



Covenant University  
7<sup>th</sup> Inaugural Lecture

**DECONSTRUCTING  
THE NATIONAL  
DEVELOPMENT AGENDA:**  
THE ROLE OF INFORMATION AND  
COMMUNICATION TECHNOLOGIES (ICTS)

CHARLES K. AYO

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# Deconstructing the National Development Agenda: The Role of Information and Communications Technologies (ICTs)

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## **1. PREAMBLE**

My inaugural lecture shall be in two parts. The first part is a session of thanksgiving and appreciation to God for all He has done for me in life having just completed my tenure as the 3<sup>rd</sup> substantive Vice-Chancellor of Covenant University and the second is the lecture proper.

Ladies and gentlemen, I was not meant to go beyond primary school education but by His grace I did; nor secondary school education but by His intervention I did. This is talking about the challenges of polygamy. Today I am standing before you having B.Sc, M.Sc and Ph.D degrees. Praise the Lord!

A more humbling testimony occurred when travelling from Lagos to Ilorin for my Ph.D oral examination in 1998. The bus I was travelling in was involved in a fatal accident between Oyo and Ogbomoso. The bus summersaulted several times and when it eventually stopped, I was the only one left inside the bus just with a scratch; alas all the other persons, including the driver, were dead bodies. Praise the Lord!

Finally, the chief of them all was my appointment as the Vice-Chancellor of this great institution, Covenant University, barely two years after my Professorial appointment. I was in the US on a Fulbright Fellowship when the post was declared vacant. Just like the ordination of David in I Sam. 16 vs11: “..... And he said, there remaineth yet the youngest, and, behold he keepeth the sheep. And Samual said unto Jesse, send and fetch him: for we will not sit down till he come hither.”

Ladies and Gentlemen, the rest is history.

## **2. SYNOPSIS**

For 56 years after independence, this country has been in search of peace, unity and viable economic and infrastructural development. To some opinion leaders, these are pointers towards a failed state. Considering the plethora of socio-economic and political problems

face by Nigeria since independence and the developmental plans made by various governments, which are classified into three namely the: Era of fixed-term planning (1962-85); Era of Rolling plan (1990-1998); and New democratic dispensation (1999-date), there is little or nothing to show for these efforts (Shehu, 2016).

In addition, Nigeria has had several Visionary goals such as Vision 2000, the National/State Economic and Empowerment Strategies N/SEEDS), Vision 2010 and Vision 20:2020. None of these have yielded the required results based on the available indices about the socio-political and economic challenges that have always bedevilled our nation (Ugwu, 2010).

The objective of this lecture is not to go into the details of each development plan but rather to evaluate them through the current economic indices in order to justify the need to deconstruct by identifying factors that can engender peaceful coexistence and national development.

This lecture takes a critical look at the application of Information and Communications Technologies (ICTs) to connect the citizens with a view to fostering peace, commonwealth and national development. The concept is borne out of the fact that we need to urgently put in an agenda that will harness our abundant human and natural resources for the common good of the populace and nation building. We need a national reorientation to revisit our norms and values so as to be able to say no to what is not acceptable no matter whose ox is gored.

In Nigeria today, we depend largely on foreign solutions to our problems, which is a pointer to the fact that our education system has failed. According Dr. Oyedepo, “Universities on African soil must respond to issues in the African society”. We send our children out for quality education thus, we lose N1.5tn annually to education tourism. The same is true of health tourism and worst still is our inability to feed ourselves. It was reported that we spent N3.1 tn (about \$11bn) annually for the importation of four consumable commodities: rice, wheat, fish

*Charles K. Ayo*

and sugar (CBN Report, 2016).

At WSIS (2005), the potential of ICTs to promote peace and prevent conflict was identified. Similarly, ITU Youth forum (2008) and Hattoluwa (2002) opined that riots, violence, and some forms of violence were largely caused by lack of communication among government, the people and among the people themselves. Consequently, ICT can bridge the gap between government and the people. It can provide an enabling environment for everyone to express his or her views, thus bringing about conflict resolution.

eGovernment is presented as an embodiment of eAdministration-improving government processes; eCitizen - connecting citizens; and eSociety - building external interactions (Agbomehre and Majaro-Majesty, 2009). Vassilios (2004) presented e-Government as the use of information and communication technology (ICT) in public administration combined with organizational change and new skills to improve public services and democratic processes and to strengthen support for public policies.

