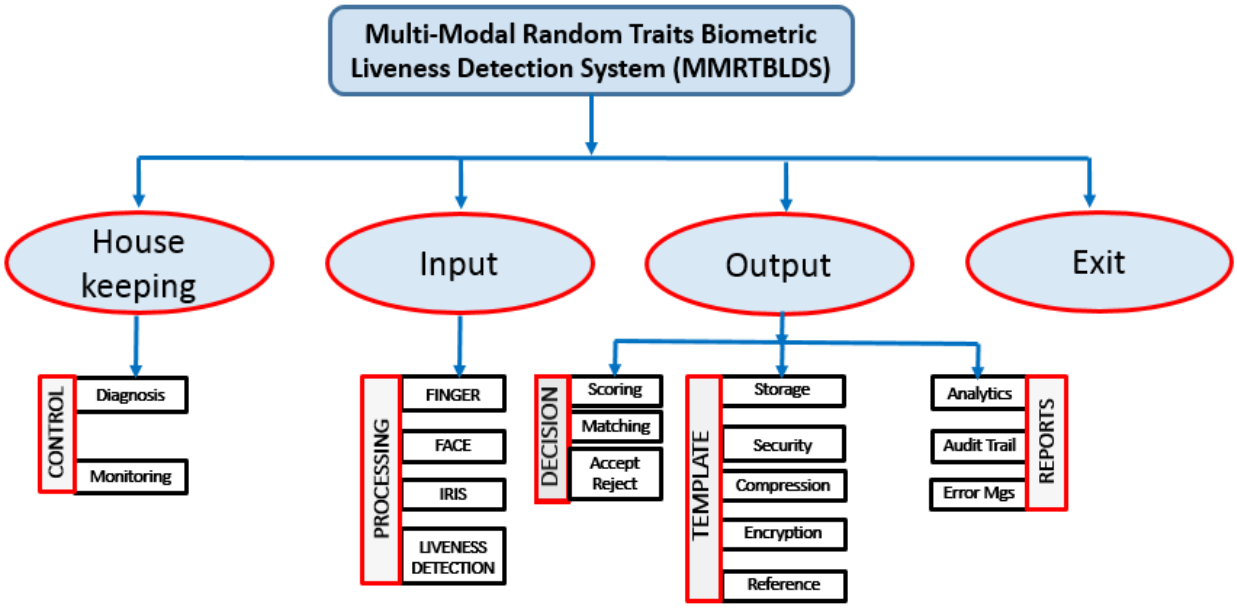

Module. etc.

Fig **3.4: High Level Model of the Multi-Moda l Random Trait Biometric Liveness Detection System**

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Development of an Intelligent Car Engine Fault Troubleshooting System (CEFTS)

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Abstract

The mass production and wider use of automobiles and the incorporation of complex electronic technologies all indicate that the control of faults should be an integral part of engine design and usage. This paper discusses an expert system application for troubleshooting car engine faults using Auto-mechanic workshops in Calabar metropolis of Cross River State-Nigeria. The method of fact-finding called knowledge acquisition which is an expert system approach to extract facts was adopted in order to achieve good judgment in the use of heuristics among experts. The results are represented as a set of IF – THEN judgments that expert mechanics can rely mostly on in the troubleshooting process. The system depends on an automated matching process between symptoms and procedures. The paper developed a new prototype named Car Engine Fault Troubleshooting System (CEFTS) using C++ programming platform. The purpose of the developed prototype is to assist motorists and auto mechanics in fault troubleshooting of car engines by providing systematic and step-by-step analysis of failure symptoms and offering maintenance or service advice. The result of this development is expected to introduce a systematic and intelligent method in car engine troubleshooting and maintenance environments and also provides a troubleshooting framework for other researchers to work on.

KEYWORDS: Expert System, knowledge base, troubleshooting, inference engine, knowledge acquisition, artificial intelligence**.**

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1. Introduction

In today's highly advanced society, computers affect our lives twenty-four hours a day. The use of computer in diverse activities of human endeavours is increasing in our society today, as awareness of the capabilities of the computer increases [1].

Almost all the activities carried out by humans are stressful. From time immemorial, man has learnt to reduce stress by developing new technologies which to a very large extent reduce stress to the barest minimum, if not completely eliminated [2].The application of computer is prominent in getting things done with high precision [3]. Like every other area of human endeavour, computers are now being applied in various fields, automobile industries inclusive.Auto mechanics have all along been seeking for effective means of improving their services to their clients and technological aid using expert system is no doubt one of these means. Expert system is an intelligent computerprogram that uses knowledge and inference procedures to solveproblems that are difficult enough to require significant human expertise for their solutions [4]. Expert systems provide powerful and flexible means for obtaining solutions toa variety of problems that often cannot be dealt with by other,more traditional and orthodox methods [5].

The mass production and wider use of automobiles and the incorporation of complex electronic technologies all indicate that the control of faults should be given an integral part of engine design and usage [6]. Today, Artificial Intelligence (AI) technology is widely suggested for systematic troubleshooting of faults where the amount of well-defined diagnosis knowledge is vast and the

sequence of steps required to identify the fault is very long.

There are many things that can affect engine performance. Today's cars are more complicated than they ever were. Electronic components and computers make them more fuel efficient, but they also make them more complicated and difficult to troubleshoot. A lot of things that made an engine run bad twenty years ago, still hold true today. The electronics make the engine run, but under all those electronics the engine hass basically remained the same. Before one try and troubleshoot any problem, there is need to check the basics. "The engine needs spark, fuel and air to operate and nine times out of ten; it is a simple and basic problem" [7].

Therefore, thepurpose of this study is to develop an expert system application for car engine faults troubleshooting and to transform the expertise of the human expert (auto-mechanics) into an intelligent Car Engine Fault Troubleshooting System (CEFTS) using expert system technology.

2. Problem Definition

Has one's car ever broken down in the middle of a long distance journey, and the motorist do not know what to do? Then, after several minutes of indecision, the motorist starts looking for a mechanic workshop. A mechanic follows the motorist, touches the distributor, and asks the motorist to start the car. The motorist jump into the car, reluctantly turn the ignition key, and then the engine starts. The mechanic then declares that the problem is solved, that the motorist should pay him and continues with the journey. How does the motorist feel? It must be a mixture of excitement and anger within him/her. This is the kind of scenario people go through on several occasions. For this reason, it becomes necessary to automate car engine troubleshooting procedure, so that car owners or motorists can begin to have a level of knowledge, which will enable them solve certain car engine problems personally.

In dealing with car engine problems and troubleshooting, mechanics are those who can help to solve them. But sometimes we donot have enough time to see the mechanics and maybe the distance is quite far, and we are in a hurry. Therefore we need instance help and solution. So it is believed that the use of expert system can be beneficial in this situation by giving a temporary and instance guides to motorists and car owners.

The following situations are the factors that initiated this study, so as to find a way of developing expert system application that can be useful in such situations.

i. Lack of knowledge by car owners or motorists to handle the easier car engine problems.
ii. Lack of knowledge by car owners or motorists to communicate the exact nature of their car engine problems to the mechanic.
iii. Inaccurate diagnosis of car engine problems by the Mechanic.
iv. Frequent occurrence of incidents on the highway, due to regular car engine malfunctioning. Some of the problems that may arise from this include delay in meeting up with appointments; one's integrity can be affected; extortion for a quick fix; exposure to robbery attack; etc.

3.0 Expert Systems

An expert system or knowledge-based system is a computer program that is designed to mimic the decision-making ability of a decision-maker(s), that is, expert(s) in a particular narrow domain of expertise [8].Expert systems are computer applications which embody some non-algorithmic expertise for solving certain types of problems. For example, expert systems are used in diagnostic applications servicing both people and machinery. They also play chess, make financial planning decisions, configure computers, monitor real time systems, underwrite insurance policies, and perform many other services which previously required human expertise [9].

The primary intent of expert system technology is to realize the integration of human expertise into computer processes. This integration not only helps to preserve the human expertise but also allows humans to be freed from performing the more routine activities that might be associated with interactions with a computer-based system [10].

Any successful decision-making is strongly dependent upon various capabilities that include the effective acquisition, storage, distribution, and sophisticated use of the knowledge of the human experts in the field. In the context of computer-aided systems for monitoring and information processing, these capabilities would be achieved through developing an expert system [11].

The author in [4] had also said that the most successful application of Artificial Intelligence (AI) in decision making so far is the development of Decision Support System (DSS), particularly expert system, which is a computer program that act as a 'consultant' or 'advisor' to decision makers.

Expert System has been applied in many ways and various fields which are meant to make human's life simple and even easier. The application of expert systems technology in the domain of environmental management is particularly appropriate in order to preserve and disseminate efficiently valuable and scarce expertise at reasonable costs. The Landfill Restoration Plan Advisor (LRPA) is an expert system designed for use in the planning of sanitary landfill restoration [12].

In medical domain, expert system seems to be really helpful which can assist both doctors and patients, and has been applied in several cases. The efficacy of expert system towards healthcare is demonstrated by discussing an on-going in-house Tele-Healthcare project TIDE—Tele-Healthcare Information and Diagnostic Environment. TIDE aims to ensure a continuum of healthcare throughout the life-time of the individual. Technical realization of TIDE involves a confluence of information technologies – artificial intelligence (expert systems, case-based and commonsense reasoning), medical informatics, multimedia, Internet and database technologies [13].

The author in [14] described a proposed expert system for car fault diagnosis called the Service Bay Diagnostic System (SBDS). This system has the ability to guide a human technician throughthe entire service process, from the initial customer interviewat the service desk to the diagnosis and repair of the car in the garage.

The author in [15] proposed and designed a decision model forcar fault diagnosis in which an expert system is utilized to helpinexperienced mechanics and drivers.

The authors in [16] proposed and developed an expert system for diagnosis heavy duty diesel engine that can be used to detect malfunctions in the engines andgive recommendation of corrective actions.

4.0 Troubleshooting

Troubleshooting is the process of finding and correcting faults in machinery. Troubleshooters are those who carry out fault tracing and fault correction in a machinery [17].

There are several standard techniques that can be used to troubleshoot problems. Using the tools and documentation provided with the hardware and software is a good starting place. Once users have familiarized with these materials, they can begin identifying the problem and testing the affected features to determine the exact cause. Problems can be caused by issues as diverse as incompatible hardware, outdated drivers, loose connections, incorrect configurations, or other issues. Users can use a variety of resources to isolate the problem and determine if it is a known issue with a documented solution [18].

There are better ways to tackle intermittent. One is to wait until the intermittent has become a more frequent or continuous problem. It's always easier to diagnose a part that has failed than one which is only misbehaving. But that approach may not sit well with a customer who wants you to fix their problem now. Most people want dependable transportation that starts every time and runs reliably. They don't want to risk being stranded or breaking down somewhere. So if they want you to fix it now, they would better be prepared to pay for the diagnostic time it takes to track down the cause of the intermittent [19].

The authors in [20] proposed 10 steps for Universal Troubleshooting Process as follows:

i) Prepare
ii) Make damage control plan
iii) Get a complete and accurate symptom description
iv) Reproduce the symptom
v) Do the appropriate corrective maintenance
vi) Narrow it down to the root cause
vii) Repair or replace the defective component
viii) Test
ix) Take pride in your solution
x) Prevent future occurrence of this problem

5.0 Car Engine Dynamics

It is a common phenomenon that no one will ever admit that he/she is a bad driver.One might have met people that admit being bad tennis players, bad skiers or football players or even bad losers. Never will anyone admit he/she is a bad driver. There must be some psychological reason behind this but that is not really the subject matter here. The mere purpose is to present the physics behind a car's road holding character.

All full time 4 wheel drive cars share some common characteristics in their handling and road holding abilities. A car's handling ability is most easily judged when cornering at high speeds. There are mainly three types of cornering behaviours[21]:

Under-steer, which denotes a car's tendency to exit the curve by following a trajectory whose radius is longer than the corner's. When a car under steers the driver has to steer more than he'd normally have to in track the corner's radius to follow the corner

- **Over-steer**, is characterized by the tendency of a car to follow a radius that is shorter than the corner's. When a car over steers the driver has to steer less than he'd have to, and sometimes counter-steer, in order to track the corner's radius
- **Neutral**, a behavior in which a car follows naturally a curve's radius

Ideally all cars should display a neutral cornering characteristic. Then again we are not living in an ideal world, are we? In real life most full time 4 wheel drive cars display a cornering character that varies while inside the corner. The car has a tendency to under-steer when entering the corner, a neutral behavior in mid-corner and an over-steering tendency when exiting the corner [21]. This, of course, is greatly dependent on parameters such as the car's power output, chassis rigidity, suspension design and dimensioning, torque distribution between axles and is mostly noticed on cars with a power output in excess of 200Bhp. Usually, the more power a car disposes the more the above handling pattern is true.

It is believed that all handling behaviors described herein are applicable in "close to the limit" situations which are to say close to the limit of grip and are mainly valid on high friction surfaces, that is, dry tarmac. Additionally these handling characters are valid when no major driver intervention or artifacts are used, that is, no hand brake use, lift-off, braking or manual differential locking.

According to the author in [7], every car has a natural tendency for one of the above mentioned road holding characteristics depending on its architecture (mass distribution, engine position, driven wheels, inertia, overhangs, turbo lag time .

Engine dynamics consists of three engine efficiency topics which include volumetric efficiency, thermal efficiency and mechanical efficiency [7].

The engine is the heart of the car, but instead of pumping blood, the engine pumps air and fuel. The engines main function is to convert air and fuel into rotary motion so it can drive the wheels of the car. Only a few basic things are necessary for the engine operation.

1. Fuel (To be exact proper air /fuel ratio, normally it is about 14/1)
2. Spark (in appropriate moment)
3. Proper timing (the ignition of the compressed air /fuel mixture must take place at exactly the correct instant)
4. Compression in cylinders (the phase in which a combination of fuel and air is compressed in a cylinder before being ignited) plus, to start the engine, the battery, the starter and the starter circuit should be okay.

If the engine would not start there is no magic – one of these theories is probably missing, most often it is a spark or fuel related problem, but often it could be versimple things like dead battery.

6.0 Research Methodology

The development of the Expert System on Car Engine Troubleshooting is based on the methodology that has been adopted from several existing methodologies for different applications especially in the field of computer science, software engineering, knowledge engineering and multimedia, since this expert system will be an integration of these technologies.

A detailed survey of expert systems was conducted and an observational methodology sometimes adopted. The method of fact-finding called knowledge acquisition which is based on the Artificial Intelligence approach, to extract facts was also adopted. Interviews and research review was also adopted to extract facts for this study. In the study and development of this expertsystem, the methods used for knowledge representationis Production System (production rule). In theproduction rule, there are one or more rules that aredesigned to solve one problem.

The research also depended on published and unpublished literatures on expert systems, intelligent knowledge based systems, troubleshooting and car engine dynamics when it becomes necessary from the internet.Finally, an implementation driven methodology was also

employed to illustrate the software tool resulting from this study.

6.1 System Architecture

This expert system was structured based on the concepts of reasoning which emulates the human's problem solving strategies as shown in figure1

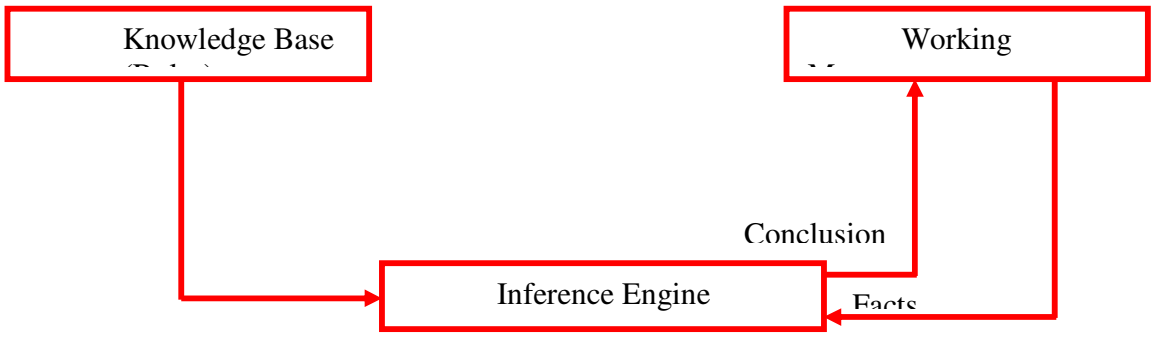

Figure 1: Structure of the Expert System's Problem Solving

6.2 Design of The Expert System

The Expert System developed in this study consists of the user interface, the explanation facility, the knowledge base, and the inference engine. The structure of the expert system is shown in Figure 2

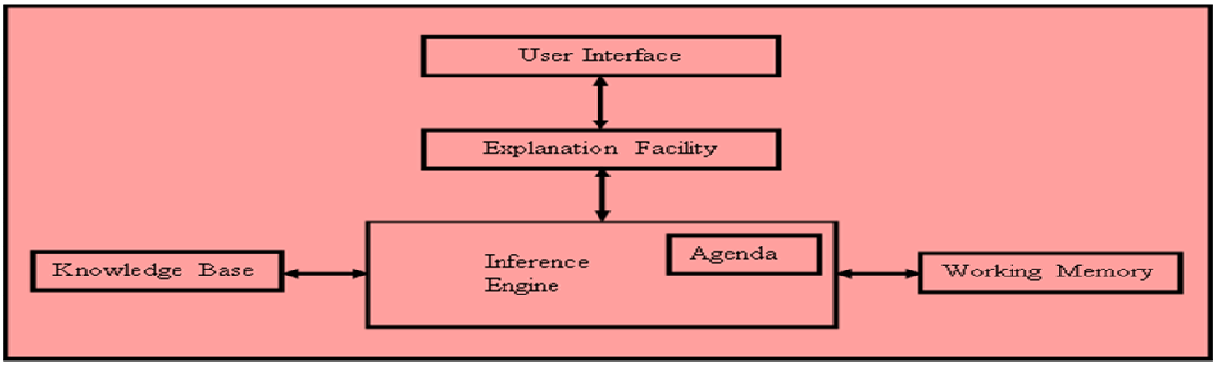

Figure Fig. 2: Structure of the Car Engine Fault Troubleshooting System (CEFTS)

6.2.1 Main Menu Design of the Proposed System

Communication between the user and the system was accomplished through main menu which is implemented in English language. The interface is characterized of a menuwhich displays the questions to the user.

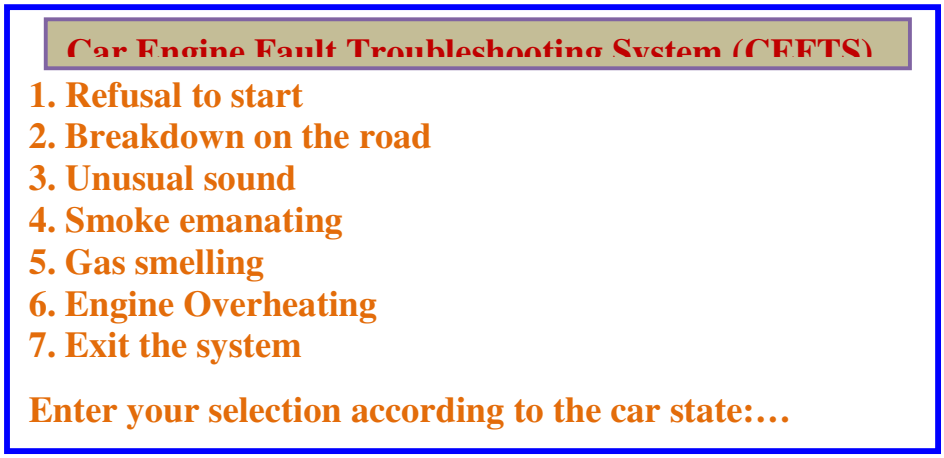

Figure 3 shows the main menu of the proposed system

When the system is started, a menu is displayed on the screen, prompting the user to select one out of some enumerated car conditions. After the selection, the user answers with a 'Yes' or 'No'to preceding cross-examinations .

6.3 Knowledge Base of the Proposed System

Table1 clearly shows contents of the knowledge base of the proposed system which consists of the car engine problems, evidence(s) or symptom(s), cause(s) and resolution(s).

Table 1: Contents of the Knowledge Base of the Proposed System

PROBLEMS	EVIDENCE	CAUSE(S)	RESOLUTION(S)
1. The engine hesitates	-The air filter is bad	-The air filter is dirty	-Replace the air filter
	-The spark plugs are worn-out	-The spark plugs are old and dirty	-Clean or replace spark plugs
	-The ignition wires are worn-out	-The ignition wires are bad	-Replace ignition wires
	-There is water in the gasoline	-Irregular filling of the gas tank	-Drain the gas tank and flushed with fresh gas and refill
	-The fuel filter is clogged	-The fuel filter is bad	-Replace fuel filter
	-The catalytic converter is clogged	-The catalytic converter is bad	-Replace catalytic converter
2. The engine surges or misfires while moving	-The carburetor choke is not properly set	-The carburetor choke is bad	-Check the choke plate and ensure that it is opening completely
	-The engine is too hot while moving	-The cooling system is faulty	-Check and repair cooling system
	-The fuel pressure level is too low	-The fuel pressure regulator is bad	-Replace fuel pressure regulator
	-The ignition timing is wrongly set	-Irregular ignition timing	-Adjust ignition timing
	-The fuel filter is partially clogged	-The fuel filter is bad	-Replace the fuel filter
	-Leakage in the vacuum	-Crack in the vacuum	-Check and replace vacuum lines
	-The EGR valve is stuck open	-The EGR valve is bad	-Replace EGR valve
	-The fuel injectors are dirty	-The fuel injectors are bad	-Clean or replace fuel injectors
3. A hissing sound is heard from the engine	-The engine is overheating	-The cooling system is bad	-Check and repair cooling system
	-The exhaust system is plugged	-The exhaust system is bad	-Check and replace exhaust system
	-The vacuum is leaking or disconnected	-The vacuum lines are bad	-Reconnect or replace vacuum lines
	-Leakage in the vacuum device	-Crack in the vacuum device	-Replace vacuum device
4. Whirring sound is heard from the engine that	-Low power steering fluid	Bad power steering fluid	-Check and refill power steering fluid
	-The alternator's bearings are bad	-Old alternator's bearings	-Replace the alternator
	-Bad water pump	-Old water pump	-Replace water pump
	-Bad power	-Old power	-Replace power steering

gets worse as the engine speed increases	steering pump	steering pump	pump
	-Bad air conditioning compressor	-Old air conditioning compressor	-Replace air conditioning compressor
5. Engine seems to use more fuel than normal and there is a strong gas odour coming from the car.	-Leakage in the fuel lines	-Crack in the fuel lines	-Replace or repair fuel lines
	-The fuel injectors are leaking	-Crack in the fuel injectors	-Replace injectors
	-Gas cap is missing or bad	-Old gas cap	-Replace gas cap
	-The fuel pressure level is too low	-Bad fuel pressure regulator	-Replace fuel pressure regulator
6. Engine does not want to increase its speed	-Dirty air filter	-Bad air filter	-Replace the air filter
	-The air filter is clogged	-Bad air filter	-Replace air filter
	-Wrong setting of ignition timing.	-Irregular ignition timing	-Adjust ignition timing
	-Catalytic converter is clogged	-Bad catalytic converter	-Replace catalytic converter
	-Water is the gasoline	-Irregular filling of the gas tank	-Drain the gas tank and flushed with fresh gas and refill.
	-Fuel pump is shot	-Old fuel pump	-Replace fuel pump
7. Engine backfires when you press the gas pedal.	-Slipped camshaft timing belt or chain	-Bad timing belt or chain	-Replace timing belt or chain
	-Wrong setting of ignition timing	-Irregular ignition timing	-Adjust ignition timing
	Burnt or broken valve and camshaft	-Bad valve and camshaft.	-Replace valve and camshaft
	Spark plug wires are placed on the wrong spark plugs	-Incompatible spark plugs	-Check firing order and place the wires on the correct spark plugs
8. Engine hesitates, and a popping is heard from the engine	-The air filter is dirty	-Bad air filter	-Replace the air filter
	-The ignition wires are bad	-The ignition wires are old	-Replace the ignition wires
	-Distributor cap or rotor glazed	-Overheating of the rotor	-Clean/sand the rotor
9. Engine makes a tapping noise when idling	-Valves need adjustment	-No valves adjustment	-Check and adjust valves
	-The engine's oil pressure is low	-Old oil pump	-Check and replace oil pump
	-Bad hydraulic valve lifters	-Old hydraulic valve lifters	-Replace valve lifters
	-Push rods bent or worn out	-Bad push rods	-Replace push rods
10. Engine makes a ticking noise	-Valves adjusted wrongly	-No valves adjustment	-Check and adjust valves
	-There is sludge in the engine	-Restriction in oil flow and bad oil filter	-Flush engine, replace oil filter and fill with new oil
	-Bad hydraulic valve lifters	-Old hydraulic valve lifters	-Replace valve lifters
	-Engine's valves are stuck	-Engine's valves are old	-Check valves and repair

	-Push rods bent or worn out	-Bad push rods	-Replace push rods

6.4 Flowchart of the Proposed System Figure 9 shows the system flowchart of the proposed car engine fault troubleshooting system

(CEFTS).

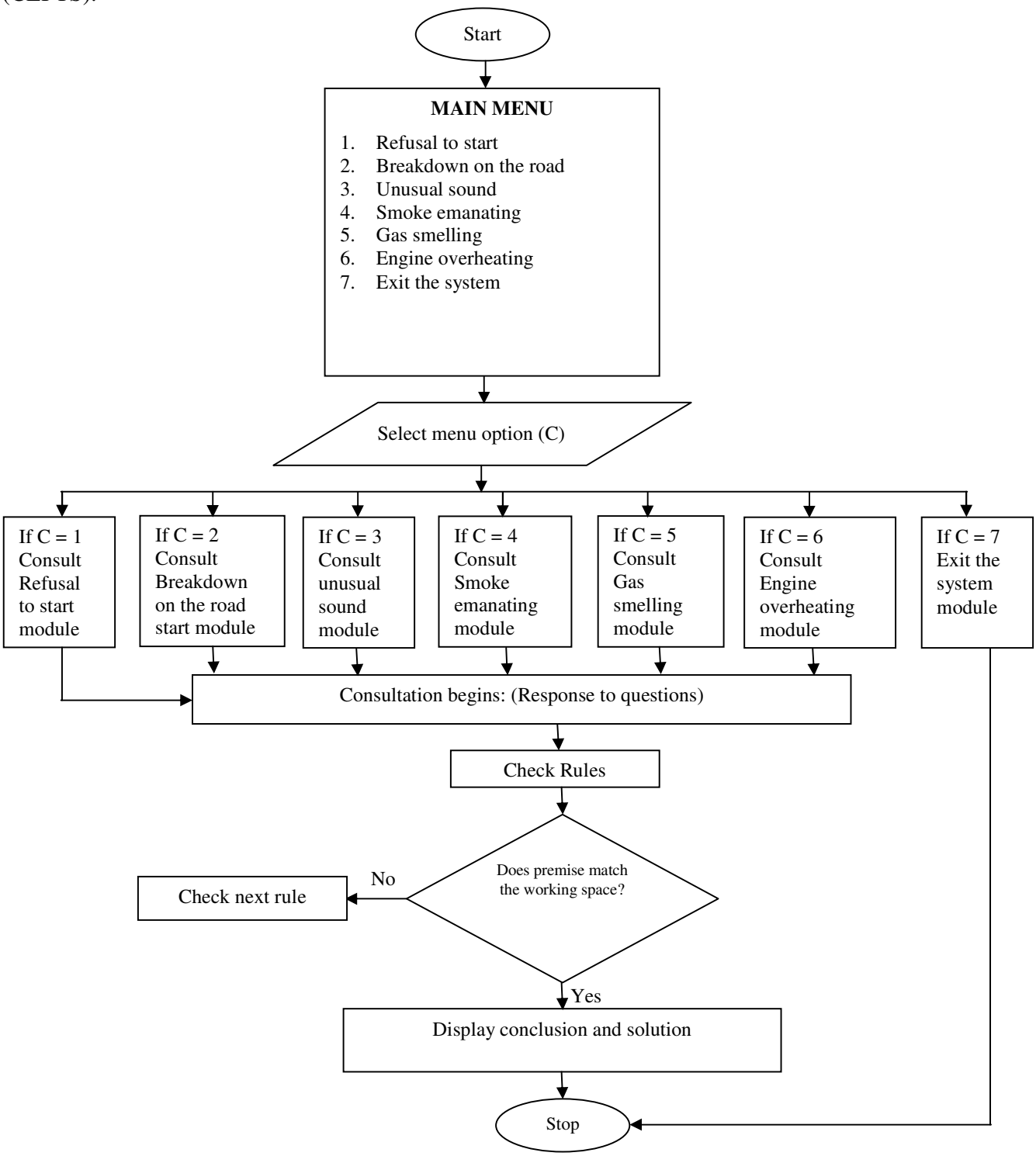

Figure 4: System Flowchart for the Proposed CEFTS

6.5 Advantages of the Proposed System

Generally, the proposed system can help inexperienced mechanics or drivers in troubleshootingcar engine faults. In addition, the system has the following advantages: Prevent the loss of customer and income. If mechanic's repair shop makes a wrong diagnosis, the customer will be reluctant to come back to the repair shop. With this system, the situation can be avoided.

i) The system can give temporary assistance to motorists who are in need of instance help, due to the limitation of time and distance.

ii) The system serves as a troubleshooting tool for training inexperienced mechanics and it will improve their productivities. Having this system may allow mechanics do more work in less time as the system will give instance guides and systematic step-by-step procedure on how to resolve the car engine problems.

iii) The system performs reasoning over the representations of human knowledge and as such can help reduce the need for scarce skilled mechanics. The repair of car engine requires a high level of expertise. With this system, inexperienced mechanics can be guided to find the fault.

iv) The system is capable working without stopping. As a human, expert mechanic will be tired if he works continuously.

7.0 Result and Discussion

A prototype of a troubleshooting system using expert system technology was developed and implemented, which emulates the human mechanic expert in resolving car engine problems. The system includes the common problems that can occur and the possible causes of those problems as well as the method(s) for resolving them. It is important to state that the system does not eliminate the consultant of a human expert (the mechanic)

The developed system provides a communication tool that connects the user with the system. It displays the questions in English to be answered by the user and shows the corresponding results.The system poses a set of questions to the user to beanswered and system decomposition is made based onuser responses.The events and the collected data for each troubleshooting process are retained in the system database to beanalyzed and exploited in enhancing the knowledgebase and constructing new rules for future use.Explanation section is provided to help ad guide the user in the troubleshooting process and on how to implement therepair tasks. See figures 5 – 9

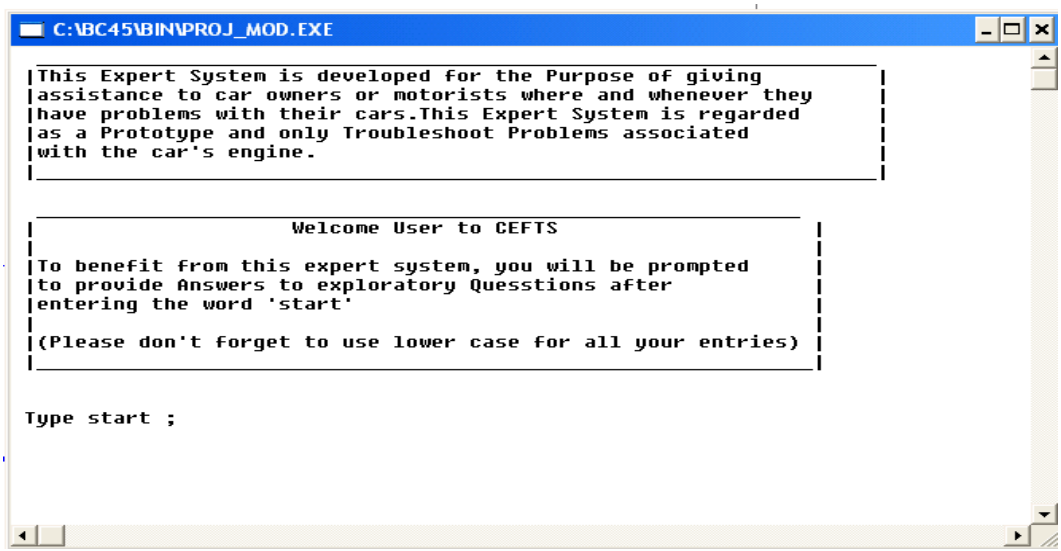

Figure 5: Welcome page of the Proposed System

```
C:\BC45\BIN\PROJ_MOD.EXE

|(CEFTS):An Expert System for Troubleshooting   |
| Car Engine Problems                           |
|_______________________________________________|
|              MAIN MENU                        |
|                                               |
| (1) Refusal to start                          |
|                                               |
| (2) Breakdown on the Road                     |
|                                               |
| (3) Unusual Sound                             |
|                                               |
| (4) Smoke Emanating                           |
|                                               |
| (5) Gas smelling                              |
|                                               |
| (6) Engine Overheating                        |
|                                               |
| (7) Exit                                      |
|_______________________________________________|

   Select a number that matches your car engine state:-_
```

Figure 6: Main Menu of the Proposed System

```
C:\BC45\BIN\PROJ_MOD.EXE

 _____________________________________________________________
|                                                             |
| If the car would not start, check simple things first.      |
| Ensure that there is fuel in the tank, oil in the engine and |
| the battery is okay.                                        |
|_____________________________________________________________|


 Do you hear a cranking sound when trying to start the car? (y/n)
y

 When you switch the ignition on before starting a car,
   does the 'check engine' light comes on? (y/n) y

 When you switch the ignition on, do you hear the pump
   buzzing sound from the gas (fuel)tank area? (y/n) y

 Before the engine died, did you experience any prior events
   such as leaving the lights on overnight? (y/n) _
```

Figure 7: Questions and Answers Section for Option 1 (Refusal to start)

```
C:\BC45\BIN\PROJ_MOD.EXE

 Discharged battery is one of the possible reasons for a car
   not to start. Very common is the situation where one forget
   to turn light off overnight, which causes the battery to
   discharge. In this case, when one is attempting to start the
   car, all you will probably hear is a clicking noise - then,
   there would not be enough power,turn the starter on.

 To Confirm discharged battery,        SELECT 1
 To Get temporal solution,             SELECT 2
 To Return to MAIN MENU                SELECT 3
 To EXIT                               SELECT 4
_
```

Figure 8: Resolution to Option 1 (Refusal to start)

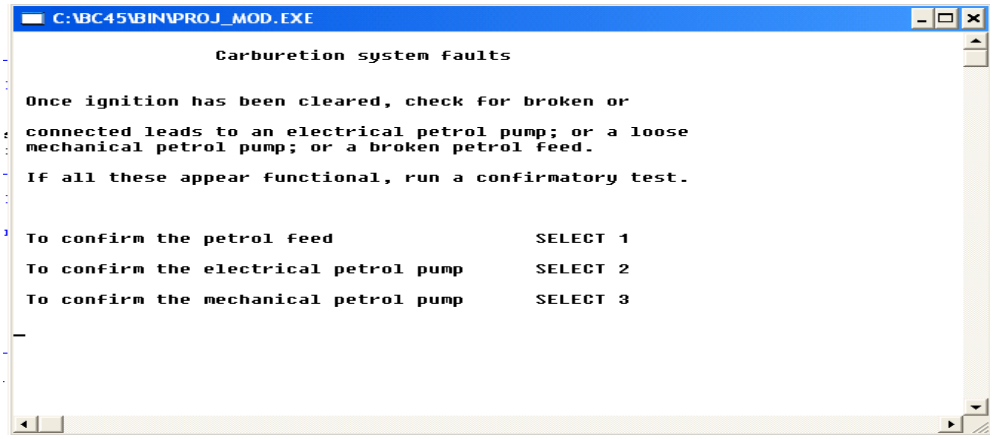

Figure 9: Tracing Carburetion System Faults

8.0 Conclusion

In this paper, an Expert System for bleshooting car engine faults was developed and implemented. The system was implemented using the C++ programming language platform. During the test phase of the system it never gave wrong diagnosis according to the rules used. The system indicated that a full expert system will be practical and can be extremely useful in providing consistent car engine fault troubleshooting. Further work is needed to improve the system by adding sufficient domain knowledge that represents domain knowledge thoroughly. Plans are underway to convene experts to use the system to assist them in their jobs of car engine faulttroubleshooting.

Preliminary validation of the program revealed that using rule-based expert system to troubleshoot. car engine is faster, accurate and more efficient than the manual approach.

The study has positively contributed to a **culture** ereby car users can begin to acquire a level of knowledge in the comfort of their homes andor offices, through the computer program developed in this study, and are able to resolve certain car problems.Finally, the study is significance as it is a **pioneering** effort, geared towards introducing a new area of application for expert systems.Furthermore, the prototype developed in this study is original, and can help other researchers carrying out further studies in this direction. It is believed that this effort will generate further research efforts in this direction, especially to have the implementation of a complete car troubleshooting expert system and further work is also needed toimprove the system by adding sufficient domain knowledgethat represents domain knowledge thoroughly

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Planning Our Smart Cities In The Internet Of Things Architects, Software Engineers And The Rest Of Us

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Abstract

This paper presents a cloud centric vision for worldwide implementation of Internet of Things that, gives an indication of what to expect of modern day architects and how they are expected to function in the Internet of Thing world to make building of our much taunted smart cities a feasible reality. The key enabling technologies and application domains that are likely to drive Internet of Things research in the near future were also mentioned. The paper focused on the role of architects in Laying such a robust foundation along with a set of design-choices, based on the characterization of the targeted system with respect to various dimensions like distribution, security, real-time, semantics, and so on to make it possible for a system architect to select the protocols, functional components, architectural options, and all other parameters needed to build these Internet of Things systems in developing smart cities for a smarter world

Key Words: Smrt city, smart living,

1.0 Introduction

Smart city is a terminology that we are going to hear a lot about in time to come. A smart city is one that has mobile technology rooted across all functions of the city. A Smart City usually consists of basic infrastructure in an order to provide a good quality of life and a clean and lively environment for a smart living. Smart Cities uses the mobile technology and information and communication technologies (ICT) to improve the quality and performance in order to connect with its people in a more active and efficient manner. [1],[3] The components of a smart City includes smart government services, efficient transport system, smart traffic monitoring, sustainable energy, smart health care, improved water and waste management. [4][16]

The major changes in technology, environment and economy have generated curiosity in building smart cities. The major goals of smarter city applications are improving the governance and transforming the lives in urban areas. A report released by Juniper Research in 2015 named Barcelona as the world's smartest city. [14]The research inspected several aspects like technologies used, transportation systems, buildings, utilities etc. The study also predicted that there would be many more smart cities springing up in the near future.

The world's most wired cities

We're already seeing hints of the potential of the Internet of Things on a large scale today. "Smart cities" like Songdo, South Korea and Masdar in Abu Dhabi offer glimpses into a future of complete connected cities, although, the cities themselves don't exactly look like something out of world. "You look at these cities and they're well designed and very rational, but they typically look like anywhere else because "The Internet of Things is generally invisible." [12][15]

But groundbreaking advances visible or not are being made. Around the world, cities frequently touted as "smart" include Tel Aviv, Barcelona, Copenhagen and London. As for American cities, Los Angeles is the world's first to synchronize traffic lights to reduce congestion, and New York City is working on America's first "quantified community," which will monitor data like foot traffic, waste production and energy usage in

real-time. In other words, the future is bright.[20][7][8][18]

Exciting possibilities

"We can't honestly think of a field of human endeavour where this innovation won't have some effect," says Jason Kelly Johnson, cofounder and design partner at Future Cities Lab, an experimental design studio, workshop and architectural think tank in San Francisco. "In architecture, specifically, it will in fact shape public space; it will intersect in a visible and tangible way." [15][4] The impacts of the Internet of Things on our cities don't begin and end with urban buildings everything from the morning commuter to public parks are incorporating Internet of Things technologies.[6][11]

What is this Internet of Things (IoT) ?

Internet of Things (IoT) is a recent communication idea that visualizes a near future, where the objects or devices used in everyday life will be equipped with sensors, microcontrollers, trans-receivers for digital communication, and suitable protocol stacks and network models will make these devices to communicate with each other and with the users, becoming an essential part of the Internet. [12][15] The Internet of Things revolves around increased machine-to-machine communication; it's built on cloud computing and networks of data-gathering sensors; it's mobile, virtual, and instantaneous connection; and they say it's going to make everything in our lives from streetlights to seaports "smart.[22][23]"

The initiative of the IoT (Internet of Things) was developed in parallel to Wireless Sensor Networks, and refers to distinctively identifiable objects in the environment and the object's virtual representations in an "internet-like" model. Though IoT does not follow a particular communication technology, but wireless communication technologies will play a major role in the advancement of the IoT. The development of a technology like IoT will make every part of the world connected. The rural and remote communities will be the key areas that will benefits from IoT the most. [2][28]

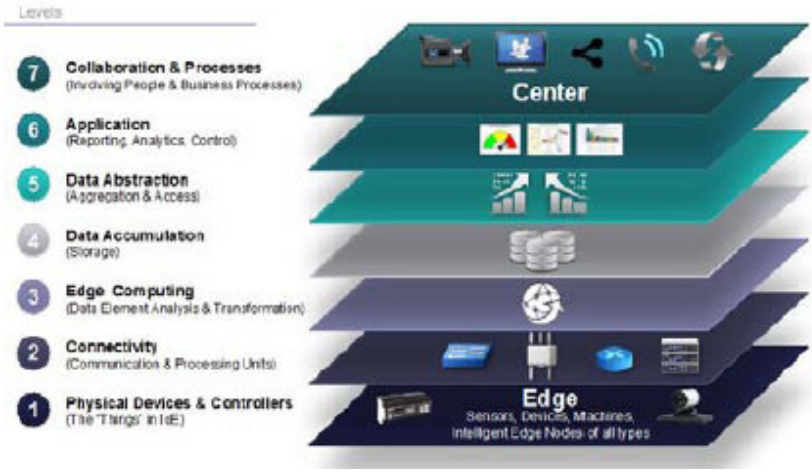

Fig.1.

The above figure is a reference model for the Internet of Things which contains 7 layers. • The first layer i.e the Physical Device layer is the first layer which consists of user devices which are equipped with sensors, nodes microchips etc. • The second layer, Connectivity layer consists of several communication protocols and communication models used for inter communication of the devices • The third layer is the edge computing layer which performs data element analysis and data manipulations. • The fourth layer is the data accumulation layer. As the name goes all the data that is collected by the mobile devices is stored here. • The fifth layer is the Data Abstraction layer that performs aggregation on the data. • The sixth layer, Application layer performs operations like displaying analytics and reposting them so that the user can understand the trends and data patterns. • The last layer is the Collaboration and process layer which people and business models and processes. [21][24][30][31][29][24][25]

What is the Internet of Things in practice?

Maybe the simplest definition is that the Internet of Things encompasses all the embedded devices and networks that are natively IP-enabled and Internet-connected, along with the Internet services monitoring and controlling those devices. [17][27][31] Here we turn information into action. The Internet of Things doesn't function without cloud-based applications to interpret and transmit the data coming from all these sensors. The cloud is what enables the apps to go to work for you anytime, anywhere.[11][14]

A sensor is not a machine. It doesn't do anything in the same sense that a machine does. It measures, it evaluates; in short, it gathers data. The Internet of Things really comes together with the connection of sensors and machines. That is to say, the real value that the Internet of Things creates is at the intersection of gathering data and leveraging it. All the information gathered by all the sensors in the world isn't worth very much if there isn't an infrastructure in place to analyze it in real time.[7] [24][25][26][32] [39

Fig 2

What is the vision of Internet of Things (IoT).

The vision of the internet of things is to manage objects around us with their own unique IP address. Internet of Things will comprise of billions of devices that can sense, communicate, compute and potentially actuate. Traditional Approach to Automation of Home and Building Management Systems consists of disparate system such as Access control, Fire Alarm, Digital Surveillance, motion and presence detection, energy management, sprinkler irrigation system, entertainment devices etc. These are, sometimes partially integrated by IP gateways but operate with proprietary protocols and standards Recent emergence of Cloud computing has triggered it. Cloud-based applications are the key to using leveraged data. [5][6] [10][13][31][41]

In the vision of the Internet of Things Internet of Things -we want to promote, a high level of interoperability needs to be reached at the communication level as well as at the service and the information level, going across different platforms, but established on a common grounding. The Internet of Things project reckons that achieving those goals comes in two steps, first of all in establishing a common understanding of the Internet of Things domain and second in providing to Internet of Things system developers a common foundation for building interoperable Internet of Things system architectures[24][28][29] [30]

Role of Internet of Things in Building Smart Cities Until now, the Internet has been used primarily as a medium for the transmitting and collecting the data and information.

Experts of the industry now believe that the next chapter in the "Internet devised for the People" is opened by the rise of the Internet of Things (IoT). Internet of Things is leading to a change in the culture as a huge number of devices, sensors, actuators, and other objects are being interconnected to each other and to next level systems. The connectivity of a huge number of devices that are programmed to collect the data gave rise to an entirely new services and features which form the basis of some important concepts like the "Smart Cities". Internet of Things and big data are both technology-driven developments. [13][14][20]

The applications of Internet of Things for Smart City will bring huge market opportunities and will make lives of the people smarter. Today the devices around us are day by day becoming more

intelligent. Furthermore, these developments are bound to change our behaviour and the way we use them. We are in the middle of an era where we are trying to discover new opportunities brought to life by new software and hardware designed to take advantage of the flow of new personal and global data. Cities all over the world are likely to invest about N12, 000 trillion on Internet of Things technologies in the next 20 years. In order to make cities smarter, the governments have started promoting several startups and other industries in order to work on the Internet of Things technologies so that they can be implemented in several spheres of urban living. Here are some of the areas that the governments must work to achieve their goal of building smart cities. [22][26]

Making Modern Architect and Software Engineer function in Internet of Things (IoT)

For modern day architects and Software Engineers to be functional in Internet of Things and contribute meaningfully in the design and development of our smart cities they must be a good collaboration and keen exchange of ideas. The architect especially must be vast in not only normal architectural design but also in mobile and cloud computing. They must understand that the overall architecture to be followed at the initial stages of Internet of Things research will have a severe bearing on the field itself and needs to be properly software engineering and designed. Most of the work relating to Internet of Things architecture has been from the wireless sensor networks perspective Efficient heterogeneous sensing of the urban environment needs to simultaneously meet competing demands of multiple sensing modalities and this implies that the real architects must have basic knowledge of networking.. This has implications on network traffic, data storage and energy utilization. Importantly, this encompasses both fixed and mobile sensing infrastructure.

Security will be a major concern wherever networks are deployed at large scale. There can be many ways the system could be attacked - disabling the network availability; pushing erroneous data into the network; accessing personal information by physically attacking erected structures and that simply means that these architects need to understand all these and provide diversified security measures. Heterogeneous networks are (by default) multi-service; providing more than one distinct application or service. This implies not only multiple traffic types within the network, but also the ability of a single network to support all applications without Quality of Service compromise people centric sensing offers the possibility of low cost sensing of the environment localized to the user. It can therefore give the closest indication of environmental parameters experienced by the user. It has been noted that environmental data collected by user forms a social currency Extracting useful information from a complex sensing environment at different spatial and temporal resolutions is a challenging research problem in artificial intelligence.

Current state-of-the-art methods use shallow learning methods where pre-defined events and data anomalies are extracted using supervised and unsupervised learning **[40].** The next level of learning involves inferring local activities by using temporal information of events extracted from shallow learning. The ultimate vision will be to detect complex events based on larger spatial and longer temporal scales based on the two levels before. The fundamental research problem that arises in complex sensing environments of this nature is how to simultaneously learn representations of events and activities at multiple levels of complexity

As new display technologies emerge, creative visualization will be enabled and embedded is physical planning and structures. The evolution from CRT to Plasma, LCD, LED, and AMOLED displays have given rise to highly efficient data representation (using touch interface) with the user being able to navigate the data better than ever before. With emerging 3D displays, this area is certain to have more research and development opportunities. However, the data which comes out of ubiquitous computing is not always ready for direct consumption using visualization platforms and requires further processing. The scenario becomes very complex for heterogeneous spatio-temporal data

An integrated Internet of Thing and Cloud computing applications enabling the creation of

smart environments such as Smart Physical Structures need to be able to (a) combine services offered by multiple stakeholders and (b) scale to support a large number of users in a reliable and decentralized manner. They need to be able operate in both wired and wireless network environments and deal with constraints such as access devices or data sources with limited power and unreliable connectivity. The Cloud application platforms need to be enhanced to support (a) the rapid creation of applications by providing domain specific programming tools and environments and (b) seamless execution of applications harnessing capabilities of multiple dynamic and heterogeneous resources to meet quality of service requirements of diverse users. [35][36][37] The Cloud resource management and scheduling system should be able to dynamically prioritize requests and provision resources such that critical requests are served in real time. To deliver results in a reliable fashion

The nature of real architectural design

The real architectural design can be visualized as the "Matrix" that eventually gives birth ideally to all concrete architectures. For establishing such a Matrix, based on a strong and exhaustive analysis of the State of the Art, we need to envisage the superset of all possible functionalities, mechanisms and protocols that can be used for building such concrete architecture and to show how interconnections could take place between selected ones (as no concrete system is likely to use all of the functional possibilities). Laying such a robust foundation along with a set of design-choices, based on the characterization of the targeted system with respect to various dimensions like distribution, security, real-time, semantics, and so on it becomes possible for a system architect to select the protocols, functional components, architectural options, and all other parameters needed to build these Internet of Things systems.

The nature of these developed Cities

From good design perspective a well-developed Internet of Things city should have the best availability, manageability and performance of Transport, water, energy, communication and buildings for residence work, entertainment and play. Internet of people with PC and Mobile devices is extending to a large number of specific application domains like Transportation, Energy, Environment, Assisted Living, most of the time pre-fixed with "Smart" sometimes for obvious marketing reasons but also -more generally- in order to emphasize the fact they embed a certain degree of intelligence and global awareness. This new breed of applications exploits Internet of Things related technologies, however, the resulting applications unfortunately appear as plain/flat designs only, meaning specific applications with specific architectures, with little place left for inter-system communication and inter-operation. Actually that is where the real issue lies: the smartness of those new applications can only reach its pinnacle if full collaboration between those plain/flat designs can be achieved.

If we consider also the fact that Internet of Things related technologies come with a high level of heterogeneity, with specific protocols developed with specific applications in mind, it is no surprise that the Internet of Things landscape nowadays appears as highly fragmented. Many Internet of Things enabled solutions exist with recognised benefits in terms of business and social impact; however they form what we could call a set of Intranets of Things, not an Internet of Things!

Conclusion

The Internet of Things is opening new frontiers for improving processes. So now we have sensors monitoring and tracking all sorts of data; we have cloud-based apps translating that data into useful intelligence and transmitting it to machines on the ground, enabling mobile, real-time responses. And thus bridges become smart bridges, cars smart cars and buildings and every item inside it becomes smart. And soon, we have smart cities, and this is a huge and fundamental shift. When we succeeded in making everything intelligent, it's going to be a major engine for creating new products, new services and jobs. The most demanding use of the Internet of Things involves the rapid, real-time sensing of unpredictable conditions and instantaneous responses guided by automated systems. This kind of machine decision making

mimics human reactions, though at vastly enhanced performance levels. The building industry, for instance, is stepping up the development of systems that can detect imminent collapse and take evasive action. . What can we achieve when smart buildings in smart city locations start talking to each other when they sense imminent earth tremor and trigger off alarm for immediate evacuations? We're going to have safer cities to live in

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Deploying ICT with Entrepreneurship Culture can Fight Cyber-Crime Menace in developing countries.

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Abstract

This paper is a cross-sectional analysis,critique and exposé of the impacts and the implications of the interfacing of ICT with entrepreneurship ventures in contest with cyber-crimes in a developing economy such as Nigeria. An entrepreneur is simply an individual who is willing to risk investing time and money in a business activity that has the potential to make a profit or incur loss. More specifically, the enterprising individual is someone who organizes production, bringing together the factors of production viz; land, labor, and capital to make goods and services. He makes business decisions, figuring out what goods to produce and how to produce them even in the face of the emerging cyber-crimes, knowing that there is no guarantee that business decisions will not be sabotaged. Again he innovates, introducing new products & technologies by the applications of information and communication technology (ICT) and related methods as new ways of organizing business.Entrepreneurs come from all types of background. The types of business they create come in all shapes and sizes. They range from, craft shops, wielding, foundries, rubber processing and vulcanizing, food eg "okpapreneur", ogiri-preneur, akpupreneur, palm-wine-preneur, compu-preneur etc. They are active in all classification of business activity, and are the foundation of the small business sector of our country's economy. Entrepreneurs are the proprietors of the apprenticeship system that provides primary vehicle for training the labor for small business. The apprenticeship system is one in which an individual serves a proprietor or master for a given period of time in order to learn a trade or craft. It generates a large multiplier effect in employment creation.Generally, there is also a reflection of gross under development of entrepreneurial culture in our academic curricula. Sorrowfully enough, the bane of our educational system curricula, inter alia, is that it is designed towards DEPENDABILITY instead of CREATIVITY to our students (FRCN Oral, 2015).Thus, the present curricula in use in our tertiary institutions should be reorganized and improved upon to serve as an engine of innovation, imagination and vision. The new curricula envisaged should expose students to courses which create opportunities for skill acquisition and entrepreneurship promotion, and broaden access to information and communication technology which encompass all computer-based systems such as tele-conferencing, video-conferencing and the Internet with its world wide web (www).The present picture of our educational system shows defects in national priorities due to lack of proper planning. Data from the National Universities commission show that, the Polytechnic and Colleges of Education enrolled relatively less number of students than the Universities. As a result, graduate output of Universities out-numbers that of other tertiary institutions designed to produce the middle level manpower. This clearly demonstrates that more managerial and executive personnel are produced than what is produced at the middle level, which otherwise should be more. Furthermore, Olaiya (1998) evaluated this problem of imbalance and posited that it has been reflecting in the poor performance of the economy. According to Ihekoronye (2000), the synthesis of this view and the lesson to be learnt from it is that a well planned manpower programme for the country ought to produce more at the middle level, bearing in mind that in an economy, where there are more managers and administrators than those producing and maintaining, there are resultant economic crisis, under-production, under-employment of high-level manpower, scarcity of necessary commodities and lack of appropriate technology development.

KEYWORDS: *Cyber-crimes, entrepreneurs, compupreneur, firewalls, computer forensics, ICT, "okpapreneur", palm-wine-preneur.*

Introduction

The Internet has become a part of our daily lives as it is used for communication, research,

networking, shopping, education, etc.With it, an individual (entrepreneur) can have access to a vast pool of information which will enable participation in, negotiation with, controlling, and holding accountable; institutions that affect the individuals life.

An entrepreneur is simply an individual who is willing to risk investing time and money in a business activity that has the potential to make a profit or incur loss. To achieve this, theentrepreneur organizes production, bringing together the factors of production viz; land, labor, and capital to make goods and services; in addition to making business decisions, figuring out what goods to produce and how to produce them. In other to add value to products/services, the entrepreneur innovates, introducing new products & technologies by the applications of information and communication technology (ICT) and related methods as new ways of organizing business. With this, he takes risks even against the emerging cyber-crimes, knowing that there is no guarantee that business decisions will not be sabotaged.

Again, entrepreneurs are the proprietors of the apprenticeship system (apprenticeship system is one in which an individual serves a proprietor or master for a given period of time in order to learn a trade or craft and it generates a large multiplier effect in employment creation). This system provides primary vehicle for training the labor for small business. They are active in all classifications of business activity, and also the foundation of small business sector of our country's economy. Arguing in support of this, Ezeano, Edmond, Isineyi, Urom, & Ikpe, (2011), asserted that there is every need to train up entrepreneurs (middle-level manpower) with appropriate qualities, characteristics and attitudes for a sustainable economic advantage, especially in this time when global economy is catalyzed by innovation.

A miracle of national transformation took place at the birth of the nation of Israel in 1948, courtesy of a providential breakfast meeting initiated by the Minister ofEducation at the home of the pioneer Prime Minister of the brand new fragile nation, Gen. Ben Gurion. The minister called on Ben Gurion early in the morning and shared with him his burden for their national survival and future.He put it like this "*you know we have been all along a trading people who have lived on law practice, buying and selling, managing money for themselves and others. In this our new state of Israel on a hostile Palestinian desert, there is not much to buy or whom to sell to. If we do not anything quick to change our lifestyle and means of living; with nothing to buy or sell, we shall soon start selling one another for survival. We MUST teach our people to start creating things with their hands i.e.* ENTERPRENEURSHIP EDUCATION**",** Nebo (2012). These two good heads put their thoughts to knock out vocational/entrepreneurial education that turned the deserts to Eden and consequently, Israel became the megastar and envy of all nations.

Why Become an Entrepreneur?

Individuals who venture out on their own into the market-place as entrepreneurs do so for a combination of three reasons:

The desire to control their own destinies. This desire brings about the greatest benefits and is often the greatest motivator. As small business owners, individuals control how they wish to run their personal lives. Entrepreneurs plan their own business activities and they schedule their professional responsibilities/duties around their personal priorities. This right is the greatest reward of entrepreneurship.

1. They desire to achieve freedom from direct supervision of a boss. Entrepreneurs still must answer to those on whom they depend, such as bankers, suppliers, or possibly transceiver; however these relationships are on equal basis and not a subordinate.
2. Desire to achieve greater profits: They strive for the potential to achieve profits greater than a salary earned from working for someone else. This is the hardest objective to achieve and usually takes the longest to accomplish. If the determination to succeed is present, it can be a reachable goal.

Review Of Literatures And Discussions

It is a well known fact that "the Internet is the ultimate vehicle for information retrieval and transmission" (http://miter.mit.edu/articlesecurity-entrepreneurs-needed-cyber-crime-and-internet-security/), in this era of information superhighway age. Individuals from around the world are linked up in real-time, families, businesses and governments,

connected. In spite of this vast expanse of digital data-flooding, otherwise known as the "cyberspace", attempts to decipher and exploit this information for personal or national gain have become increasingly pervasive. All information being stored and transmitted over the internet is vulnerable to attack.David, Karl, and William (2010) stressed that "four out of every five computer crimes (cyber-crime), investigated by the Federal Bureau of Investigation (FBI) in 1993 involved unauthorized access to computers via the Internet."In this age of connectivity, so many organizationshavesufferedfrom the activities of cyber-criminals.

Cyber crime, otherwise known as computer crime, e-crime, hi-tech crime or electronic crime is the use of computers to facilitate crime that is aimed at individuals/organizations, or at computers. This "crime is responsible for the economic losses that internet users have been facing lately" (http://www.spamlaws.com/fighting-cyber-crime.html).This can range from designing viruses, writing malware, cyber stalking, identity theft and various other crimes.Indeed, computer criminals do masquerade as authorized users and in the process, be able to figure out how to log-in and steal the business plans which an entrepreneur may have labored over years, secret information about a product to be soon released or disclose a confidential material that may lead to loss of trade secret status; thus empowering a competitor to gain advantage of the market. Surely this will undermine the two cardinal goals of an entrepreneur/entrepreneurship --- i.e. creating wealth and employment opportunities.

Utomi (2003), posited that "entrepreneurship is the persistent pursuit of opportunity to create wealth through innovative creation of a product or service that meets the need of customers, using scarce resources in a way that results in the expectation of stakeholder whose roles sustain the business". With the use of the internet, in consulting others and exchanging of ideas among other things, the cost of production of goods/services will be greatly reduced.

Of a truth, Marcin Kleczynski (2012), revealed that small businesses, which are often the primary product of entrepreneurship and have an important role to play in any given economy; are increasingly the target for cyber criminals. To ensure the stability of an economy, the owners of these businesses need to understand the risks and take such measures to ensure that they are protected. To fight cybercrime there needs to be a tightening of national/international digital legislation and of cross-border law enforcement co-ordination. Interestingly, there is an important executive Bill before the Nigerian National Assembly called the "**Computer Security & Critical Information infrastructure Protection Bill" ("the Bill")**. This Bill would further assist the Nigerian National Assembly and the Nigerian people in having a better Law on wire-tapping, computer/cyber crimes, and anti-terrorism. The problem is the lack of operational law against cybercrimes in a country like Nigeria.

With the number of computer users worldwide increasing daily, as well as the different devices employed in accessing the Net, many users are becoming more complacent about the information they provide about themselves. The indiscriminate supply of personal information exposes a user to running the risk of allowing cybercriminals to gain an advantage (ITNOW, 2012). Computer usage is increasing, for both social and scientific areas, and it will continue to do so. This naturally leads to an increase in the ways in which individuals and the organizations' work may be attacked. In order to stay consistently ahead of a moving opponent, the criminals, organizations, and states that pose asa threat one needs to develop technical solutions, and improve one's capability in all areas of information security.

The introductory part of the Bill on "**new wire-tapping, cyber-crimes & anti-terrorism bill in Nigeria",** describes its objectives to include "… securing computer systems, networks and protecting critical information infrastructure in Nigeria by prohibiting certain undesirable computer-based activities…" This Bill seeks to create legal liability and responsibility for modern global crimes carried on a computer or over a computer-network, i.e. the internet. Some of these crimes carry penalties of fines ranging from the average sum of ₦100, 000.00 (One Hundred Thousand Naira) to terms of imprisonment ranging on the average, six months imprisonment, other cyber-crimes with penalties include:-

- Hacking and unlawful access to a computer or computer network.
- Spamming: This is the process by which unsolicited mails /fraudulent electronic mails, etc. are sent to different internet users.

- Computer fraud, computer forgery, and system interference.
- Identity theft and impersonation on the internet: This crime is becoming the order of the day because most internet users are not cautious with personal information such as National identity number, date-of-birth, credit card number, drivers license number etc. To avoid being a victim, one should always be careful with the provision of such information.
- Cyber-terrorism: This is described by this Bill to include any act which is a violation of the Nigerian Criminal Code or Penal Code, that endangers life, the physical integrity or freedom of any person or causes serious injury, death, loss or damage to public property, natural resources, the environment, cultural heritage, etc. Also, cyber-terrorism can be described as the use of computer, computer networks/internet to commit or promote terrorist crimes.. The penalty on conviction for acts of terrorism is a fine of not less than ₦10Million or a term of imprisonment for not less than 20 years or to both (Ehijeagbon, 2008).
- Cyber squatting: Cyber squatting is the assuming of the name, personality, trade or business name, trade mark, domain name or other names registered to or belonging to another person/local government/state/federal government in Nigeria. The penalty for breaching this provision on conviction is a fine of not less than ₦100, 000.00 (One Hundred Thousand Naira) or imprisonment of not less than one year or to both. (InEzeano, et al 2012).

Because of the seriousness of cyber-crime, Section 3 of the said Bill makes it an offence for any person, without authority or in excess of such authority where it exists, to access any computer or access a computer for an unlawful purpose. Also, a disclosure of any password, access code or any other means of having access to any computer program without lawful authority is also inclusive. Section 12 of this Bill requires every service provider to keep a record of all traffic and subscriber information on their computer networks for such a period as the President of the Federal Republic of Nigeria may, by Federal Gazette, specify. Service Providers are further required to record and retain any related content at the instance of any Law Enforcement Agency. This Bill also allows any Law Enforcement Agency in Nigeria, on the production of a warrant issued by a Court of competent jurisdiction, to request a service provider to release any information in respect of communications within its network, and the service provider must comply with the terms of the warrant. (ibid). This Bill seeks to ensure the protection of the privacy and civil liberties of persons by requiring that all communications released by a service provider shall only be used for legitimate purposes authorized by the affected individual or by a Court of competent jurisdiction or by other lawful authority. All law enforcement agencies carrying out their duties under this Bill must also have due regard to the constitutional rights to freedom of privacy guaranteed under the 1999 Nigerian Constitution and "… take appropriate technology and organizational measures to safeguard the confidentiality of the data retained, processed or retrieved for the purposes of law enforcement". To ensure compliance by the service providers or a corporate body, who are the providers of all form of telecommunication services in Nigeria, this Bill recommends that any breach of the provisions of the contemplated Law, by these persons, shall on conviction be liable to the payment of a fine of not less than ₦5Million. In addition, each Director Manager or Officer of the service provider shall be liable to a fine of not less than ₦500,000 or imprisonment for a term of not less than three years or both i.e. the fine and the term of imprisonments.

Wire Tapping And Unlawful Interception Of Communication

Wire tapping, which in modern parlance is known as Lawful Interception, described as the "… monitoring of telephone and internet conversations by a third person, often by convert means". It is unlawful, under the Bill, for any person to intercept any communication without the authority of the Owner of the communication. A conviction for a breach of this provision is a fine of not less than N5Million or imprisonment for a period of not less than ten years or to both the fine and the term of imprisonment.

It is mandatory under this Bill for all service providers to ensure that their networks are accessible and available to enable law enforcement agencies, on the production of an order of a Court of Law or of any other lawful authority, to intercept and monitor all communications on their networks, access call

data or traffic, access the content of communications, monitor these communications uninterrupted from locations outside those of the Services providers, provided that these convert activities are for the purpose of law enforcement. The meaning of "…any other lawful authority …" is not defined in this Section or in the other Sections of the Bill neither is the responsibility of who bears the added technological costs of complying with these very stringent provisions indicated in the Bill. Any Service Provider that breaches the above provisions on cooperation with the law enforcement agencies would on conviction incur a fine of not less than ₦10million. As corporate bodies are artificial persons, additional liability is provided for each responsible Director, Manager or Officer of the Service Provider who allows any breach of the provisions of the Bill. A conviction of this group of individuals attracts a fine of not less than ₦500, 000 or imprisonment for a term of not less than three years or to both the fine and the terms of imprisonment.

Furthermore, some other assistance required of Service Providers and other relevant corporate bodies in prosecuting cyber-crimes include:-

- Identification, apprehension and prosecution of the offenders.
- Identification, tracing and confiscation of proceeds of any offence or property, equipment or device used in the commission of any cyber offence.
- Freezing, removal erasure or cancellation of the services of the offender from the network of the Service Provider.

The role of Internet access points in the facilitation of cyber crimes in Nigeria has been studied by Longe et al (2008). Their findings revealed that cyber cafes more than any other internet access points, have facilitated most cyber crimes. Indeed, of all the grand corruption perpetrated daily in our communities, most are of the agencies of computer and internet fraud , confirmed by (Onwudebelu, 2012) in (Ribadu ,2007)

Some Real Life Examples Of Cyber-Crime

The Central Bank of Nigeria (CBN) in its banking sector supervision report revealed that the banking sector lost N7.2Billion (Vanguard, 2009) to Internet fraud in a year. Some customers have never recovered their money. Also, Shan Symington, a postman in Hampshire, UK, is yet to find those who stole £130,000 from him in MySpace, another networking website, in September 2007 by a Nigerian. Again, if Ola Bolawole, a graduate of Mechanical Engineering had examined a mail that came into his box requesting him to provide his personal account details for upgrading Automated Teller Machines (ATM), cautiously; he would not have been fleeced by internet fraudsters of his ₦800,000= lamented (Femi, 2010). The 419 scam letter ended with, "This email has been sent to all our bank customers and it is compulsory to follow, as failure to verify account details will lead to account suspension".

Victims of Automatic Teller Machine

BANK CUSTOMER	GENDER	OCCUPATION	DEFRAUDED THROUGH	DEFRAUDED BY	AMOUNT (N)
1	M	Engineer	E-mail/ATM	Fraudster	800,000
2	F	Media practitioner	ATM	Unknown	40,000
3	M	Businessman	E-mail/ATM	Fraudster	350,000
4	M	-	ATM	Banker	490,000
5	F	-	ATM	Banker	10.8million
6	F	-	ATM	Unknown	133,000
7	M	Journalist	ATM	Unknown	40,000
8	F	-	ATM	Unknown	45,000
9	M	Businessman	ATM	Unknown	784,000
10	M	Planning officer	ATM	Unknown	30,000
11	F	Lecturer	ATM	Unknown	120,000
12	F	-	ATM	Family	50,000
13	M	Businessman	ATM	Banker	1million
14	M	Columnist	ATM	Banker	25,000

15	M	Student	ATM	Banker	6,000
16	M	System Analyst	ATM	Banker	5,000
17	F	Businessman	ATM	Fraudster	500,000

Sample output from a survey (Onwudebelu et al, 2012).

Cyber crime has become a career choice for an increasing number of highly educated young people who dismiss more conventional employment options (www.entrepreneurmag.co.za). There areserious threats to these entrepreneurial aspirations and developments via cyber-crimesentrepreneurs guard and reinforce whatever cyber security measures that are available.

What Is Cyber Security?

It is a means of protecting ones personal digital information, and/or asset stored in the computer or in any digital memory device. There are different forms of threats and each one has its own levels of seriousness and solutions. The higher the degree of the terror, the more advanced or complicated the approach to enforce safety measures. The following are some of the reasons why cyber security is needed:

Hackers are everywhere:

These could be a business rival, or neighbor, who has decided to take over another person's computer. Here software loopholes are capitalized on in hijacking another computer through backdoors, usually installed programs, or through cracking software. Having gained access to the target computer, all personal and confidential information (such as bank accounts, credit cards, or top trade secret, etc) can be employed in attacking other networks.

Internet Scams and Frauds are Rampant: These include phishing, (a very organized cyber crime), which deceives people into giving their banking details. Cyber criminals, pretending to be representatives from legitimate financial institutions, send e–mail messages and ask unsuspecting people to verify their passwords, account numbers, and other vital information.

Cyber Theft is a Common Cyber Crime:

This is the most reported crime that has increasingly become an easy one used to steal information from computers, not only from individuals but for companies, banks, and other organizations as well. Though, hardly report, big companies lose large amounts of money.

Virus infestation: Virus reaches your system through a number of entryways. One is through unsecured and unknown websites from which you download files, programs, applications, or tools free of charge.

Virus can slow down the system or even crash it.

Spyware: This is a program that automatically installs itself on one's computer.It tracks personal information in one computer

Cyber Security Panacea

The National Computer Crimes Squad estimated that between 85 and 97 percent of computer intrusions are not even detected. Fewer than 10 percent of all computer crimes are reported (mainly because organizations frequently fear that their employees, clients, and stockholders will lose faith in them if they admit that their computers have been attacked),and few of the crimes that *are* reported are ever solved (David Icove, Karl Seger, and William VonStorch, 2010). Due to this ugly development, any internet user (entrepreneur) that wants to stay ahead of the game of cyber criminality and stay protected should apply the under-listed steps amongst others.

- ***Use Strong Passwords:*** Avoid using names, birthdays, addresses, and other personal information as password. Do not use a word found in the dictionary as well, since hackers have found a way to decipher dictionary-generated passwords using certain tools. In general, a good password is at least eight-characters long and should be hard to crack. One can combine upper – and lower–case letters, numbers and symbols. Alternatively, one can use other methods to form a password that are unique and encrypted. This must be changed periodically.
- ***Regular updating of security Software:***

Instalationand regular updating of security programs on one's computer is imperative so as to ensure that the business is protected against the latest emerging threats. Also, software such as web browsers, operating systems, adobe readers etc. need to be kept up to date.

- **Get anti-malware software:-**

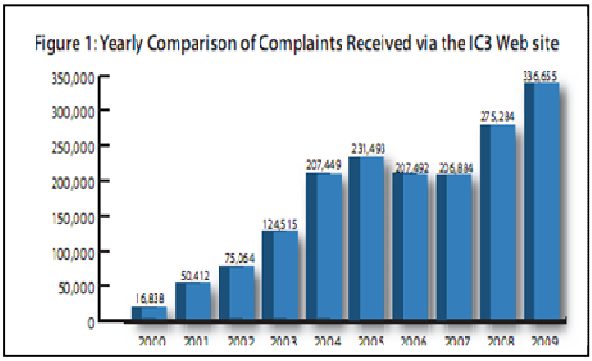
Malware or malicious software is aterm used for a number of different types of programs designed to break into or damage one's computer (www.entrepreneurmag.co.za). Malware include; Viruses, Worms, Trojans, Spyware, etc.

- **Avoid Opening Files sent through Instant Messenger:**
- **Ignore the Links on Pop-up Windows:** Block pop-up ads and windows to close an entryway for malware and other forms of attack.
- **Avoid Downloading Files, Programs, Applications, or Tools from Unknown Websites**
- **Make Sure to keep your System Clean:** Remove any tool, application, or program that is not in use.

Findings

In today's age, when everything from small gadgets to nuclear plants is being operated through computers, cyber-crime has assumed threatening ramifications. Indeed, the figures1&2, below – taken from the Internet.

Crime Complaint Center (IC3), highlight that the number of identity theft, stolen credit-card fraud and online



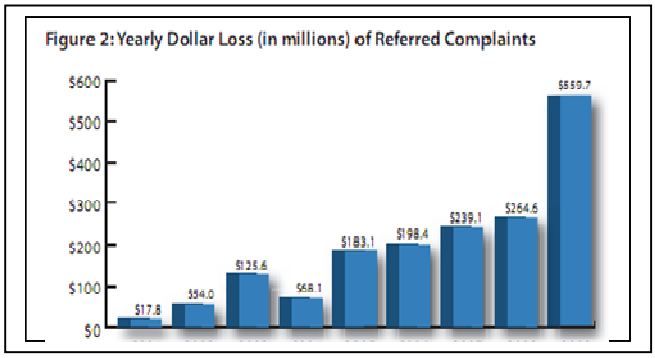


Fig 2: Yearly dollar loss (in millions) of referred Complaints .

Source: http://miter.mit.edu/articlesecurity-entrepreneurs-needed-cyber-crime-and-internet-security/ Chuck

McCutcheon (2005) alerted that there is an urgent need to educate non-computer professionals (entrepreneurs) on computer security. This will evidently curtail the huge financial and social burdens associated with cyber-crime even as these entrepreneurs join other information technology workers in protecting themselves online.

The Nigerian government is not left out in this fight against cyber crime. This has led to the establishment of a cybercrime working group called the Nigerian Cyber Working Group (**NCWG**). The NCWG is an inter-agency body made up of all key law enforcement, security, intelligence and ICT agencies of government, plus major private organizations in the ICT sector. The group has agencies like the Economic & Financial Crimes Commission (EFCC), Nigeria Police Force (NPF), the Nigeria Communications Commission (NCC), Department of State Services (DSS), National intelligence Agency (NIA), Nigerian Computer Society (NCS), Nigeria Internet Group (NIG), Internet Services providers' Association of Nigeria (ISPAN), National Information Technology Development Agency (NITDA), etc saddled with the task of eradicating the scourge from the nation, (Onwudebelu et al, 2012).

Summary/Conclusion

Cyber criminals are relentless, highly organized, slick, and extremely manipulative in using more sophisticated methods to extract and abuse sensitive data. Since the internet has come to stay, and Cyberspace is at best lawless; only the one who understands/appliesthe relevant steps of self-protection survives. Although Cyber security professionals and police are in a depressing number, and the field being a relatively new area of information technology (recently pushed over the top by the increasing number of internet frauds and scams, cyber thefts, system crash, and other forms of cyber attacks); that should not make any entrepreneur to throw in the trowel.

It is encouraging to note that the Federal Government has approved 1% of the Federation Account for National Agency for Science and Engineering Infrastructure's (NASENI) activities. Soon, therefore, Nigeria should have enough funds to carry out work relating to its national needs in the area of entrepreneurial developmentseven in our developing country, in order to fast-track the nation's**vision 20:2020**, if the legislation against cyber-crime is implemented

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Ethics and the Challenge of ICT: Advisory Note for Users and IT Professionals

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Abstract

This paper has attemted to provide advice to IT Professionals and Users on the professional ethical bevaviours in the IT industry. It is an advisory note to guide professionals and users to provide a guide on best practices in the areas of software licensing and application, misuse of IT resources and the need to comply with corporate IT polices particularly on securities and the need to avoid creative accounting

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Introduction

What is ethics? What is ICT? Ethics is ***a set of principles by which people live***. ICT (short for Information communications technology) can be described **as *all matters concerned with the furtherance of computer science and technology and with the design, development, installation, and implementation of information systems and applications [1] [3] [4]***. This definition can be further expanded to include the technology architecture which is an integrated framework for acquiring and evolving IT to achieve strategic goals. It has both logical and technical components. The communications [C] component deals with the transmission of electronic signals via specified media channels for extended diffusion of information services across very wide spectrum [.

Ethics and ICT is a new field. The Internet has been a force for bad as well as for good and has generated w whole new set of issues. It is rarely clear what is "right" and what is "wrong" and we should not let issues of personal taste cloud our judgment. Few of the items to be discussed here include Software Licensing, Pornography, misuse of resources by employees

2.0 Software licences

Is all your software appropriately licenced? Do you have a licence for every PC running Windows and Office? Not sure? Ensure you pay for your software! If you have an unlicenced copy of computer software you can buy the licence or stop using it and move onto free and open source software**.**

The most common issue arising from an IT audit in a small organisation is that there are often more copies of a particular piece of software (MS Office is a good example) installed on the computers than there are legitimate licenses. This puts IT professionals and circuit riders in a difficult position. Yes, we can advise you to purchase more but do we follow it up? Do we say "you should" but whisper off the record "but we know you don't have the funds so it's OK to wait a bit"? Do we steer you in the direction of open source alternatives (Open Office – free to download and use for example)? Or do we simply forget about it? Ethics deman that you purchase a software on license because software is an intellectual property. Clean and guilt-free living makes you happier!.

3.0 The importance of policies and procedures

Where does HR end and ICT begin? You wouldn't tolerate someone looking at porn magazines in your office so why should you tolerate someone looking at porn on a computer screen in the furthest corner of the office? Does it do any harm if you don't know about it? What is porn anyway? What if you access a website and

get a dodgy popup (probably means your security software isn't doing its job either)?

All organizations should have an acceptable use policy and a process for referring and managing issues as they arise. This would also cover abuse of resources (using too much bandwidth for internet radio, spending too much time booking holidays or concert tickets, accessing inappropriate material).

4.0 Multimedia nightmares – misuse of resources

I once worked in an office where someone sent a copy of a Star War movie trailer (all 25MB of it down a 56k line. It delayed all the emails for a couple of hours but the Managing Director didn't know any different until a client started nagging down the phone (good job they had more than one line). No one got hurt although the ears of the employee took a verbal bashing.

Lots of us enjoy internet radio or video at home. It's great entertainment, relaxing and surely no harm to use as 'background noise' in a busy office. However, if you think what's its doing to your broadband costs (not to mention squeezing bandwidth and slowing down emails and web traffic), is it still acceptable? The implications of file-sharing media (often illegal anyway) and internet media can have significant negative impacts on how effectively your ICT system works and how productive your staff are.

5.0 Creative accounting

Do not you love the first three months of the year? Money to spend quickly and easily. Few IT professionals or providers have been immune to being asked for products and services in a hurry. Even better is the creative accounting 'can you charge me for X now and provide me with Y later'. Yes, it happens. Organizations know, furter know, consultants/suppliers know. It always will whilst the ridiculous restrictions on end of year spending continue – spend it now or give it back. Hmmm… Do we 'go with the flow' or say no, you can only spend your money appropriately and you'll have to give back what we can't spend sensibly this month?

6.0 The ethical dilemma

If, as your ICT adviser, I keep nagging you as a small, underfunded organisation to buy licences for those 'extra' copies of Microsoft Office on your computers, how long before you get fed up and start working with someone else? Does it change the nature of our relationship? Do I have a moral duty to report you for copyright theft? In the eyes of the law, you are a thief. Should I turn a blind eye and say "I shouldn't really but I will install this copy onto another three PCs"?

Should you let your staff use their internet connection in their breaks to book holidays, order goods online, read the news etc.? Why not? Who is it harming as long as the material isn't offensive and resources aren't being used for harm? What's the balance between a member of staff spending 20% of their day on personal activities and being 20% more effective the rest of the time they're in the office?

7.0 Advice for IT professionals (with some thoughts for senior management)

This is a developing issue and there is no clear guidance available but here are a few guiding thoughts:

1. Remember your first duty is to inform and educate and help organisations make an informed choice and take ownership of decisions. (As a senior manager you need to make that choice/decision.)
2. You should always promote good practice and act in the best interests of the organisation and its mission so highlighting misuse of resources to senior management is sensible.
3. Ask yourself if it's any of your business or whether you're being driven by nosiness rather than a desire to help the organization (your client) or their clients.
4. Ensure you have a clear contract and description of your responsibilities (as a senior manager of a voluntary organisation, just what do you expect from your IT staff?)
5. Ensure you're clear what your legal responsibilities are (you might want to take formal advice on this) and what process you will follow. This would include reporting illegal pornography,

money laundering, hacking and evidence or terrorism or bomb-making instructions. You would almost certainly report these issues to the client first. Senior managers would typically dismiss the employee concerned but would be unwise to do so without legal advice.

6. Be aware of privacy implications (and the individuals right to privacy). How hard do you want to dig? Finding an image of someone in a bikini in a web cache does not make the user a pervert.

7. Be careful about making false accusations without any evidence. What if the material reached the system accidentally (a dodgy link on a webpage, a virus, a pop up).

8. If you find material which is distasteful (but not illegal), check the internet use policy. You might just have to accept it's none of your business.

9. Document what happened and cover yourself in writing

10. Respect confidentiality but escalate to your manager (or a trusted colleague if you don't have a manager)

11. Having a good relationship with your client is a big help – discussing concerns informally is much easier than having to commit to writing in first instance (you should commit to writing at some stage)

As IT professionals, we need to be clearly informed what we can and can't do and where to go for help. This article is a step in that process to highlighting the legal ramifications and developing support networks.

As managers in voluntary organisations, we need to be clear what we do and why and where the limits of our responsibilities lie.

8.0 Some things to watch out for

1. Your computers or servers are working very slowly – it could be a number of things but too much internet radio or video is a possible cause (old, badly maintained computers is another one!)

2. You've been hit by a significant viral outbreak but all your emails are screened – has one of your members of staff been surfing where they shouldn't?

3. You (or someone else) finds porn on your computer – are you covered for this? Is it in your acceptable use policy? Do you even have a policy? Now's the time to check…

Someone in your office always has their screen turned away and has a habit of closing down browsers/applications or turning their screen off when somene approaches

9.0 Organizational Concerns

Given the central and essential role of Information and Communication Technologies (ICT) in organisations, Simon Rogerson (1998) has posited that ethical sensitivity percolates decisions and activities related to ICT. In particular organisations need to consider:

- how to set up a strategic framework for ICT that recognises personal and corporate ethical issues;
- how the methods for systems development balance ethical, economic and technological considerations;
- the intellectual property issues surrounding software and data;
- the way information has become a key resource for organisations and how to safeguard the integrity of this information;
- the increasing organisational responsibility to ensure that privacy rights are not violated as more information about individuals is held electronically;
- the growing opportunity to misuse ICT given the increasing dependence of organisations on it and the organisational duty to minimise this opportunity whilst accepting individuals have a responsibility to resist it;
- the way advances in ICT can cause organisations to change their form - the full impact of such change needs to be considered and, if possible, in advance, and the way the advent of the global information society raises new issues for organisations in how they operate, compete, co-operate and obey legislation; and
- how to cope with the enormous and rapid change in ICT, and how to recognise and address the ethical issues that each advance brings.

Thus there is an ethical agenda associated with the use of ICT in organisations. This agenda combines issues common to many professions and issues that are specific to ICT. New advances in ICT and new applications may change the agenda. If organisations wish to secure benefits to their business in the long term and enhance their reputation they have to address a comprehensive agenda. The following steps provide a way in which organisations can establish such an agenda and address the ethical issues arising in the field of ICT.

1. Decide the organisation's policy, in broad terms, in relation to ICT. This should:
   - take account of the overall objectives of the organisation, drawing from such existing sources as the organisational plan or mission statement;
   - use the organisation's established values, possibly set out in its code of practice, for guidance in determining how to resolve ethical issues;
   - set the scope of policy in terms of matters to be covered.
2. Form a statement of principles related to ICT that would probably include:
   - respect for privacy and confidentiality;
   - avoid ICT misuse;
   - avoid ambiguity regarding ICT status, use and capability;
   - be committed to transparency of actions and decisions related to ICT;
   - adhere to relevant laws and observe the spirit of such laws;
   - support and promote the definition of standards in, for example, development, documentation and training; and
   - abide by relevant professional codes.
3. Identify the key areas where ethical issues may arise for the organisation, such as:
   - ownership of software and data;
   - integrity of data;
   - preservation of privacy;
   - prevention of fraud and computer misuse; the creation and retention of documentation;
   - the effect of change on people both employees and others; and global ICT.
4. Consider the application of policy and determine in detail the approach to each area of sensitivity that has been identified.
5. Communicate practical guidance to all employees, covering:
   - the clear definition and assignment of responsibilities;
   - awareness training on ethical sensitivities; the legal position regarding intellectual property, data protection and privacy;
   - the explicit consideration of social cost and benefit of ICT application;
   - the testing of systems (including risk assessment where public health, safety and welfare, or environmental concerns arise);documentation standards; and security and data protection
6. Whilst organisations have a responsibility to act ethically in the use of ICT so to do individual employees. Those involved in providing ICT facilities should support the ethical agenda of the organisation and in the course of their work should:
   - consider broadly who is affected by their work;
   - examine if others are being treated with respect;
   - consider how the public would view their decisions and actions;
   - analyse how the least empowered will be affected by their decisions and actions; and consider if their decisions and acts are worthy of the model ICT professional

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Effect of Determinants of Infant And Child Mortality In Nigeria: Hazard And Odds Ratio Models

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Abstract

Infant and child mortality is a major public health problem; however, quantifying its burden in a population is a challenge. Routine data collected provided a proxy for measuring the incidence of mortality among children under five years of age and for crudely estimating mortality rate. The data collected from National Demography Health Survey [NDHS, 2013] were used to investigate the determinants of infant and child mortality in Nigeria. Cox proportional, logistic model were developed to timely hazardously and probabilistically continuous variable, mother age and other specific covariates such as educational level, household income level, residence type and place of delivery which are categorical data.The Cox proportional analysis showed that the hazard risk and odds ratios of infant and child mortality are significantly less frequent over specified covariates, insignificant in residence type but significant in odds ratio. Also, there is an increased risk of infant and child mortality in place of delivery. It is evident from the results obtained that social economic risk factors contribute significantly to infant and child mortality in Nigeria. Finally these findings revealed that Mothers' educational level determines place of delivery (home, health centre) which should be improved; increase in household income contributes to child survival and reduces child mortality in Nigeria

Key words: odds ratio, hazard ratio, mortality

Introduction

One of the Millennium Development Goals is the reduction of infant and child mortality by two-thirds by 2015. Infant and child mortality in the agenda of public health and international health organizations has received attention as a part of millennium goal. In order to achieve this goal, all the countries of the world have been trying their best to determine the major factors responsible this and also put efforts towards identifying cost-effective strategies as many international agencies have advocated for more resources to be directed to health sector. Universally, there is huge literature that focused on the determinants of infant and child mortality. A great deal of efforts were made to target communicable diseases as majors determinants of Infant Mortality(IM) such as malaria, measles, diarrhea, respiratory infections and other immunisable childhood infections(Mutunga, 2004); however, it was noticed later that disease oriented vertical programmes were not adequate to reduce IM. Most of the studies have shown significant association between socioeconomic, demographic factors and infant-child mortality.

Ksenhya [7] categorized environmental health risks into traditional hazards related to poverty and lack of development, such as lack of safe water, inadequate sanitation and inadequate waste disposal, indoor air pollution, food contamination, occupational injury hazard, natural disasters and modern hazards such as urban air pollution, water pollution, solid and hazardous waste accumulation, chemical and radiation hazards, infectious disease hazards, ecological changes and climate changes. WHO (2002) reported that among the 10 identified leading mortality risks in high-mortality developing countries, unsafe water, sanitation and hygiene, indoor smoke from solid fuels. About 3% of these deaths (1.7 million) are attributable to environmental risk factors and child deaths account for about 90% of the totalpopulation.

In Kenya, it was reported that there was inconsistent relationship between socioeconomic status (measured by wealth index) and infant mortality(Hishma and Clifford 2008). The results indicate that sanitation, education and per capita income contributed to the

decline in infant mortality in Brazil, the effects being stronger in the long run than in the short run. The fixed effects associated with municipality characteristics help explain the observed dispersion in child mortality rates [4].The proximate determinants are found to have stronger influence on under-five mortality than the socioeconomic factors considered in the study carried in Bangladesh (Chowdhury, 2013).Pandey and Manoj (2009) reported a strong association between maternal health and child mortality in rural India; the effects of maternal height, weight, presence of any disease and anemia were found significant.

Ghenga*et.al,* [5] revealed that maternal, child and family were important risk factors of U5M in Nigeria using multivariate logistic method of analysis . The following factors were included in the study: Maternal (current age, education, occupation, parity, marital status, age at first marriage, family planning, preceding birth interval, breastfeeding and health seeking behaviour); Childhood (sex, birth order, birth weight); Household (family size, sanitation number of wives, wealth index, fuel and water sources); Paternal factors (age, occupation); and other factors (place of residence, ethnicity and geopolitical region).

Uddin *et.al*, (2009) investigated the predictors of child mortality using cross tabulation and multiple logistic regression and reported that father's education and occupation of father, mother standard of living index, breastfeeding status, birth order have impact on child mortality

Zerai [10] examined socio-economic and demographic variables in a multi-level framework to determine conditions influencing infant survival in Zimbabwe. He employed Cox regression analysis to the 1988 Zimbabwe DHS data to study socioeconomic determinants of infant mortality; and Joshua*et.al*, [6] showed that the strength of the relationships of the independent (maternal, socioeconomic and sanitation) variables with the dependent variables (infant and child mortality) remain much smaller in the 2005-06 ZDHS survey than in the other ZDHS surveys. They employed multivariate Proportional Hazards Regression

Table 1. Absolute and percent distribution of explanatory covariates

Variables	Frequency	Percentage
Childmortality		
dead	2,886	9.17
alive	28, 596	90.83
Education level		
No education	14762	46.89
Primary education	6432	20.43
Seceondary education	8365	26.57
Higher education	1923	6.11
Residence type		
Urban	21,131	67.12
Rural	10,351	32.88
Household income		
Starved	7,076	22.48
Poor	7386	23.46
middle	6272	19.92
Rich	5806	18.44
Very rich	4942	15.70
Place of delivery		
Delivery at home	19619	62.32
Delivery at health	11512	36.57
centre	351	1.11
Others		
Age of respondents		
Less than 20	18,665	59.29
Between 20 and 29	12,009	38.15
Between 30 and 39	794	2.52
Between 40 and 49	14	0.04

Table1. The total number of children born alive was 28, 596while dead were 2,886with 90.83 and 9.17 percent respectively, for the distribution of explanatory variables over the total sample at risk in the overall mothers' age interval 0-49months

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Table 2.Descriptive Study Of Childmortality With Percentage

Factors	Infant and Child Mortality		Total
Age of respondent	Dead	Alive	
Less than 20 years	1912(6.07%)	16753(53.22)	18665
Between 20 and 29	916(2.91))	11093(35.24)	12009
Between 30 and 39	57(0.18)	737(2.34)	794
Between 40 and 49	1 (0.03%)	13(0.04)	14
Total	2886(9.17)	28596(90.83	31 482
Residence type			
Urban	2220 (7.05)	18 911(60.07)	21 131
Rural	666 (2.12)	9685(30.76)	10 351
Total	2886(9.17	28 596(90.83	31 482
Education level			
No education	1657 (5.26)	13 105(41.63)	14 762
Primary education	596 (1.89)	5836(18.53)	6432
Secondary	547(1.74)	7818(24.83)	8365
education	86 (0.27))	1837(5.84)	1923
Higher education	2886(9.17)	28 596(90.83)	31482
Total			
Place of delivery			
Delivery at home	1970 (6.26)	17649(56.06)	19,619
Delivery at health	778(2.47)	10734(34.10)	11,512
centre	138(0.44)	213(0.68)	351
Others	2886	28 596	31482
Total			
Household income			
Starved	835(2.65)	6241(19.82)	
Poor	887(2.82)	6499(20.64)	
Middle	502(1.60)	5770(18.33)	
Rich	412(1.31)	5394(17.13)	
Very Rich	250(0.79)	4692(14.90)	
Total	2886(9.17)	28596(90.83)	

A total of 2886 deaths were registered among 3142 children hospitalised for study in 2013. Table 1shows the proportion of infant and child that died at different covariate levels. The proportion varies with age of respondent, type of residence, level of education, place of delivery distance. The number of infant and child mortality decreased as the age of mother increased. It drops from 66.25% in the age of mother <20 year to 31.74% at age of between 20-29 years and also decreased in the 30–39 years groups to 1.98% and further decreased in the age of between 40-49 to 0.04%. The number of infant and child mortality is relatively more in the urban(76.92%) than rural(23.04%) area in relation to the total number people leaving in those areas.

Percentage of death recorded when mother has no education was 57.42% and drastically reduced when they had higher education with 2.98%. The death recorded when delivery was taken at home was 68.26% with total number of 19619 mothers as respondents; and at health centre 26.96% with total number of 11512 mothers**.**

Methods And Models

In this section we present our model for describing infant and child mortality. We employmultiple logistic regressions to investigate predictors of infant and child mortality and also consider cox regression for which the goal is to investigate the effect of a covariate of interest, mother' age(x_1), on time failure, possibly adjusted for other predictors variables place of delivery, education level, income level and place of birth, and region. For continuous covariate, mother' age, the effect is measured as a hazard ratio. This hazard ratio is associated with one unit increase in mother age ,

when the other covariate are held constant and for a binary predictor, the effect is a ratio of hazards or log hazards corresponding to two categories of continuous covariate when other covariates are held constant.

In a cox PH model, Cox regression is used to analyze time-to-event data, that is, the response is the time an individual takes to present the outcome of interest. Individual infant and child that die are assigned the total length of time of the follow-up when they are alive assigned the time of the end of the follow-up. Cox regression estimates the hazard rate function that expresses how the hazard rate depends upon a set of covariates. The model formulated is

$$h(t) = h_0(t)\exp(\beta_1(1\text{mother's age}) + \beta_{2\text{place of delivery}} + [\beta]_1(3\text{education level}) + \beta_1(4\text{income level}) + \beta_1(5\text{place of birth}) + \beta_1 6\text{region})$$

where no distributional assumption is made about the baseline hazard, $h_0(t)$. Under the assumption the regression coefficient, β_1, is the log hazard ratio, ln (Δ), the change, associated with one unit increasein mother age when the other predictors are held constant, and the exponentiated regression coefficient, $\exp(\beta_1)$, is the hazard ratio, Therefore, the effect of mother age on time to failure can be investigated by performing an appropriate test based on the partial likelihood (Hosmer Jr., Lemeshow, and May 2008; Klein and Moeschberger 2003) for the regression coefficient, β, from a Cox model. . We focus on children that are born alive by estimating the probability of a child dying within the mother next birthday after surviving(cuddling/attention/ health care/ mother care) for tyear, as a result of environmental factors..The mortality rate of child at mother age t can be interpreted as the intensity at which a child dies at this age, given that the child survived until mother age

In logistic regression model**,** given a set of observations $(y_i, \mathbf{x}_i)$, $i = 1, \cdots, n$, where yi is a binary response such that $y_i = 1$ if a child died and $y_i = 0$ a child lived, and $\mathbf{x}_i = (x_{i1}, \cdots, x_{ip})'$ are covariates, we consider a multiple logistic model to estimate the probability of dying , $y_i = 1$ versus the probability of being alive, $y_i = 0$. The response is distributed as a Bernoulli random variable in which fitted response function defined is $\pi_i = [1 + \exp(-X_i' b)]^{-1}$,Where $X_i' b = b_0 + b_{1\text{motherage}i1} + b_{2\text{educational level}i2} + b_{3\text{income}i3} + b_{4\text{place of delivery}i4} + b_{5\text{residence}i5}$.Odd ratio model $= \frac{\pi_i}{1 - \pi_i}$

Discussion of Results

This study investigates the predictors of child mortality in Nigeria. It utilizedthe nationally representative data from the National Demographic Health Survey(NDHS, 2013. Cox Proportional and Logistic regressiontechnique were used to ascertain the effect of predictors of infant and childmortality. From these analyses several interesting observation can be made, although the analysis itself was subject to various types of problem. Sometimes, it is observed that logical or theoretical hypothesis is supported by the results of fittedhazard and logistic response function.

Logistics revealed that infant and child mortality significantly decreased as a result of unit change in educational level(No education, Primary education, Secondary education and Higher education) by 17%, household income(Starved, Poor, Middle, Rich and Very Rich) by 15%, residence(urban and rural) by 20% and mother age by 10%.However, infant and child mortality significantly increased as a result of unit change in place of delivery(Delivery at home, Delivery at health centre and Others) by 46%. Cox proportional also revealed that educational level at 17%, household income at 16%, residence type at 13% significantly decreased risk, and residence type at 13% significantly decreased risk, while place of delivery at 42% significantly increased risk (with hazard ratio of one, indicating the chance of infant and child not being alive) of not infant and child mortality as mother's age increases.

So, urgent attention should begiven to place of delivery and other factors in order to further reduce the risk of infant and childmortality in Nigeria.

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Appendix 1Appendix 2

		σ=1					σ=5
0.99	0.999	0.8	0.9	0.95	0.99	0.999	0.8
22.661	248.616	0.985	2.043	4.315	24.262	266.182	3.034
0.380	0.374	0.512	0.433	0.397	0.376	0.370	0.475
1.003	0.998	0.773	0.831	0.915	0.974	0.966	0.739
0.538	0.764	0.529	0.443	0.424	0.529	0.744	0.508
0.975	0.996	0.664	0.687	0.795	0.947	0.964	0.652
0.878	0.980	0.846	0.722	0.721	0.859	0.949	0.818
1.003	0.998	0.773	0.831	0.915	0.974	0.966	0.739
0.880	0.982	0.571	0.590	0.663	0.859	0.951	0.615
0.975	0.996	0.664	0.687	0.795	0.947	0.964	0.652
0.773	0.952	0.682	0.605	0.611	0.760	0.925	0.725
0.921	0.988	0.896	0.840	0.822	0.898	0.957	0.933
0.830	0.972	0.522	0.535	0.600	0.811	0.942	0.569
0.887	0.985	0.789	0.704	0.705	0.864	0.954	0.832
0.397	0.398	0.439	0.404	0.394	0.394	0.395	0.455
0.993	0.997	0.805	0.804	0.872	0.964	0.965	0.804
0.627	0.832	0.486	0.442	0.464	0.616	0.809	0.478
0.961	0.995	0.691	0.665	0.750	0.933	0.963	0.695
0.595	0.736	0.479	0.472	0.493	0.588	0.721	0.573
0.968	0.996	0.857	0.812	0.834	0.940	0.964	0.889
0.748	0.927	0.467	0.471	0.531	0.733	0.899	0.496
0.932	0.993	0.738	0.670	0.715	0.905	0.961	0.768
0.628	0.667	0.451	0.458	0.514	0.621	0.654	0.549
0.951	0.995	0.818	0.760	0.785	0.922	0.963	0.846
0.750	0.900	0.468	0.470	0.542	0.736	0.875	0.501
0.925	0.992	0.714	0.647	0.694	0.898	0.961	0.737
10.031	106.098	0.482	0.956	1.947	10.338	109.346	0.952
0.386	0.446	0.636	0.522	0.447	0.393	0.385	0.614
0.923	0.855	0.769	0.743	0.810	0.969	0.986	0.801
0.458	0.634	0.662	0.537	0.456	0.470	0.684	0.653
0.866	0.853	0.727	0.649	0.677	0.909	0.981	0.752
0.784	0.839	1.057	0.814	0.736	0.821	0.956	1.012
0.923	0.855	0.769	0.743	0.810	0.969	0.986	0.801
0.758	0.837	0.608	0.569	0.601	0.793	0.955	0.654
0.866	0.853	0.727	0.649	0.677	0.909	0.981	0.752
0.677	0.797	0.824	0.666	0.617	0.704	0.913	0.798
0.814	0.820	0.927	0.864	0.805	0.844	0.958	0.923
0.700	0.820	0.574	0.526	0.546	0.730	0.937	0.618
0.751	0.828	0.863	0.765	0.687	0.780	0.954	0.854
0.395	0.460	0.531	0.455	0.418	0.402	0.404	0.558
0.897	0.854	0.841	0.772	0.777	0.942	0.985	0.859
0.527	0.714	0.602	0.499	0.455	0.544	0.765	0.609
0.835	0.851	0.775	0.673	0.653	0.876	0.979	0.792
0.541	0.670	0.537	0.489	0.489	0.556	0.697	0.603
0.858	0.852	0.897	0.823	0.778	0.895	0.979	0.898
0.627	0.780	0.544	0.481	0.485	0.650	0.877	0.583
0.790	0.847	0.824	0.717	0.655	0.828	0.973	0.825
0.583	0.647	0.527	0.470	0.477	0.600	0.659	0.574
0.821	0.852	0.864	0.772	0.718	0.857	0.976	0.877
0.641	0.770	0.563	0.489	0.487	0.664	0.853	0.591

0.776	0.847	0.800	0.686	0.625	0.812	0.971	0.808
9.536	104.240	0.396	0.826	1.746	9.794	107.059	0.732
0.397	0.389	0.634	0.517	0.445	0.393	0.385	0.472
1.034	1.050	0.759	0.728	0.829	1.010	1.026	0.833
0.519	0.752	0.660	0.535	0.466	0.512	0.738	0.559

Modeling Blood Pressure:Comparative Study Of Seemingly Unrelated Regression And Ordinary Least Squares Estimators

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Abstract

Most authors have focused on Systolic Blood Pressure(SBP) and Diastolic Blood Pressure(DBP) separately. The effect of some identified risk factors on SBP and DBP can be estimated separately since they are affected by different factors.This study is aimed at developing a model that can appropriately capture the relationship between SBP and DBP rather than estimating the two separately. Also, to compare the efficiency of joint estimator; Seemingly Unrelated Regression(SUR) over the separate estimator; Ordinary Least Squares(OLS). The SUR model which is a special case of multivariate regression model was used to simultaneously capture the effect ofSBP and DBP. Data collected on age, sex, weight, waist, profession, history, Triglycerides(TRS) and Body Mass Index (BMI) from 100 patients of Olabisi Onabanjo University Teaching Hospital were used for the analysis. The results showed that there is a positive correlation between the SBP and DBP.The standard errors of SUR estimator were consistently lower than that of OLS estimator. The Correlation between SBP and DBP is $|\rho| = 0.4434$ *which confirmed the report of Zellner, 1962, Dieliman1989 Aebayo, 2003;and shows that SUR is an appropriate estimator for this study.The simultaneous estimation of SBP and DBP gave a higher precision in this study*

Key words: *systolic and diastolic blood pressures, joint and separate estimators*

Introduction

Blood Pressure (BP) is regarded as a major public health problem (Murray and Lopez, 1997) and a major threat to the health of adults in sub-Saharan Africa (Cappucio *et al.* 2004; 1997). This proves theEmerging evidence that identifies hypertension as a major cause of morbidity and mortality globally (Cooper *et al*. 1997; Olatunbuson *et al*. 2000; Rufus et.al. 2008). High BP is considered to be the result of environmental influences acting over time on the genetically predisposed individual (Pickering, 1967). High level of hypertension in the South Africa community with inadequate treatment status(Steyn k *et al*, 1998).It is higher in persons engaged in occupations involving little physical activity than those who are more active (Mial, 1959; Idahosa, 1987). In Nigeria, 30 million people suffer from hypertension which is the main risk factor for stroke and renal failure; 1.5 billion people worldwide suffer from high BP which claims about 7 million lives every year (Abubakar *et al*. 2009). Blood pressure (BP) is higher in the urban area African population than in their rural counterparts (Akinkugbe and Ojo, 1969; Pobee *et al.*1977)and this supports the indications that the burden of Non-Communicable Diseases (NCDs) such as hypertension is increasing in epidemic proportions in Africa; according to the World Health Report (2001), NCDs accounted for 22 percent of the total deaths in the region in the year 2000; cardiovascular diseases alone accounted for 9.2 Percent of the total deaths, killing even more than malaria (WHO, 2002). From 5,200 civil servants, factory and plantation workers living in an urban setting in the South Eastern part of Nigeria, the prevalence of hypertension, using the WHO criteria among the workers was 8.1 percent, and was lower in women than men, 3.5 and 8.9 percent respectively (Ekpo *et al*. 1992).

Approximately 25 percent of the adult population of the United States is hypertensive. In Framingham and Massachusetts, 37 percent of men and 51 percent of women who died of cardiovascular disease had been noted previously to have had BP over 140|90 mmHg Sleight *et al.* (1971). The prevalence of obesity is rising in developed and developing nations, which is the main risk factor for early mortality (WHO, 1998).Over nutrition is obesity which is the leading cause of hypertension in Framingham (Kannel, 2000). Body Mass Index (BMI) is the most useful epidemiological measure of obesity (WHO, 2000). About 50 million

adults are hypertensive in China. A number of reports have shown intrauterine growth retardation and low birth weight as risk factors for high BP in adult. To support this argument, a study investigated BP in 1,183 Chinese nuclear families (mother, father and first two children), there was a strong familial aggregation of BP in this population and it shows that a familial influence can be detected from early childhood onward (Wang *et al.* 1999).

The prevalence of hypertension is 27.2 percent in the adult population aged between 35 to 74 years in China (Gu *et al*. 2002). Both nutrition and non nutrition factor should be paid attention to rather than single risk factor (WHO, 1983). In Malaysia, The National Health and Morbidity survey of 21,391 individuals over the age of 30 in 1996 showed a high prevalence of high BP with 33 percent of adults having hypertension (Lim *et al.* 2004). In a survey of rural Filipinos age 30 and above, the prevalence of hypertension is 23 percent (Reyes-Gibby and Aday 2000). In Spain, family history(53 percent), high cholesterol level(37 percent), smoking(35 percent), obesity (33percent), alcohol consumption (13 percent) and diabetes mellitus (11 percent) showed in hypertensive patients (Gavalda *et al*.1993). In a longitudinal study in Japan from 1997 to 1999, family history of hypertension, obesity, diabetes mellitus associated with the elevation of BP and that the number of risk factors positively associated with the increase in the level of both SBP and DBP (Tozawa *et al*. 2002).Kearney *et al.* (2005) projected that three quarters of World's hypertensive population will be in economically developing countries and also women will have a 0.5 percent higher prevalence of high BP compared to men by year 2025

Method of the study:Comparison study

We compared seemingly unrelated regression(SUR) and ordinary least squares(OLS) estimators in analyzing blood pressure.Disturbances measured at the same time especially in cross sectional studies are often correlated. Systolic Blood Pressure (SBP) and Diastolic Blood Pressure (DBP) are measured simultaneously; it will therefore be a statistical fallacy to measure this independently since their error might be correlated. The SUR which is capable of dealing with these contemporaneous disturbances is then employed rather than estimating the effects of SBP and DBP separately which might yield consistent but inefficient estimates.This is achievable because different variables affect DBP and SBP which is one of the conditions for SUR model. Some identified risk factors used to capture SBP are age, sex, weight, waist, profession, history, Triglycerides(TRS), and Body Mass Index (BMI) while for DBP are exercise, sex, weight, waist, profession, history, TRS and BMI (Sudijanto, 2007).

A Seemingly Unrelated Regression system comprises several individual relationships that are linked by the fact that their disturbances are correlated Moon and Perron (2006). Such models have found many applications.The correlation among the equation disturbances could come from several sources. Equations explaining some phenomenon in different cities, states, countries, firms or industries provide a natural application as these various entities are likely to be subject to spillovers from economy-wide or worldwide shocks. It is in this case that a SUR model is a collection of two or more regression relations that can be analyzed with data on the dependent and independent variables.SUR model explains the variation of not just one dependent variable, but the variation of a set of m dependent variables Zellner (2006).There are two main motivations for use of SUR. The first one is to gain efficiency in estimation by combining information on different equations. The second motivation is to impose and/or test restrictions that involve parameters Zellner (1962), Srivastava and Giles (1987) and Fiebig (2001)

Zellner(1962) showed that SUR is efficient over separate equation by equation when the correlation between disturbances is high and explanatory variables are uncorrelated in two-stage approach. He found that definite gains are obtained for all sample sizes when $|\rho|>0.3$ where ρ is the contemporaneous correlation for the disturbances in the equations.

Adebayo (2003) claimed that the larger the contemporaneous correlation among disturbances , the more efficient SUR is than OLS using Bayesian Approach. He discovered that definite gains are obainted when$|\rho|>0.333$ which confirmed Dieliman(1989) who used a frequestist approach. Alaba *et al.* (2010) showed that the standard errors of the SUR estimator is consistently lower than the OLS estimator. Therefore,

the SURE performs better than OLSE when the errors are correlated between the equations. Zellner (2003), Kmenta & Gilbert (1968), Telser (2004), Kunitomo(1977) and Adebayo(2003) showed that SUR is more efficient than OLS when $|\rho| \geq 0.3$ and for at least sample size of 23 for cross sectional data (Mehta and Swamy, 1976)

In this work, the above statistical methods when used will give us insight to efficiency of SUR over OLS.

The framework Consider,

$$y_1 = X_1\beta_1 + \varepsilon_1$$

$$y_1 = X_2\beta_2 + \varepsilon_2$$

.

.

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$$y_M = X_M\beta_M + \varepsilon_M$$

that is,

$y_i = X_i\beta_i + \varepsilon_i$, i = 1… M equations with T observations. Where Y_i are response variables, X_i are explanatory variables, β_i are regression coefficients ε_i are error terms

$$\varepsilon = (\varepsilon_1, \varepsilon_2 .....\varepsilon_M) \; with \; E\{\varepsilon / X_1, X_2, ...X_{Mi}\} = 0$$

$$E\{\varepsilon\varepsilon / X_1, X_2, ...X_{Mi}\} = \Omega$$

$$E\{\varepsilon_{it}\varepsilon_{js} / X_1, X_2, ...X_{Mi}\} = \sigma_{ij}$$ if s=t and 0 otherwise.

The SUR model stacked together is given as

$$Y = \begin{bmatrix} y_I \\ y_2 \\ . \\ . \\ y_M \end{bmatrix} = \begin{bmatrix} X_1 & 0.....0 \\ 0 & X_2.....0 \\ . & \\ . & \\ 0 & 0.....X_M \end{bmatrix} \begin{bmatrix} \beta_1 \\ \beta_2 \\ . \\ . \\ \beta_M \end{bmatrix} + \begin{bmatrix} \varepsilon_1 \\ \varepsilon_2 \\ . \\ . \\ \varepsilon_M \end{bmatrix} = X\beta + \varepsilon$$

The variance- covariance matrix formulation is

$$E\{\varepsilon_i\varepsilon_j / X_1, X_2, ...X_{Mi}\} = \sigma_{ij} I_T = \Omega =$$

$$\begin{bmatrix} \sigma_{11} I & \sigma_{12} I & ...\sigma_{1M} I \\ \sigma_{21} I & \sigma_{22} I & ...\sigma_{2M} I \\ . & & \\ . & & \\ \sigma_{MI} I & \sigma_{M2} I & ...\sigma_{MM} I \end{bmatrix} = \sum \otimes I$$

Where $\begin{bmatrix} \sigma_{11} & \sigma_{12}.....\sigma_{1M} \\ \sigma_{21} & \sigma_{22}.....\sigma_{2M} \\ . & \\ . & \\ \sigma_{MI} & \sigma_{M2}.....\sigma_{MM} \end{bmatrix}$

The different estimator of SUR is the Generalized Least Squares (GLS).

The inverse of $\Omega = \sum \otimes I$ is $\Omega^{-1} = \sum^{-1} \otimes I$

$$\hat{\beta} = \left(X'\hat{\Omega}^{-1}X\right)^{-1} X'\hat{\Omega}^{-1} y = \left(X'\left(\hat{\sum}^{-1} \otimes I\right)X\right)^{-1} X'\left(\hat{\sum}^{-1} \otimes I\right)y$$

(4)

Expansion of the kronecker product gives

(5)

This is the asymptotic covariance matrix for GLS estimator.

Assume that $X_i = X_j = X$ so that $X_i' X_j = X'X$ in (4), the inverse matrix becomes $[(\Sigma]^{-1} \otimes X'X)^{-1} = [\Sigma \otimes (X'X)^{-1}]$ and each term $X'Y_j = X'Xb_j$. If we then move the common term $X'X$ out of the summations, we obtain.

$$\left[(X'X)\sum_{1}^{M} j\,\sigma^{1l}\mathbf{b}_l @ (X'X)\sum_{1}^{M} j\right.$$

(6)

Therefore, OLS is the same as GLS. This implies that disturbances are uncorrelated across observation. The OLS is used to estimate one equation at a time, that is, each equation is a classical regression.

When Is SUR preferred to OLS?

1. The equations are actually related by the errors

2. The equations have different independent variables.

In these instances the regressions are not "seemingly," but actually, unrelated.

Zellner (2003), Kmenta & Gilbert (1968) have shown that when |ρ| = 0, OLS is preferred while SUR is more efficient than OLS when |ρ| ≥0.3 where $\rho = \frac{\sigma_{ij}}{\sqrt{\sigma_{ii}\,\sigma_{jj}}}, \sigma_{ij} \neq 0$ (See Revankar, 1974)

The asymptotic covariance matrix of $\hat{\beta} =$ in (5) is given by
Est. Asy Cov
Editor0)

$$\left(\hat{\beta}_i, \hat{\beta}_j\right) = \hat{\sigma}_{ij}\left(X' X\right)^{-1} \; i, j = 1, \ldots\ldots, M$$

$$\hat{\sum}_{ij} = \hat{\sigma}_{ij} = \frac{1}{T} e_i' e_j$$

Statistical Analysis

Analysis was performed for comparison study between SUR and OLS ondata collected on the reading of systolic and diastolic blood pressureon age, sex, weight, waist, profession, history, Triglycerides (TRS) and Body Mass Index (BMI) from 100 patients in Olabisi Onabaanjo University Teaching Hospital using statistical software(STATA). We developed model for systolic and diastolic BP that included above mentioned independent variables. To deal with correlation of errors between different equations (systolic and diastolic equation), we used statistical methods which are SUR and OLS estimators and also to estimate the effects on dependent variables; descriptive statistics and scatter diagram were also employed. Blood Pressure Model:$Systolic_i = \beta_0 + \beta_{1AGE\ i} + \beta_{2SEX\ i} + \beta_{3WEIGHT\ i} + \beta_{4WAIST\ C.\ i} + B_{5PROFESSION i} + \beta_{6HISTORY\ i} + \beta_{7TRSi} + \beta_{8BMI\ i} + \varepsilon_i$ and $Diastolic_j = \beta_0 + \beta_{1SEX\ j} + \beta_{2WEIGHT\ j} + \beta_{3WAIST\ C.\ j} + B_{4PROFESSION\ j} + \beta_{5HISTORY\ j} + \beta_{6TRSj} + \beta_{7EXERCISE\ j} + \beta_{8BMI\ j} + \varepsilon_j$

Results

Table 1 gave general characteristics of the study of dependent variables with their risk factors of small sample sizes of 100.The mean of systolic blood pressure 131.56(SD. 2.561341) was high normal and diastolic blood pressure 79.81(SD.1.617811) was normal with CI of 126.477-136.6423 and 76.5991-83.02009 respectively. The average age of patients was 44years which means that the patients were middle aged people and in their economically active age.The averagely body mass index of patients was 27.48(SD=0.5398) and this consequently means that they were overweight.Mean, standard deviation(SD), Confidence Interval(CI) reported confirmed high normal blood pressure(systolic, 130-140 and diastolic, 85-90), suggested optimal for normal blood pressure (systolic, 120 and diastolic, 80) and BMI=weight(kg)/height(m)^2(overweight, 25-29).Table2 shows the comparison between SUR and OLS. Here it was apparent that SUR outperformed and more efficient than OLS; the estimates were consistently smaller in SUR than in OLS. Figuer1 showed the systematic nature of relationship among identified risk factor and of course presence of outliers which are also for further research work.Table3 and 4 showed that the coefficients of determination 23, 27 percent variations in systolic and diastolic blood pressure respectively explained by identified risk factors. The risk factors that are significant to systolic are sex, weight, BMI and to diastolic are exercise, weight and TRS with (P=0.05).Table3 and 4 show thatsystolic and diastolic equations are ificant with 0.0017 and 0.0003Table5 reveals that error correlation between systolic and diastolic with identified risk factors is ρ=0.4434 which confirmed what many researcher reported in the literature.

Discussion of Results

The results of the study indicate that SUR performed better than OLS in modelling blood pressure**.** The study is intended as a quick method of simultaneously handling systolic and diastolic blood pressures under different identified risk factors affecting them. The cross sectional data for the study were relatively small; and while the study was not only intended to establish a model that appropriately capture risk factors affecting blood pressure but also to ascertain the efficiency of joint estimator over separator estimator, the possibility of biasness cannot be overlooked. Correlations among risk factors could be differed between systolic and diastolic blood pressure The based population from which the subjects were drawn cannot be enumerated with any accuracy because major medical assessment was taking place within Olabisi Onabanjo University Teaching Hospital and private hospital in Ibadan

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Table 1. Summary of Continuous Variables

Variable Names	Means	Standard Error
Systolic	131.56	2.5613
Diastolic	79.81	1.6178
Age	44.46	1.3219
Weight	69.90	1.3838
Waist	92.05	1.3838
Trs	6.79	1.1639
BMI	27.48	26.4089

Table 1 shows average systolic(131.56mm) and diastolic(79.81mm) with average age, 44.46 and average BMI, 27.48 which means the patients examined are slightly overweight.

Figure1 is a scatter plots showing the systematic pattern of the regression relationship between BPs and the identified risk factors

Table2: Estimated Coefficients and Standard Deviation of β_{ij} of Comparison Study

Risk factors	Systolic(SUR)	Systolic(OLS)	Diastolic(SUR)	Diastolic(OLS)
Age	0.3293(0.1962)	0.3865(0.2259)		
Sex	-14.5568(6.9657)	-15.0945(0.2259)	-3.2849(1.5315)	-4.2039(1.7634)
Weight	0.7803(0.3764)	0.8163(0.3988)	0.5149(0.2193)	0.5098(0.230)
Waist	0.2980(0.4698)	0.1427(0.4876)	-0.1626(0.2729)	1.5773(0.2866)
Profession	0.1891(1.9406)	0.1427(2.0358)	1.6256(1.1936)	1.5773(1.2518)
Trs	1.9532(1.1468)	1.8714(1.2095)	2.1073(0.7018)	2.1998(0.7394)
Bmi	-2.1705(0.8763)	-2.1688(0.9186)	-0.8421(0.5396)	-0.8449(0.5656)
History	-0.7548(1.9524)	-0.6615(2.0523)	0.2775(1.1961)	-0.8449(0.5656)
Exercise	-3.2849(1.5315)	-4.2039(1.7634)		

Table2: Estimated Coefficients and Standard Deviation of β_{ij} of Comparison Study

Risk factors	Systolic(SUR)	Systolic(OLS)	Diastolic(SUR)	Diastolic(OLS)
Age	0.3293(0.1962)	0.3865(0.2259)		
Sex	-14.5568(6.9657)	-15.0945(0.2259)	-3.2849(1.5315)	-4.2039(1.7634)
Weight	0.7803(0.3764)	0.8163(0.3988)	0.5149(0.2193)	0.5098(0.230)
Waist	0.2980(0.4698)	0.1427(0.4876)	-0.1626(0.2729)	1.5773(0.2866)
Profession	0.1891(1.9406)	0.1427(2.0358)	1.6256(1.1936)	1.5773(1.2518)
Trs	1.9532(1.1468)	1.8714(1.2095)	2.1073(0.7018)	2.1998(0.7394)
Bmi	-2.1705(0.8763)	-2.1688(0.9186)	-0.8421(0.5396)	-0.8449(0.5656)
History	-0.7548(1.9524)	-0.6615(2.0523)	0.2775(1.1961)	-0.8449(0.5656)
Exercise	-3.2849(1.5315)	-4.2039(1.7634)		

Table 3: Estimated Coefficients and Standard Errors on OLS

Risk Factors	Models	Coefficients	Standard errors	P value
Age	Systolic	0.3865	0.2259	0.090
	Diastolic			
Sex	systolic	-15.0945	7.3545	0.043
	diastolic	-2.6981	4.4064	0.542
Weight	systolic	0.8160	0.3988	0.0239
	diastolic	0.5098	0.2866	0.029
waist	systolic	0.2583	0.4876	0.598
	diastolic	-0.1881	0.2866	0.513
Profession	systolic	0.1427	2.0358	0.944
	diastolic	1.5773	1.2560	0.211
Trs	systolic	1.8714	1.2095	0.125
	diastolic	2.1998	0.7394	0.004
Bmi	systolic	-2.1688	0.9186	0.021
	diastolic	-0.8449	1.2518	0.884
History	systolic	-0.6615	2.0523	0.020
	diastolic	0.1842	1.2518	0.884
Exercise	systolic			
	diastolic	-4.2039	1.7634	0.019

Table 4. Estimated Coefficients and Standard Errors on SUR

Risk Factors	Models	Coefficients	Standard errors	P value
Age	Systolic	0.3292	0.1962	0.095
	Diastolic			
Sex	systolic	-14.5568	6.9657	0.038
	diastolic	-3.2849	4.1921	0.460
Weight	systolic	0.7803	0.3764	0.040
	diastolic	0.5149	0.2193	0.020
Waist	systolic	0.2989	0.4608	0.517
	diastolic	-0.1626	0.2728	0.543
Profession	systolic	0.1891	1.9405	0.922
	diastolic	1.6256	1.1936	0.175
Trs	systolic	1.9532	1.1467	0.090
Bmi	diastolic	2.1073	0.7018	0.003
	systolic	-2.1705	0.8763	
History	diastolic	-0.8421	0.5396	0.014
	systolic	-0.7548	1.9524	0.120
Exercise	diastolic	0.2775	1.1961	0.700
	systolic			0.817
	diastolic	-3.2849	1.7634	
				0.033

Table5. Correlation Matrix of Residuals

Equation	SystolicDiastolic
Systolic	1.0000
Diastolic	0.44341.0000

Table 5 shows that systolic and diastolic equations are not insignificant, 0.0005 and 0.0001 with 5 percent level of significance with error correlation, $\rho = 0.4434$ between the equations

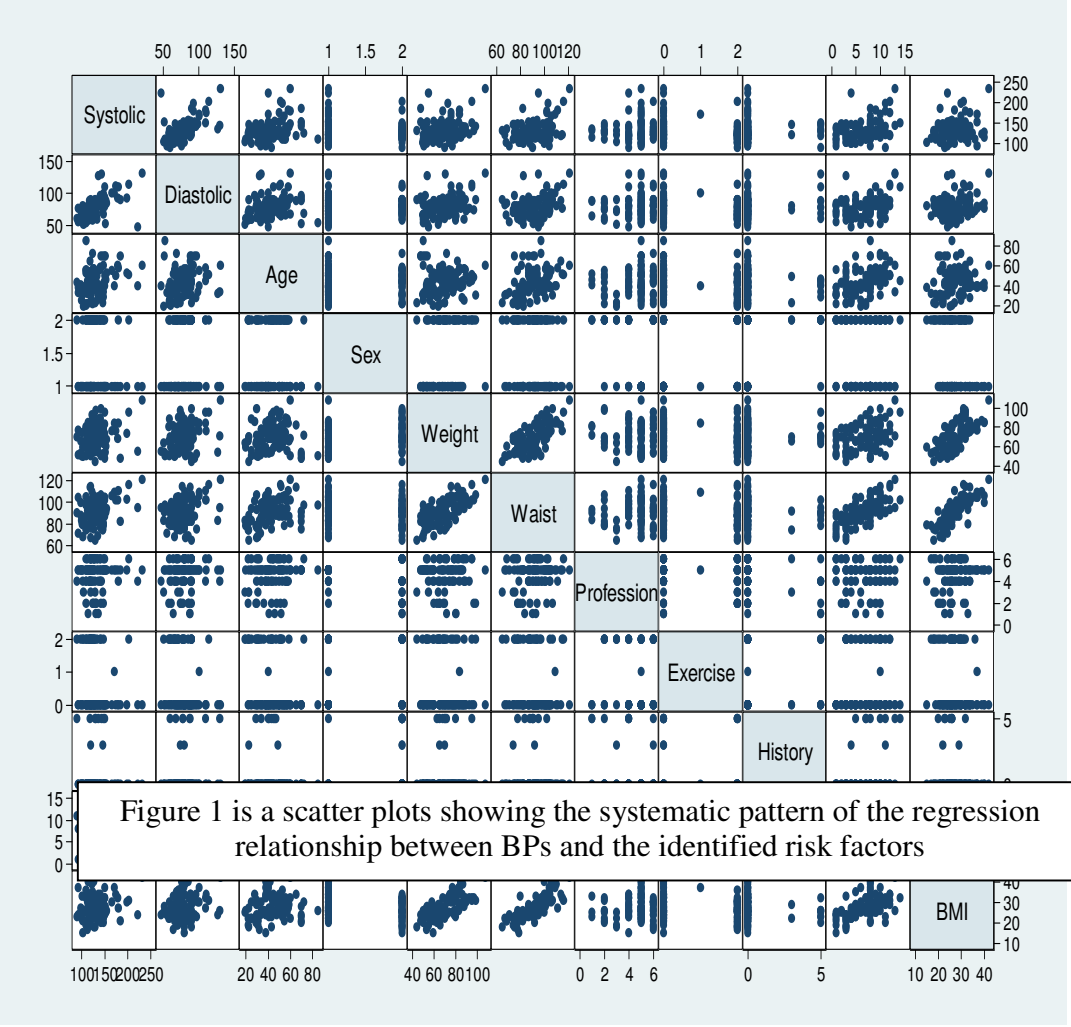

Figure 1 is a scatter plots showing the systematic pattern of the regression relationship between BPs and the identified risk factors

Appraisal of Cashless Policy on the Nigerian Financial System

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Abstract

The Central Bank of Nigeria (CBN) has been active in the inauguration of policies and schemes to foster the implementation of the cashless policy in Nigeria. However the current transition to cashless economy raises a lot of concerns with no substantial evidence yet to justify its implementation. This study was carried out in order to appraise the implementation of the cashless policy since its introduction into the Nigerian financial system in 2012 and also to examine the persistent challenges facing its implementation. In view of the above stated objective, primary data were collected with the aid of the questionnaire, which was randomly administered to 120 respondents ranging from First Bank, Zenith Bank and United Bank for Africa. The banks were selected based on their total assets and the information collected covered the activities of the CBN and that of these banks towards implementation of the cashless policy from 2012 till date.The data collected were presented and analyzed with the aid of the Statistical Package for Social Sciences (SPSS) using descriptive statistics and one-sample t-test. The results led to the conclusion that despite the need to operate cashless transactions dominating the modern Nigerian economy, the cashless policy will have the desired impact only if a lot is done to ensure the implementation of an effective cashless system.

Keywords: Cashless Policy, Cashless Economy, Electronic Payment System, Financial System

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1.0 Introduction

ashless economy depicts an economic situation whereby transactions are done without the necessary movement of cash as a means of exchange or as a means of transaction but rather with the use of credit card or debit card payments. Several scholars have attempted to analyse this policy, but only few of them presented a comprehensive evaluation of its implications in developing countries [16]. They either took a one sided look by examining either the benefits or the cost of cashless policy, or did not examine comprehensively the policy implication. Bruno Hildebrand (1812-1878), a German economist, took a historical approach to investigate phases of monetary development and he argued that, a society would advance from barter (a state of natural economy where goods were exchanged directly for goods) to monetary exchange before achieving its most elevated union in a credit economy (cited in [6]). Though Hildebrand, in the end neglected the development of a coherent system of economics, his vision of a barter-money credit advancement model of economic development provides theoretical evidence of the existing correlation between the medium of exchange and economic development. Whereas no country can function optimally without an efficient financial system [12], having a payment system that is secure, convenient and comfortable fosters the development of nation's economy [2].

A well-functioning e-payment system, according to the Central Bank of Nigeria – CBN (2011), has been recognized to having much relevance on the financial stability, monetary policy and overall economic activities of a country but the cashless policy which was adopted in Nigeria on June 2012has constituted a burden to the learned, the poor and non-exposed traders. According to the CBN, the cashless policy was introduced to drive the development and modernization of the Nigerian payment system in line

with the nation's vision 2020 goal of being among the top 20 economies in the year 2020 but the use of cash, according to Nwaolisa and Kasie [12], as a means of carrying out transactions still remains very high in Nigeria. Poor network and connectivity which results most often into debiting customers' account more than once, high transaction cost, as well as security and technical setback, are some of the factors still posing as challenges to the recent move. The current transition to a cashless economy raises a lot of concerns and there is yet no substantial evidence to justify its implementation in Nigeria. This study therefore sought to provide such evidence by evaluating the implementation of the cashless policy since its introduction into the Nigerian financial system and also to examine the persistent challenges facing its implementation. Specifically, this study examined the effect of the cashless policy affects on both the confidence of customers on the safety of their accounts and the banks' profitability. Also the extent to which the cashless policy affects the liquidity position of customers was determined.

2.0 Review of Literature

Most developed countries in the world operate the cashless economy and Nigeria, as a developing country, has to catch up with the trend in order to compete internationally. The policy which is more evident in developed countries in the world (Humphrey, 2004), is aimed at reducing physical cash transaction and promote electronic means of making payments [5]. A basket of huge benefits are expected to be derived by stakeholders from an increased utilization of e-payment such as: Increased convenience, more service options, reduced risk of cash related crimes, cheaper access to out of branch banking services, access to credit and financial inclusion, faster access to capital, reduced revenue leakage, and reduced cash holding costs. Cashless policy contributes to the economy by reducing risks of cash related crimes, and providing a more convenient, better and cheaper access to banking services.

Addressing issues pertaining to the benefits and challenges of a cashless economy in Nigeria, Ikpefan and Ehimare [9], in their paper, "Fast tracking business through a cashless economy in Nigeria: Benefits and challenges", estimates an over 70% of cash in circulation, in the Nigerian economy, existing outside the formal banking system. They went further to explain that there is a gap in the existing cash management by the CBN. The paper concludes that amongst others; the success of the new cashless policy hinges on a strong legal framework, state of infrastructure, availability of real data, investments in technology, and adequate security.Taking it from another perspective, Ochei [13], studying the effective strategies for monitoring and controlling overspending in a cashless society as lessons for citizenship empowerment, proposes a set of flexible strategies for monitoring and controlling overspending among citizens: Arrange, Acquire and Appraise. Humphrey and Berger (1990) presented one of the earliest attempts to comprehensively estimate the private and social costs for nine separate payment instruments-cash, cheques, credit cards, money orders, Point of Sale (POS), Automated Clearing House Transfers (ACH), ATM bill payments, travellers' cheques and wire transfers (cited in [3]). Alao and Sorinola further explained that, from the social cost perspective, cash was found to be the cheapest payment instrument, followed by ACH, POS and ATM bill payment while from the private perspective, cheques emerge the cheapest one followed by cash, ACH and POS. From a social perspective, a card-based system is considerably more efficient than a cash-based system because diseconomies of scale in cash supply rises as cards displace cash, and this displacement relegates cash to smaller transactions because smaller transactions must cover the fixed costs of the cash system [14]

As cited in Alao and Sorinola (2015), early studies such as Fisher (1896) and Patinkin (1965) attempted the explanation of the root cause of price indeterminacy (p.44). It was established that for any given real demand for money, there are infinitely many combinations of money stock and price levels that will do the job of bringing about money market equilibrium. Although volatilities in output and inflation decline due to observed loss in the predictive power of money in a monetary economy (Gali & Gambetti, 2009, cited in Odior & Banuso, 2012, pp. 294-295), in a cashless economy, money demand equation can be derived without influencing output and inflation (Gali, 2008).

2.1 Cashless Economy

Contrary to what is suggestive of the term, cashless economy does not refer to an outright absence of cash transactions in the economic setting but one in which the amount of cash-based transactions are kept to the barest minimum. It is an economic system in which transactions are not done predominantly in exchange for actual cash. However, it is not an economic system where goods and services are exchanged for goods and services (the barter system), rather goods and services are bought and paid for through electronic media. It is defined as "one in which there are assumed to be no transactions frictions that can be reduced through the use of money balances" [16]. As noted above, the cashless economy does not imply an outright end to the circulation of cash in the economy but an operation of a banking system that keeps cash transactions to the barest minimum.

The alternative ways to cash payments:

1. Cheques
2. Automated Teller Machines (ATMs): used, with the aid of a payment card linked to customers' account, for making variety of payments (utility bills, subscriptions, GSM recharges, etc) and transfers across Nigeria.
3. Mobile Money: enables users to transfer funds, make payments or receive balance enquiries through their mobile phones using their banks' mobile application.
4. E-transfers: permits bank customers who have subscribed to internet banking to carry out basic banking transactions within and outside Nigeria from their computers or mobile devices (iPad, mobile phones, tablets, etc) anytime and anywhere via the web.
5. Point of Sales Terminal (POS): An e-payment platform that allows customers purchase or makes payment with no cash, rather pays by using any of the payment cards (Visa, MasterCard, Verve) issued to them by their banks.
6. Pay Attitude: It is a NFC (Near Field Communication) based tag-type, contact less solution that enables a user make POS payments without a debit card. It is pin protected and converts a user's device into a payment tool by attaching the NFC tag, which is linked with user's account, to the device. When the customer wants to make a transaction he just taps the POS machine and the transaction is completed.

2.1.1Advantages of a Cashless Economy

Specialists have called attention to particular regions in which the cashless economy will improve the quality of life. These include:

1. Speed of transactions: transactions are going to be faster and the problems of long queues are going to be in extinct.
2. Improved hygiene: reduction in the carriage of cash (coins and notes) will generally reduce the spread of germs through these means.
3. Eradication of problem associated with the counting and sorting cash.
4. With the creation of numerous payment options, the process of cash collection will be made simple and the cost and risk associated with cash transfer and processing reduced.
5. It is beneficial to both banks and merchants as it increases customer coverage and satisfaction, as it notifies customers about recent activities carried out on their accounts, increases personalized relationship with customers, and faster documentation and tracking of transactions.
6. It is a good tool in the tracking of corruption and money laundering accustomed with a number of internet fraud.
7. The system will reduce the pressure on the Naira but this is possible if there is an effective and standard cross-border electronic transmittal's reporting system.
8. It will increase transparency in business transactions.
9. It will increase the involvement of individuals in active banking hereby increasing public participation and reducing the informal money in circulation.
10. Central banks' policy tools will be made more effective in the achievement of economic development and stability goals.

2.2 Cashless Policy in Nigeria

Cashless policy was initiated in 2012 by the former CBN Governor, Lamido Sanusi. Its aim is to establish an environment where an increasing proportion of transactions are carried out through electronic platforms. The cashless policy is projected to provide mobile payments services, breakdown the traditional barriers holding the financial inclusion of

most Nigerians, and bring low cost, secure and convenient financial practices to urban and rural areas across the country. Taking into account the goal of discouraging cash transactions as much as possible and not to discourage cash holdings, the CBN set the daily cumulative withdrawal and deposit limits for both individuals and corporate entities to be N500, 000 and N3 million respectively, with a respective penalty fees of 3% and 5% to be charged per extra N1000 (Ezumba, 2011, cited in Okoye & Raymond, [15]. These daily cumulative withdrawal and deposit limits does not imply that individual/corporations cannot hold cash in excess of N500, 000/N3million respectively at any single point in time but that their cumulative cash transactions with the bank must not exceed these limits over a period of one day. This policy on limits implies that an individual can actually have more than N500, 000 under his pillow at home, buys goods and services with it but must not pay more than N500, 000 into his bank account in one day without attracting a fine of 3% per N1000 for the excess.

The move towards a cashless Nigeria seems to be beneficial, although it came with high level of security concerns, as well as cost management resulting from its implementation, [14][12). Nwankwo and Eze [11] examining the flaws and advantages a cashless economy in Nigeria, establishes that the e-payment system has great implication on the Nigerian cashless economy but it will lead to significant decrease in the performance of deposit money banks in the areas of deposit mobilization and credit allowances. In addition, [1] opined that there may be no going forward in the successful implementation of a cashless economy in Nigeria until adequate security and human capital, the minimum technical/equipment infrastructure required and other structural enablement are sufficiently addressed.

2.2.1 Fears of Cashless Economy in Nigeria

For the cashless economy to work certain factors must be present, and in the right quantity and quality. It is for this reason that many analysts question the readiness of Nigeria for a cashless system. The drive by the CBN to make the Nigerian economy cashless, though pleasant, may be an undue haste to run without first crawling. For a successful running of a cashless economy, the issue of infrastructure must be deliberately tended to. The issue of security is also very serious; the vulnerability of the cashless system to various forms of internet-related crimes must be addressed. Nigeria's low Point of Sales (POS) thickness and poor last mile network constitute huge downsides to the achievement of this policy. The whole scepticism about Nigeria's preparedness is summed up in the following:

1. What grounds exist in Nigeria to facilitate the introduction of a cashless economy?
2. Is the literacy level and level of acquaintance with Information Communication Technology (ICT) among Nigerians high enough?
3. How many Nigerians can use electronic banking services and what infrastructures are there to support electronic banking? Assuming most Nigerians are educated and ICT-compliant is it enough to flood the nooks and crannies with ATMs, with their vulnerability to fraud unresolved?
4. Can we guarantee a sufficiently sophisticated system as to scale the hurdle of cyber-attacks which are capable of derailing the whole cashless system?

[8] pointed out some of the challenges of e-payment system in Nigeria as follows:

1. There is no specific law put in place to regulate e-payment.
2. Though the policy is adequately monitored in Abuja and Lagos, it is not strictly so in other states.
3. The cash limits are not in favour of the upper class citizens of Nigeria who do business beyond the stated limits every day.
4. With the crippled level of power supply in Nigeria, banks have to incur more costs. Even the cost of switching services is higher to users when facilities are used abroad.
5. Most rural branches of banks in Nigeria do not have ATMs. Same applies to POS.
6. There is insufficient skilled manpower to watch over various equipments and also to effect necessary repairs when necessary.
7. There is a low level of acceptance. Most of the citizens seem not to trust these alternative forms of payment especially those who in the past lost money through them.

2.3 Electronic Payment System

Payment systems are social infrastructures that support all economic activities, and the financial markets will require more sophisticated payment systems with greater safety and efficiency [10]. However, modern technology has changed conventional payment system into a more efficient and effective system, devoid of 'cash and carry' syndrome. The easiness of transacting economic substances as well as a safer and quicker access to funds, among other factors, has placed e-payment system on a more glorified pace than cash-based system [4]. In this new era, e-payment system has become a medium through which monetary substance circulates conveniently and its evolution, as well as the convenience of e-money transactions has furthered the transition and the argument of society into a cashless one. According to Nakajima (2012) the evolution of payment systems will never stop.

3.0 Methodology and Methods

3.1 Research Design and Sample Size

The research design used for this study is the exploratory design because it clarifies important relationships existing between variables. The targeted population of study includes all staffs of First Bank, Zenith Bank and United Bank of Africa. These banks were judgementally selected because they signify a sizeable population in the banking sector. Judgemental sampling is a sampling technique used for selecting items which the researcher considers an illustrative of the population based on his knowledge and professional judgement and it is regularly used in qualitative research where the request of the researcher happens to be to improve hypotheses rather than to generalize to larger population. As a result, sufficient and diverse opinion relating to the level and impact of internet banking on the Nigerian banking environment can be generated from the three (3) selected banks. A sample size of 120 respondents, which implies forty (40) from each of the banks, was obtained through random sampling.

3.2 Data Collection Method

Primary data was collected through the use of questionnaire, interview and direct observation; however the questionnaire was mainly used.

3.2.1 Research Instrument

The questionnaire was the primary instrument used. Questions were structured in such a way that the respondents would be able to give appropriate answers that are accurate and correct. The questions were derived from the statement of problem, research question, research objectives, and hypotheses for testing. The questionnaire is divided into three (3) sections with a total of 26 items. Section A centres on the bio data of the respondents, and strict confidentiality was maintained, Section B is on the awareness and general opinion of respondents and Section C focuses on how to achieve the objectives of the study. The questionnaire was personally administered to the respondents and followed up to ensure accuracy and reliability. This is to ensure fast and easier collection of questionnaires.

3.2.2 Validity and Reliability of Research Instrument

Validation is based on the fact that the research question and hypothesis are used to structure the questionnaire in order to get results from the respondents. However, research instrument is valid when it is able to measure the variable for which it is constituted to measure. For this study, content validity was used. In addition, the reliability of the instrument was tested using the test-retest method and a Cronbach's Alpha of 0.732 was obtained. The test-retest method examines performance over time and gives an estimate of stability.

4.0 Data Presentation and Analysis

4.1 Data Presentation

A total of 120 questionnaires were randomly distributed to bank officers and staff from each of the three (3) selected banks and a response rate of more than 85 percent was recorded. Out of this percentage, 34% were from First Bank, 35% Zenith Bank and 31.1% were from UBA. In addition, 65% of them strongly agree to 'being aware of the cashless policy put in place by the CBN', while 36% only agree. This indicates a good level of knowledge of the cashless policy among the selected staffs of the three banks. Also, 86% of the respondents do receive regular update from their bank concerning new products and services; this could have explain why a good number of them have the knowledge of the cashless policy introduction in Nigeria.

4.2 Descriptive Analysis

4.2.1 Demographic Presentation

10.7% of respondents are below 22 years, 24.3% are within the range of 22-30 years, 36.9% within ages 31 to 40, 15.5% are within 41 to 50 years and 12.6% of respondents are 51 years and above (*see appendix I*).This indicates that most respondents are within the age range of 31 to 40. Similarly, most of the respondents are males, as well as married; constituting 51.5% and 54.4% of the respondents respectively. In terms of their educational background, 56.3% holds the BSc degree, 22.3% HND and 20.4% PhD; indicating that more than half of staffs in these banks has only the BSc degree. In addition, 37.9% of the respondents have work experience of between 1 month and 6 years, 35.9% have worked for 6-10 years, and 20.4% for over 10 to 15 years. Also 4.9% have work experience for 16-20 years and only 1% for more than 20 years. This indicates that majority of the respondents have less than 16 years of working experience in the bank.

4.2.2 Cashless Policy Implementation in Nigeria

A large proportion of bank customers in Nigeria utilize electronic banking and 68% of respondents from the three banks used for the study strongly agree to this statement (*see appendix II*). Whereas 22.3% only agree that a large proportion of their customers utilize electronic banking, 6.8% and 3.9% were undecided and did only disagree respectively. However, there exists some level of its ignorance on the part of customers with the public not well educated on how to use the online transactions. 34% of respondents strongly agree to the ignorance on the part of customers, 50.5% agree, 9.7% remains undecided, and 2.9% strongly disagree. Likewise, 12.6% of the total respondents strongly agree that there is no public education on how to use online transactions, 36.9% agree, 22.3% are undecided, 24.3% disagree and 3.9% strongly disagree.

In relation to the benefits of the cashless policy, the results in appendix II also reveal that the introduction of cashless policy has eased banking transaction and this 45.6% of respondents strongly agree to and 52.4% only agree with. 1% were both undecided and in disagreement with the statement. In addition, the advent of the cashless policy has helped banks in Nigeria to increase their customer base, and make customers' accounts really accessible. 21.4% of respondents strongly agree with the increase in customer base benefit, 37.9% are in agreement, 38.8% were undecided and 2%. In relation to customers' account accessibility, 31.1% of the respondents strongly agree to this benefit, 40.8% only agree, 8.7% remain undecided and 19.4% disagree. Customers are at liberty to have access to their accounts 24 hours, hence increasing the banks' turnover and this 25.2% strongly agree with, 61.2% only agree with and 13.6% could not come to a decision. Furthermore 28.2% of the total respondents strongly agree to banker/customer relationship having been boosted by electronic banking. 49.5% agreed with the statement, 15.5% are undecided, 4.9% disagree and 1.8% of the total respondents strongly disagree. This indicates that banker/customer relationship has been boosted due to electronic banking in Nigeria.

Cashless policy also boosts the confidence of individuals to carry out transactions and do enhances bank's operational efficiency through its provision of swift and timely responses to customers' demands. 16.5% of the respondents strongly agree with the statement about cashless policy boosting the confidence of individuals to carry out transactions, 42.7% agree, 19.4% were undecided and 21.4% disagree. Likewise, 31.1% of the respondents strongly agree with the policy enhancing bank's operational efficiency through the provision of swift and timely responses to customers' demands, 48.5% agree, 19.4% remains undecided, while 1% was in disagreement. The policy also has an effect on banks' profitability and a continuous positive influence on banks' activities and their income structure. This, 42.7% and 59.2% of the respondents strongly agree to, with 41.7% and 32% only in agreement respectively.

The introduction of cashless policy in Nigeria will improve the payment system, make customers to hold less cash in hand and can be used to prevent fraud. As also seen in appendix II, 23.3% of respondents strongly agree to the statement that cashless policy has made customers to hold less cash in hand, 48.5% agree while 10.7% remains undecided but 17.5% disagree with the statement. In the same vein, all the respondents were in agreement with the statement that the introduction of cashless policy will improve the payment system in Nigeria; with 48.5% strongly

agreeing and 51.5% only in agreement. Also 39.8% strongly agree that cashless policy can be used to prevent fraud, 39.8% agreed, 16.5% remain undecided, 2.9% disagrees and 1% strongly disagrees.

However, the adoption of cashless policy has led to unauthorized access to customers' accounts, untraceable embezzlement by bank officials, fake internet bank websites and cloning of smart cards in Nigeria, as well as having some negative effects on residents in rural areas. 35.9% strongly agree with cashless policy having a negative effect on residents in rural areas, 45.9% agrees while 14.6% are undecided. But 2.9% of the respondents strongly agree to the other part of the statement, 6.8% agree, 1% undecided, 53.4% disagrees, and 35.9% strongly disagree. Nevertheless the cashless policy can be achieved in Nigeria when customers no longer have to pay cash for all their purchases. This 60.2% of respondents strongly agree with, 35.9% were only in agreement with while 3.9% remain undecided**4.3 Test of**

4.3.1 Cashless Policy and Confidence of Customers on the Safety of their Accounts

Table 1: One-Sample Statistics

		Mean	Std. Deviation	Std. Error Mean
Cashless policy boosts the confidence of bank customers to carry out transactions online		2.4563	1.00759	.09928

Source: Fieldsurvey report, 2016

Table 2: One-Sample Test

	Test Value = 0					
	t-value		Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
Cashless policy boosts the confidence of bank customers to carry out transactions online	24.741		.000	2.45631	2.2594	2.6532

Source: Field survey report, 2016

The calculated t-value in table 2 above is 24.741 and the critical value is 1.9835 at 5% level of significance and the degree of freedom of 102. The null hypothesis (H_0) is therefore rejected since the calculated t-value is higher than the critical value. Hence, it can be concluded that cashless policy does affect the confidence of customers on the safety of their accounts

4.3.2 Cashless Policy and Bank Profitability

Table 3: One-Sample Statistics

		Mean	Std. Deviation	Std. Error Mean
Cashless policy has positive effects on banks profitability		1.7282	.71667	.07062

Source: Fieldsurvey report, 2016

Table 4: One-Sample Test

	Test Value = 0					
			Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
Cashless policy has positive effects on banks profitability			0.000	1.72816	1.5881	1.8682

Source: Field survey report, 2016

From table 4, the calculated t-value of 24.473 is higher than the critical t-value of 1.9835 at 5% level of significance and the degree of freedom of 102. The null hypothesis (H_0) is also rejected; consequently, cashless policy can be said to have enhances bank profitability

4.3.3 Cashless Policy and the Liquidity Position of Customers

Table 5: One-Sample Statistics

		Mean	Std. Deviation	Std. Error Mean
The advent of cashless policy has made customers to hold less cash in hand		2.2233	.99933	.09847

Source: Field survey report, 2016

Table 6: One-Sample Test

	Test Value = 0					
	t-value		Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
The advent of cashless policy has made customers to hold less cash in hand	22.579		0.000	2.22330	2.0280	2.4186

Source: Field survey report, 2016

Table 6 indicates that, at a significance level of 5% and the degree of freedom of 102, the calculated-value is 22.579 and is higher than the critical value of 1.9835. The null hypothesis (H_0) is therefore rejected. Hence, cashless policy affects the liquidity position of customers

5.0 Summary, Conclusion and Recommendation

5.1 Summary

5.1.1 Theoretical Findings

1) The implementation of cashless policy is technically feasible in Nigeria provided that infrastructural challenges which might hamper the efficiency of the policy, such as epileptic power supply, non-availability of cash in the ATM and lack of information technology are dealt with.
2) The cashless policy has numerous benefits in Nigeria since the result indicates that the policy will help fight corruption/money laundering, reduce the rate of carrying cash, and increase the convenience of business transactions.
3) However, there are challenges associated with the implementation of a cashless policy in Nigeria, resulting from complexity and high prohibitive cost of implementation of policy, inadequate POS system, awareness level, inadequate security amongst many others.

5.1.2 Empirical Findings

1) The study confirmed that the introduction of cashless policy has eased banking transactions in Nigeria.
2) It was also established that the advent of cashless policy has made customers to hold less cash in hand.
3) Banks activities and their income structure are continuously being influenced positively by the introduction of cashless policy.
4) It was also noted that cashless policy enhances banks' operational efficiency through swift and timely responses to customer's demand.

5.2 Conclusion

One most significant contribution of the cashless policy in any economy is that it aidsthe reduction of the risk associated with carrying cash. The development of an innovative cashless policy has the potential to transform economic activity into achieving developmental goals. From the analysis carried out, it appears much has already been done in creating awareness on the introduction of the cashless economy. The e-payment system is gaining prominence in Nigeria, to the extent that the era of cash payment is gradually fading away as the need to operate cashless transactions dominates the modern Nigerian economy.

It can also be concluded from the study that the cashless system will be helpful in the fight against corruption and money laundering. Therefore if an effective cashless banking system can be developed and the recommendation below carried out, cashless policy will have a desired impact on the Nigerian economy.

5.3 Recommendation

Based on the findings, the following measures on how to efficiently and effectively improve the cashless policy are recommended:

1) Public enlightenment programs on the cashless system should be put in place by the CBN to foster conversance with the system before the introduction of the policy, since it affects every citizen.
2) There should be strategic plans by the government to educate the illiterates to help them understand the necessities of the new move and how to function in a cashless economy.
3) The government ought to ensure a conscious ty to prevent online fraud, and to protect the fraud

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APPENDIX I

Table 1: Demographic presentation of respondents

		Frequency	Percent	Valid Percent	Cumulative Percent
Age	below 22 yrs	11	10.7	10.7	10.7
	22-30 yrs	25	24.3	24.3	35.0
	31-40 yrs	38	36.9	36.9	71.8
	41-50 yrs	16	15.5	15.5	87.4
	51 and above	13	12.6	12.6	100.0
	Total	103	100.0	100.0	
Sex	Male	53	51.5	51.5	51.5
	Female	50	48.5	48.5	100.0
	Total	103	100.0	100.0	
Educational Qualification	B.Sc	58	56.3	56.3	56.3
	HND	24	23.3	23.3	79.6
	PhD	21	20.4	20.4	100.0
	Total	103	100.0	100.0	
Marital Status	Single	43	41.7	41.7	41.7
	Married	56	54.4	54.4	96.1

	Divorced	3	2.9	2.9	99.0
	Widowed	1	1.0	1.0	100.0
	Total	103	100.0	100.0	
Years of experience in the bank	Less than 6 yrs	39	37.9	37.9	37.9
	6-10 yrs	37	35.9	35.9	73.8
	10-15 yrs	21	20.4	20.4	94.2
	16-20 yrs	5	4.9	4.9	99.0
	Above 20yrs	1	1.0	1.0	100.0
	Total	103	100.0	100.0	

APPENDIX II

Table 2: A large percentage of our customers utilize electronic banking services provided

	Frequency	Percent	Valid Percent	Cumulative Percent
Strongly Agree	23	22.3	22.3	22.3
Agree	70	68.0	68.0	90.3
Undecided	7	6.8	6.8	97.1
Disagree	3	2.9	2.9	100.0
Total	103	100.0	100.0	

Table 3: There is ignorance on the part of customers (service users)

	Frequency	Percent	Valid Percent	Cumulative Percent
Strongly Agree	35	34.0	34.0	34.0
Agree	52	50.5	50.5	84.5
Undecided	10	9.7	9.7	94.2
Disagree	3	2.9	2.9	97.1
Strongly Disagree	3	2.9	2.9	100.0
Total	103	100.0	100.0	

Table 4: There is no public education on how to use online transaction

	Frequency	Percent	Valid Percent	Cumulative Percent
Strongly Agree	13	12.6	12.6	12.6
Agree	38	36.9	36.9	49.5
Undecided	23	22.3	22.3	71.8
Disagree	25	24.3	24.3	96.1

	Strongly Disagree	4	3.9	3.9	100.0
	Total	103	100.0	100.0	

Table 5: The introduction of cashless policy has eased banking transaction

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Agree	47	45.6	45.6	45.6
	Agree	54	52.4	52.4	98.1
	Undecided	1	1.0	1.0	99.0
	Disagree	1	1.0	1.0	100.0
	Total	103	100.0	100.0	

Table 6: Cashless policy has helped to increase the customer base

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Agree	22	21.4	21.4	21.4
	Agree	39	37.9	37.9	59.2
	Undecided	40	38.8	38.8	98.1
	Disagree	2	1.9	1.9	100.0
	Total	103	100.0	100.0	

Table 7: Cashless policy has made customers account really accessible

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Agree	32	31.1	31.1	31.1
	Agree	42	40.8	40.8	71.8

	Undecided	9	8.7	8.7	80.6
	Disagree	20	19.4	19.4	100.0
	Total	103	100.0	100.0	

Table 8: Cashless policy ensures customers have 24 hours access to their accounts hence increasing their turnover

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Agree	26	25.2	25.2	25.2
	Agree	63	61.2	61.2	86.4
	Undecided	14	13.6	13.6	100.0
	Total	103	100.0	100.0	

Table 9: Banker/customer relationship has been boosted due to electronic banking

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Agree	29	28.2	28.2	28.2
	Agree	51	49.5	49.5	77.7
	Undecided	16	15.5	15.5	93.2
	Disagree	5	4.9	4.9	98.1
	Strongly Disagree	2	1.9	1.9	100.0
	Total	103	100.0	100.0	

Table 10: Cashless policy boosts the confidence of bank customers to carry out transactions online

		Frequency	Percent	Valid Percent	Cumulative Percent
	Strongly Agree	17	16.5	16.5	16.5
	Agree	44	42.7	42.7	59.2
	Undecided	20	19.4	19.4	78.6
	Disagree	22	21.4	21.4	100.0
	Total	103	100.0	100.0	

Table 11: Cashless policy enhances bank's operational efficiency through swift and timely responses to customers demands

		Frequency	Percent	Valid Percent	Cumulative Percent
	Strongly Agree	32	31.1	31.1	31.1
	Agree	50	48.5	48.5	79.6
	Undecided	20	19.4	19.4	99.0
	Disagree	1	1.0	1.0	100.0
	Total	103	100.0	100.0	

Table 12: Cashless policy has positive effects on banks profitability

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Agree	44	42.7	42.7	42.7
	Agree	43	41.7	41.7	84.5
	Undecided	16	15.5	15.5	100.0

Total	103	100.0	100.0	

Table 13: Cashless policy continues to influence banks activities and their income structure positively

	Frequency	**Percent**	**Valid Percent**	**Cumulative Percent**
Strongly Agree	61	59.2	59.2	59.2
Agree	33	32.0	32.0	91.3
Undecided	8	7.8	7.8	99.0
Disagree	1	1.0	1.0	100.0
Total	103	100.0	100.0	

Table 15: The advent of cashless policy has made customers to hold less cash in hand					
		Frequency	**Per cent**	**Valid Percent**	**Cumulative Percent**
	Strongly Agree	24	23.3	23.3	23.3
	Agree	50	48.5	48.5	71.8
	Undecided	11	10.7	10.7	82.5
	Disagree	18	17.5	17.5	100.0
	Total	103	100.0	100.0	

Table 16: Cashless policy can be used to prevent fraud					
		Frequency	**Percent**	**Valid Percent**	**Cumulative Percent**
	Strongly Agree`	41	39.8	39.8	39.8
	Agree	41	39.8	39.8	79.6
	Undecided	17	16.5	16.5	96.1
	Disagree	3	2.9	2.9	99.0
	Strongly Disagree	1	1.0	1.0	100.0
	Total	103	100.0	100.0	

Table 16: Cashless policy can be used to prevent fraud

Table 17: Adoption of cashless policy has led to unauthorized access to customers' accounts, untraceable embezzlement by bank officials, fake internet bank websites and cloning of smart cards

	Frequency	Per cent	Valid Percent	Cumulative Percent
Strongly Agree	3	2.9	2.9	2.9
Agree	7	6.8	6.8	9.7
Undecided	1	1.0	1.0	10.7
Disagree	55	53.4	53.4	64.1
Strongly Disagree	37	35.9	35.9	100.0
Total	103	100.0	100.0	

Table 18: Cashless policy will have a negative effect on customers residing in rural areas

	Frequency	Percent	Valid Percent	Cumulative Percent
Strongly Agree	37	35.9	35.9	35.9
Agree	51	49.5	49.5	85.4
Undecided	15	14.6	14.6	100.0
Total	103	100.0	100.0	

Source: Fieldsurvey report, 2016

Table 19: A cashless policy can be achieved when customers no longer have to pay cash for all their purchases

	Frequency	Percent	Valid Percent	Cumulative Percent
Strongly Agree	62	60.2	60.2	60.2
Agree	37	35.9	35.9	96.1
Undecided	4	3.9	3.9	100.0

Total	103	10 0.0	100.0	

Empirical determinants of consumers' uptake of electronic banking in selected states of Nigeria

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Abstract

Financial institutions have been adopting internet banking since the mid-90s, predominantly due to lower operating costs associated with electronic banking and pressure from non-banks interested in entering the electronic banking market. In addition, customers utilizing electronic banking facilities are increasing. This isdue tothe cost savings associated with transactions over the electronic platform. Internet banking enables speedy transactions, access, time and money savings through providing free paper, and complete and up-to-date transactions. The competitive landscape of financial institutions is shifting as internet banking is no longer a competitive advantage but a competitive necessity for banks all over the world. While previous research works dwelt on wide range of issues relating to electronic banking issues, unfortunately, there is little empirical research on the effect of electronic channels on consumer's buying behaviour and banking channel preferences in Nigeria as a developing economy. This study examined consumers' decision-making between electronic banking and non-electronic banking in Nigeria. The research uses the consumer decision making process to identify factors that consumers use when deciding between electronic banking and non-electronic banking services. These factors include but not limited to service quality dimensions, service product characteristics, perceived risk factors, user skill factors, and price factors. The demographic variables include age, gender, marital status, ethnic background, educational qualification, employment, and income. Findings revealed a correlation between most of the above listed factors as some of the reasons for the poor adoption of electronic banking services in Nigeria as a developing economy.

Keywords:e-*Banking, ICT,Service Quality, Risk factors, Trust*

1.0 Introduction and background of the study

The last three decades have witnessed an explosion of popular interest in new financial communication technologies. And the dawn of the new millennium brought with it a plethora of new technological innovations and applications which have impacted strongly on the academic fields and consumers' adoption of these new technologies have continued to generate a great deal of interest in the academic arena and the business world is not an exception. The financial industry, being one of the great recipients of this great innovation, is constantly responding to changes in customer preferences and needs. However, the increasing competitions from non-banks, changes in demographics and social trends, information technological advances, channel strategies, and government deregulations of the financial service sector all have a great impact on the adoption and usage of electronic banking services.

Yap et al., [87] argued that the success or failure of many retail banks is dependent upon the capabilities of management to anticipate and react to such changes in the financial marketplace. Agwu [3] stressed that in the search for sustainable competitive advantages in the competitive and technological financial service industry, banks have recognized the importance to differentiate themselves from other financial institutions through distribution channels; and this has resulted Rose, et al., [73] in banks developing, and utilizing new alternative distribution channels to reach their customers. Furthermore, information technological developments in the banking industry have speed up communication and transactions for

customers [62]. Agwu [3] pointed out that the information technology revolution the financial industry distribution channels began in the early 1970s, with the introduction of the credit cards, the Automatic Teller Machines (ATM) and the ATM networks. This was followed by telephone banking, cable television banking in the 1980s, and the progress of Personal Computer (PC) banking in the late 1980s and in the early1990s; however, these technological innovations only gained prominence in Nigeria between 2002 and 2007; and have since come to stay. Information technology enabled electronic channels to perform many banking functions that would traditionally be carried out over the counter. According to Laukkanen, [48], the rise of electronic payments media such as debit and credit cards has caused the value of checks paid in the all over the world to fall. Furthermore, paper checks are gradually being supplement with electronic images, permitting greater storage capacity, reducing costs and improving customer services [1].

The evolution of electronic banking, such as internet banking from e-commerce, has altered the nature of personal-customer banking relationships and has many advantages over traditional banking delivery channels. This includes an increased customer base, cost savings, mass customization and product innovation, marketing and communications, development of non-core businesses and the offering of services regardless of geographic area and time [3] Internet banking is expected to become a widely adopted method for disseminating information and exchanges in the near future. Similar to its international counterparts, the adoption of electronic banking such as internet banking is growing in Nigeria. During the last quarter of 2007, there were approximately 8,502 regular internet users utilizing internet banking facilities to conduct their banking transactions (CBN 2009). This reflects a 9% increase from 7,800 users during the same quarter of 2006. It is predicted that the usage of internet banking in Nigeria will continue to grow in the near future, as customer support for internet banking is mounting. Internet users adversity to internet banking due mainly to the past bank failures has fallen from 87 percent in 2006 to 63 percent at the end of 2008, and of the various internet users whom have not yet adopted internet banking services, 4percent indicate they are willing to adopt this new banking channel [3]. In addition, the decreasing charges of internet service providers in Nigerian financial institutions are further enhancing the utilization of internet banking services especially within the towns and cities. The literature for this study featured numerous published research papers, articles and books addressing a wide range of issues relating to electronic banking [44] [48] [59] [62] [73]. However, there is little empirical research on the effect of electronic channels on consumer's buying behaviour [3] or banking channel preferences in Nigeria. Therefore, the purpose of this study is to examine consumers' decision-making between electronic banking and non-electronic banking in Nigeria as a dev eloping economy. The research uses the consumer decision making process to identify factors that consumers use when deciding between electronic banking and non-electronic banking. These factors include service quality factors, individual factors, price factors, risk factors, service product factors, and user input factors.

2.0 Review of related literature

2.1 Economic profile

The Nigerian economy depends heavily on oil, though other mineral and agricultural deposits abound (CBN 2009). In the same vein, IMF] report [40] placed Nigeria among the richest country in the world, the country is also ranked among the major exporters of petroleum products. Despite these opulence and wealth, majority of the populations live below the poverty line (UNDP 2010), this is because 28% new born babies die before the age of three, basic amenities such as schools, roads, electricity, pipe borne water, hospitals, etc, are in very short supply [21]. The root cause of these are often blamed on the more than 30 years of military rule, unfortunately the major cause of these problems, according to Akpan [5], are lack of economic blueprints by the military men and women. The result of which has led to a poor economy, lack of jobs, high crime rates, kidnappings and demand for ransoms by youths, cybercrimes, etc. As a result of these, the Nigerian global image was severely dented. Furthermore, Agwu [3] states that this was as a result of the new phase of crime nicknamed advance-fee-fraud captioned in section 41.9 in the criminal code, and an example was the celebrated and well publicized case, captioned: *''Nwude, wealthiest ''419'' Kingpin in the net''* in various tabloids (p. 23). Based on these and

more, the international financial institutions views payments such as cheques, electronic payments, and other financial instruments, from Nigeria with caution and some are rejected outright. Soludo [77] noted that past and present governments have constituted different bodies to fight these corruption from all fronts, the recent being the Economic and Financial Crimes Commission (EFCC). Though not much have been achieved by this and other bodies, however, government oppositions often point to it as a ''political tool''. The recent consolidation of the banks may be the right step in the right direction with a view to restoring confidence and trust in the Nigerian financial institutions [78] [19]/

2.2 Technological profile

The deregulation of the telecommunication sector and the emergence of mobile phone providers have been lauded home and abroad as one of the greatest achievements of the immediate past administration of President Olusegun Obasanjo [3]. However, it was also noted by other researchers that the solid foundation required for the introduction of such an innovation was never in place especially within the school curriculums, as ICT was not widespread in schools and colleges and even the universities. Others include electricity, pliable roads, and jobs for the youths, etc.,[5]. The usage of mobile phones as opposed to landlines which most Nigerian are accustomed to, became a tall order, for those who has the means and wishes to purchase handsets. Agwu, [3] stressed that the basic infrastructures were also lacking, however, the supply of mobile phones was more than demand despite lack of knowledge on its usage, and the intention to possess same were mainly seen from social influences, hence the huge demand. Hand in hand with this is the epileptic electricity supply with which to charge these mobile handsets. The epileptic electricity supply initially dissuaded many from purchasing mobile phones. Chukwuemeka [21] stressed that Nigeria generates more than 3500 megawatts of electricity which is about 18% of 35000megawatts needed for constant electricity supply for the entire nation. This low generation may have accounted for the constant power outages and the pressing need to possess a generating set by businesses and individuals. [5] stressed that more than 92% of public and private businesses in Nigeria have mostly resorted to the use of generators, a commodity that is rare in the developed countries. It has however become a norm for any business venture to own a generating set in order to be in business. It is a common site to find public and private businesses with different sizes and shapes of generating set; these include the Central Bank of Nigeria, government agencies, banks, and various business organizations. It is estimated that Nigeria as a nation spends about N1.95 trillion on generators per annum. The current unsavory news emanating from government quarters was the idea of Ghana, a neighboring country, selling electricity to Nigeria from 2015 as a result of a drop in the megawatts as stated above. This is a draw-back for a country that should be self-sufficient – however, this was further blamed on poor maintenance of the infrastructures [21]. Cost and maintenance of computers and its accessories, according to Agwu, [1] tops the list of reasons for lack of interest on new innovations such as the purchase of computers (desk and laptops). Furthermore, as a result of the level of income as well as levels of education in many parts of Nigeria, many see the investment on computers and its accessories as white elephant projects as a result of their lack of ability to maintain same with the epileptic nature of electricity supply and other factors.

2.3 Information technology and the Global Market

The globe has more or less become a village; this is as a result of the internet and in fact the World Wide Web (www) whose impact has been felt by all sectors as well as all aspects of human endeavours. The ripple effect of globalization an offshoot of the internet and World Wide Web has breathed a new life into the way individuals and businesses communicate [43]; it has also amalgamated various cultures as well as brought high level but stiff economic competition among various players in the global business arena. The banks and other financial institutions has leveraged the explosive powers of this super-high way and most banks now use it as the main vehicle of marketing, selling as well purchasing [44]. The era of brick-and-mortar and high costs attached to its establishment are now gradually giving way to simple and lower cost form of business transactions simply over the internet and the world-wide-web mostly in the developed countries, and now creeping into the developing countries/

2.4 Perceived Risk Factors

Consumers perceive greater risks when buying services than tangible goods [23] [89] perceived services as riskier than goods because services are intangible, non-standardized, and often sold without guarantees or warrantees. Consumers can rarely return a service to the service provider since they have already consumed it, and some services are so technical or specialized that consumers possess neither the knowledge nor the experience to evaluate whether they are satisfied, even after they have consumed the service [89]. Perceived risk is considered an important risk attribute that impacts on the consumer decision-making process when buying a product or consuming some services [59] [28]. Electronic banking is a technology-enabled channel and consumers' perceive the use of electronic banking as a risky decision because technology-enabled services exhibit pervasive technological, unfamiliar and ambiguous stimuli [28] Therefore, when consumers decide to use electronic banking, they are exposed to uncertainties such as the availability, the compatibility, and the performance of the complementary electronic banking channels [24] [39] [54] empirically support that the use of electronic banking involves risk. Ho and Ng [[39] suggested that consumers perceived an existence of risk was present with the use of electronic banking. Similarly, Lockett and Littler [54] identified risk as an important characteristic of electronic banking. These include financial risk, performance risk, physical risk, social risk and psychological risk. Financial risk represents the financial loss in using electronic banking, as consumers may perceive that reversing a transaction, stopping a payment after discovering a mistake, or a refund may not be possible. Performance risk in electronic banking is less satisfying than non-electronic banking, as consumer may perceive that electronic banking cannot be used to complete a transaction when needed due to the denial of access to their account. Physical risk in electronic banking refers to potential injury when personal information is accessed by a third party. Social risk refers to the older generation who may disapprove of the use of electronic banking due to their perception that non-electronic banking is personal and friendly. Psychological risk represents consumer perceptions that the use of electronic banking would lower their self-images, or have a negative effect on their perceived image from other consumers. Time risk in electronic banking implies that it takes more time to complete a banking transaction than a non-electronic banking transaction. Thus the following relationship is hypothesized: Higher perceived risk is negatively related to consumers' positive choice of electronic banking.

2.5 User Input Factors

Previous studies have identified that user input factors are a function of control, enjoyment and intention to use [62]. Control could be described as the amount of effort and involvement required by consumers in electronic banking. Enjoyment is the perceived playfulness and intrinsic value that consumers experience from the utilization of electronic banking. The intention to use is described as the level of resistance to change, which is associated with consumers' intention to change from non-electronic banking to electronic banking. Mantel [58] concluded that the control attribute was one of the most important aspects that customers were concerned with when they used electronic banking. Similarly, Liao and Cheung [52] identified that user control, such as the amount of control or contribution involved in electronic banking transactions, was a significant determinant for consumers' decision to use electronic banking. Similarly, Bateson [10](1985) identified that consumers chose to use a technology-based channels in the delivery of a service, not because of the monetary incentives, but because they perceived a stronger sense of control as a result of a self-service option [10]. Control in electronic banking relates to the consumers' perceived involvement, or sense of control, if they utilize electronic banking [58]. Gerrard and Cunningham [35] identified that consumers who were more financially innovative had a higher probability of adopting electronic banking than less financially innovative consumers. Similarly, Sathye [75] found that even when consumers were aware of the availability of electronic banking, some consumers might still not utilize this type of banking due to consumers' low intention to use electronic banking. Empirical evidence from Sathye's [75]. Gerrard and Cunningham's [35] studies suggested consumers' intention to use electronic banking was positively influenced the use of electronic banking.

2.6 Price Factors and Product Characteristics

The service product characteristics of electronic banking includes but not limited to consumers' perception of a standard and consistence service, the time saving feature of electronic banking, and the absence of personal interactions, have been empirically found to influence consumers' use of electronic banking [70] [44]. The Wallis Report [86] indicated that for consumers to use technologies, the price to use technologies needed to be reasonable when compared to alternatives. Sathye, [75] stressed that perceived relative economic advantages will motivate consumers to use electronic banking. For example, consumers using electronic banking could lower the fixed and variable costs that are associated with the banking process, due to reductions in personal error and labour cost savings. Sathye [75] argued that, in the context of internet banking, two kinds of price were accounted for; the normal costs associated with internet activities, and the bank costs and charges. A study conducted by Polatoglu and Ekin's [70] identified that users of electronic banking were significantly satisfied with the cost saving factor through electronic banking. Other researchers such as Karjaluoto, Mattila and Pento, [43] Gerrard and Cunningham, [35], and others, have also suggested that consumers perceive electronic banking as inexpensive and that it does not offer any extra cost benefits. Despite these conflicting findings, Sathye [75] identified that the costs associated with electronic banking, such as the cost of electronic banking activities and bank charges, had a negative effect on electronic banking adoption. This study further looked at the relationship between price as a factor and its determinant as a factor for consumer uptake of electronic banking.

2.7Individual Resources and Service Quality Factors

Consumer resources also influence the use of electronic banking. Mols [61], Sathye [75] and Karjaluoto, Mattila, and Pento's [43] studies showed that some consumers lacked access to a personal computer (PC) and this prohibited the adoption of electronic banking. Studies have also shown that consumer resources including computer proficiency influence the consumers' employment of electronic banking. Sathye [75] demonstrated that consumers described incomprehensibility as a reason for not using electronic banking. Similarly, Karjaluoto, Mattila, and Pento's [45] empirical results suggested that non-electronic banking users considered electronic banking as difficult to use because they found computers difficult to operate. Agwu (2012) found that consumers who were non-adopters of electronic banking could be differentiated by their lower computation proficiency and computer skills. Jun and Cai [41]in their study, identified bank customers' perceptions of service quality dimensions using quantitative techniques. These was based on three quality perspectives; banking service product quality, customer service quality and online systems quality. Bank service product quality was primarily related to product variety and the diverse features of the service products. Customer service quality was related to the differences between customers' expectations of service provider's performance and their evaluation of the services they received. Online system quality was associated with the quality that the customer perceived when they were the end-users of an information system. The authors also identified seventeen underlying dimensions of electronic banking service quality including; product variety/diversity features, reliability, responsiveness, competence, courtesy, credibility, access, communication, understanding the customer, collaboration, continuous improvement, contents, accuracy, ease of use, timelines, aesthetics, and security. In the case of the responsiveness dimension, Karjaluoto, Mattila and Pento [45] demonstrated that electronic banking users believed that electronic banking responded faster to their needs than other traditional modes of banking, for example, the speed of bill payment via the internet. In addition, Polatoglu and Ekin [70] identified instant feedback, quick transactions and easy access, as important attributes in electronic banking. Furthermore, Liao and Cheung [52] and Gerrard and Cunningham [35] found that the transaction speed (the perceived speed of response from electronic banking) and the fast access to electronic banking accounts were important attributes for consumers that used electronic banking. Thus the following relationship is hypothesized: A higher level of performance on the service quality dimensions is positively related to consumers' positive choice of electronic banking. Moreover, Parasuraman, Zeithaml and Berry [65] stressed that SERVQUAL as a measurement instrument five dimensions identified and

these have been used extensively in various financial institutions. This singular service quality instrument has become a boardroom instrument in assessing most financial service quality.

2.8 The erosion of customers' confidence on the Nigerian banking system

ina and Ayo [(2010) asserts that after the deregulation of the banking sector in early 1990s, the way was paved for all non-professionals to infiltrate the banking sector, however, the weakness of the regulatory institutions led to the oversight of so many issues. Unfortunately, the CBN and other regulatory bodies, have not, despite its different departments, being able to stem the tide of financial malpractices perpetrated by commercial banks top management staffs [(Ezeoha 2006, 2006a, Olalekan 2011); these could be blamed on the high level of political influences by government officials and some super-rich individuals and organizations that are well connected. The banking culture in Nigeria has become one which is riddled with distrust and fear (Olalekan 2011). The lack of trust on the Nigerian banking system by more than 60% of the populace is a resultant effect of the constant distress, collapse, merger and acquisition of so many banks in which many have lost all their life savings (Chiemeke, Okpara [63]. And the daily news on the electronic and print media with respect to frauds within and outside the banks have further added to the reasons for the poor banking culture in Nigeria [63].It is the confidence bestowed on banks that makes customers to surrender their hard-earned money and valuables to the banks for safe-keeping. The various bank failures have its negative effect on customers and thus the banking industry's efforts to mobilize deposits are jeopardized as a result of the confidence crises (Somayo 2008). This has resulted in people keeping money at home or utilizing them to buy goods or putting the money on short term investments, thereby creating socio-economic instability in the country, which further slows down the economic growth of the nation (Olalekan 2011). Although the Nigerian government has shown some attention to bank failures due to local and international concerns, but the issue has become so severe that every family or extended families have one tale of the other to tell about money lost as a result of bank collapse and the ripple effect, like a scar, is still fresh on the minds of many business man and woman, especially the age group between 30 – 60, [5]. Somayo [79] further states that the weaknesses and failures of so many banks resulting in merger and acquisitions pose the biggest threat to the stability and viability of the Nigerian financial system

and the economy at large. Based on the above analysis, the Nigerian population may have lost confidence on the ability of banks to perform their vital roles as agents of economic growth. And this has accounted for more money in circulation being in the hands of individuals, but not in the banks. Many small businesses, individuals and corporate organization [(Ezeoha 2006) have little or no confidence in the banking industry. Furthermore, most are only interested in the banks because of the promise of loans and most of these loans are never repaid (Adesina and Ayo 2010). The problem has been that the get rich syndrome has become a national tragedy, and pushes even bank managers to collude with well-known business men and women to take out chunks of loans with high interests but end up not repaying, and most business men and women often take out huge loans with the intention of purely defrauding the banks. Summarily, Adesina and Ayo (2010) and Olalekan (2011) argued that there are evidences of poor banking culture in Nigeria, and this is as a result of lack of trust and confidence as a result of past bank failures in which so many customers lost all their savings – the memory still lingers, however, the lack of patronage of the banks is also a problem with the usage of the technology provided by the banks. Olalekan (2011) further stressed that the patronage of Nigerian banks and its services have nose-dived in recent years as a result of distresses and loss of live savings by the bank customers in the not too distant past as well as the 2008 global bank crisis. Customers' trust and confidence are central to this research as it is a pillar to financial transactions, based on this therefore, this study will further investigate the level of customers' trusts and confidence in the adoption of internet banking services in Nigeria.

2.9 Electronic banking adoption among older and younger generations

In addition, Agwu [3] findings showed that the younger the consumers, as it is in Nigeria, the more comfortable they were in using electronic banking.

Similarly, Karjaluoto, et al., [44] demonstrated that electronic banking users were younger than non-electronic banking users. These findings imply that older consumers are less likely to favor electronic banking. As for the impact of marital status on the assessment of electronic banking, Stavins [80] identified that married consumers were more like to use electronic banking. Katz and Aspden's [42] findings showed that males were more likely to use electronic banking than females. Similarly, Karjaluoto, et al., [44] found that electronic banking users were dominated by males. Using the findings from these studies, it can be proposed that male gender positively impacts on the choice of electronic banking. In terms of the consumers' ethnic background in electronic banking, Katz and Aspden [42] found evidence that consumers' ethnic backgrounds were an influential factor in using electronic banking. Stavins [80] identified white-collar consumers as being most likely to use electronic banking. It can be postulated that occupation status (namely white-collar) is positively related to the choice of electronic banking. Al-Ashban and Burney [6] and Stavins [80] studies showed that as consumers increased their educational qualification level, their adoption of electronic banking would increase as well. Chan [20] established that income was the single most important variable that influenced a consumer's use of a credit card. Empirical findings of income positively influencing adoption of electronic banking can be found in Al-Ashban and Burney's, Stavins's [80] and Karjaluoto's [43] studies. For example, Agwu [3] studied the relationship between consumers' area of residence and the use of electronic banking. The author suggested that consumers who reside in different residence areas have heterogeneous tastes and preferences in relation to electronic banking. This research seeks to determine which age group has the greatest tendency to use electronic banking since different age groups reflect differences in mix and types of banking services used by the respondents. This research would also like to determine if gender plays a part in differentiating respondents who are electronic banking user and those who are not. It would also like to determine whether more educated respondents would likely be electronic banking users. Lastly, it seeks to determine which income group would be most likely to be electronic banking users. Additionally, income was divided into low, medium and high; age group was divided into young (between 16 to 30 years old), medium (31 to 50 years old) and old (above 56 years old); employment level was divided into blue-collar works, white- collar worker, casual worker (including unemployed, students and housekeepers) and retirees and ethnic group was divided into the major tribes comprising of Hausa, Ibo, Yoruba and others. For example, Agwu [3] study showed that the adoption rates of ATM were higher among younger users in all towns and cities in Nigeria.

3.0 Methods

As this research pivots round consumers and the decisions they make, the understanding of how customers make choices is important for this study. It is also important for organizational managers to put in place the necessary strategies, product designs, and business investment decisions. Recent advances in theory and empirical methods have resulted in an improvement in understanding human choice behavior and the ability to analyze and predict choice behavior. The dependent variable is based on the question asked in the quantitative survey: *"Do you use the internet banking channel?"*Furthermore, the demographic characteristics such as age, gender, marital status, education, ethnic group, area of residence, and income were hypothesized to influence the respondent's decision to use electronic banking.

3.1 Data analysis

Data for this analysis was obtained through a survey method. The instrument used were set of questionnaires. These was sent to 450 household in five states of Nigeria cutting across, the West, East and Northern states. The questionnaire gathered information on consumers' decisions to use electronic banking versus non-electronic banking. Six Assistant Lecturers in three universities in the above mentioned areas were engages to assist in the questionnaire administration and collation and this took place over six weeks. The questions were phrased in the form of statements scored on a 5-point Likert-type scale, where 1 = "strongly disagree," 3 = "neither disagree nor agree," and 5 = "strongly agree." A total of 579 useable surveys responses were returned resulting in a useable response rate of 72.36%. From the total of 529 useable questionnaires, 51.49% of the respondents were electronic banking users, while 48.51% of respondents

considered themselves as non-electronic banking users. The sample respondents comprised of 36.46% females and 63.54% males. Furthermore, 59.09% of the respondents were married at the time of the survey. The majority of the survey respondents were between 20 to 44 years (41.03%) and 45 to 53 years (21.66%) and 37.58% of the respondents resided in the suburban areas. The three main ethic groups made up the major respondents of 88.09% and the median education level of the respondents was determined to be at the tertiary level and the median annual household income for the sample respondents was between =N=600,000 to =N=10,000,000 per annum. Furthermore, the distributions of non-electronic banking users are similar to the distributions of the electronic banking users in terms of marital status, gender, ethnic background and area of residence. However, the distributions of age group, occupation, annual income, and educational qualification for the non-electronic banking respondents are different from the electronic banking respondents. The non-electronic banking users are older than the electronic banking users, with the median age groups between 54 and above. In addition, a higher proportion of retired respondents dominate the non-electronic banking group when compared with the electronic banking group. The majority of the non-electronic banking users' annual incomes are slightly lower than the electronic banking respondents. The educational qualification levels of non-electronic banking respondents are same with the electronic banking respondents.

3.2 Analysis

The items used to measure each construct were tested for reliability by using a Cronbach's Alpha value of 0.60 as the cut-off point. A value of 0.60 or more indicates satisfactory internal consistency reliability in exploratory studies (Creswell 2009). The scores of the items (questions) representing each construct were totaled, and a mean score was calculated for each construct. Using these means, together with the demographic characteristics the logit equation was estimated. Empirical estimates of the logit model via maximum likelihood assure large sample properties of consistency, efficiency, normality of the parameter estimates and validity of the t-test of significance. In general, the model fitted the data quite well. The chi-square test strongly rejected the hypothesis of no explanatory power and the model correctly predicted 92% of the observations. The estimated coefficients indicate that service quality dimensions (reliability, assurance and responsiveness) and user input factors (control, enjoyment and intent to use) have a positive impact on consumers' likelihood to use electronic banking. This implies the level of service quality in electronic, the independence and freedom associated with electronic banking and the enjoyment that could be derived from electronic banking will favourably influence consumers' decision in using electronic banking. Perceived risk factors (financial risk, performance risk, physical risk, social risk and psychological risk) were found as hypothesized, to negatively affect the probability to use electronic banking. Research tells us a consumer who is risk adverse perceives electronic banking as a financial risk when it is not possible to reverse a mistakenly entered transaction or stopping a payment. Furthermore, the threat of personal information accessed by a third party negatively influences a consumer's likelihood to use electronic banking. This supports the finding of Ho and Ng, [62], Lockett and Laukkanen, et al., [56] [48]. The demographic variables (age, employment, education, income and residence) were also significant in explaining the respondents' probability in using internet banking services in Nigeria. For example, the negative coefficient of the age group above 54 years showed that senior consumers were less likely to use electronic banking. Senior consumers are more risk adverse and prefer a personal banking relationship to non-personal electronic banking. Customers with low educational qualifications may be less likely to use internet banking due to their low income status. Furthermore, electronic banking transaction could be costly and seen as a misfit for this age group who primarily depend on pension. As expected, very high income respondents were less likely to use electronic banking as they may prefer to deal with the bank staff directly when doing complex transactions and handling large sums of money instead of using electronic banking. The significant and positive coefficient for white-collar employment suggests this employment level has a positive impact on the respondents' probability in using electronic banking. Furthermore, the estimated coefficient casual is also positive and significant implying that a respondent who is either unemployed or a student or a house person has a strong

probability in using electronic banking. This may be attributed to a low ownership of motorized transport associated with this group. Gender and married status do not have an impact on a consumer's decision to use electronic banking. In addition, a positive relationship was found between the respondents who reside in a rural area and electronic banking, but mainly the ATMs. This relationship may be interpreted as distance, a significant determinant for using electronic banking. Additional information can be obtained through analysis of the marginal effects calculated as the partial derivatives of the non-linear probability function, evaluated at each variable's sample mean (Greene, 1990). For example, in the case of estimation of the parameter on employment level, the probability that the respondent is an electronic banking user, ceteris paribus, is approximately 8.93% lower than if respondent is not a white collar worker. If the perceived risk is decreased by one unit then the probability of a respondent using electronic banking will increase by 18.47%. A unit increase in user input factor will result in an estimated 9.21% increase in consumers' probability in using electronic banking.

4.0 Conclusions

The findings of this study confirms the positive relationship between the service quality and user input factor dimensions and electronic banking, and they are consistent with Karjaluoto, Mattila and Pento's [45], Laukkanen, et al., [48]; Yap, et al., [87] findings. The negative relationship between the perceived risk factors and electronic banking also support Ho and Ng's [39], and Agwu [3] findings. Furthermore, various relationships between electronic banking and demographic characteristics are identified in this study. For example, the results of this research support Barnett's [9] and Karjaluoto's [43] findings that consumers in the older age group are negatively disposed towards to electronic banking. Furthermore, the estimated coefficient "Young" was not significant and contradict our hypothesized sign. This is because the medium age group is the base line on the analysis. Thus the probability that a young respondent will use electronic banking is slightly lower than the medium age group. The positive relationship between consumers in white-collar occupations and electronic banking use is also identified in this study, and it parallels Stavins' [80] findings. In addition, the findings support Stavins' [80] results that the consumers' different residence areas have different impacts on electronic banking use. There is a positive relationship between low income consumers and electronic banking even though it is statistically insignificant. It can be argued that the costs associated with electronic banking are currently more affordable than when electronic banking was first launched in 2001 in Nigeria. Therefore, even low income consumers are not inhabited in their access to electronic banking within the Nigerian financial landscape, and in fact, it may be a lower-cost channel for these consumers due to reduced travel costs of mobile phones, access costs, and maintenance. Al-Ashban and Burney (2001) suggested that the increased availability of electronic banking and the decreasing costs associated with electronic banking could result in an increase in the utilization of electronic banking. In contrast, high income consumers are less likely to use electronic banking due to security reasons.

5.0 Managerial implications

This findings of this study revealed that the internet banking users of different ages are burdened with various problems within the Nigerian landscape. Most bank customers do not use internet banking due mainly to the various risks.

And unfortunately no one reaches out to them as obtained in the developed countries such as the United Kingdom where banks directly market every segments of the society well as design special products for them. In most instances, these problem are often over looked or not given adequate attention by bank mangers. In addition, this lack of attention, based on the outcome of this research shows that various bank customers go in and out of bank branches with little or no knowledge of banking products and services, its advantages and its usages, example is the internet banking services. Therefore the importance of the need to create detailed awareness of this very important channel cannot be over-emphasized. Considering the importance of this low-cost product, it is important that this all important channel is given the right promotion and given its right of place

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