Ugbogbo H., Akwemoh M., and Omoregie C., (2013) identified the need for a development-focused education system that engenders creative ability to embrace socio-political, economic and technological change; as well as the ability to appreciate, relate and interact with people of different cultural and religious beliefs.

Funding obviously is an issue but not the most critical. Annually, about 1m applicants in Nigeria are denied access to higher education in Nigeria while the total capacities of the universities alone is put at 1.7m. There are other creative ways to adopt.

For example, Indira Gandhi National Open University has a population of 3.5m, Allama Iqbal Open University (Pakistan) has a population of about 1.2m and the National Open University of Nigeria has about 0.3m population. ICTs can be engaged with private, public partnership.

According to Olukotun (2016), each Nigerian university needs at least N45b annually for the next 10 years to be listed among the top 200 universities in the world. This is not practicable in the light of the

current economic atmosphere.

The situation we are in is not peculiar to us. America in the 19th century adopted the Land-granted Universities where American institutions of higher learning were established under the first Morrill Act (1862). Under the provisions of the Act, each state was granted 30,000 acres (12,140 hectares) of federal land for each member of Congress representing that state.

The lands were sold and the resulting funds used to finance the establishment of one or more schools to teach “Agriculture and the Mechanic arts.” Its intent was clearly to meet a rapidly industrializing nation's need for scientifically trained technicians (mechanical) and agriculturalists.

Examples of such institutions include:

Alabama A&M University  
Cornell University  
University of California  
Florida A&M University  
Kansas State University  
Massachusetts Institute of Technology  
Texas A&M University  
University of Wisconsin–Madison  
etc.

### **Lessons to Learn**

- Some states in the US may have less than 6 months of farming, yet, there is food security.
- Education in Nigeria was not targeted at meeting the needs of the nation.
- In most African States, education is not the priority of governments.

The rest of this lecture is presented as follows: section 3 discusses the evolutionary trends of ICTs, section 4 presents the emerging and future trends of ICTs, section 5 presents my academic accomplishments in scholarly journals, section 6 presents future application of ICTs and some challenges, section 7 presents the conclusion to the work, while sections 8 and 9 presents the acknowledgments and some references.

### 3. EVOLUTION OF ICTs

Going through the history of computers, there are distinct generations from the Abacus (450 BC) to Pascal adding machine (1642), Charles Babbage, the Father of Computers (1822), the Hollerith punched cards (1890), through to the Electronic Numerical Integrator and Calculator (ENIAC – 1946), the Electronic Delay Storage Automatic Calculator (EDSAC – 1949), to the Universal Automatic Computer (UNIVAC), the first commercially available computer in 1951 (Alan and Kendall, 2010).



*Figure 1: Electronic Numerical Integrator and Calculator (ENIAC – 1946)*



Thereafter, the International Business Machine (IBM), the International Computers Limited (ICL) and several others led the business of Computer manufacturing.



*Figure 2: A UNIVAC computer at the Census Bureau.  
Image Source: United States Census Bureau*



*Figure 3: IBM 7094 series  
Image Courtesy: [www.ibm.com](http://www.ibm.com)*

Therefore, the evolution was from Mainframe computers to Mini Computers and Microcomputers. The various flavours of Micros include: Desktop, Laptop, Notebook, Palmtop or Handheld computers like Smart phones. All these categories are based on sizes and weights. Thus, a Computer can simply be defined as an electronic device that has the capability of accepting data (Input), processing them through a set of instructions (Program), to produce information (Output). Information and Communication Technology on the other hand is defined as the use of the computer system and telecommunications equipment for information processing (Ayo, 2009). It is made up of three basic components namely:

- electronic processing of information using the computer;
- transmission of information using telecommunications equipment; and
- dissemination of information in multimedia.

For short, ICT can simply be defined as the acquisition, processing, storage and dissemination of vocal, textual, pictorial and numerical information by a micro-electronic based combination of computer and telecommunication. Often times the terms IT and ICT are used interchangeably.

### **ICTs Subscription Statistics**

Global (ITU, 2016):

- World Population – 7.45bn
- Mobile Subscription – 7.29bn
- Internet Subscription – 3.46bn

Nigeria (NCC, 2016):

- Population – 184m
- Mobile Subscription – 152.80m
- Mobile Internet Subscription – 93,52m

Thus, ICT devices include: Computer, Internet, mobile devices such as cell phone, iPod, smart phone, PDA etc.



*Figure 4: Information and Communication Technology (ICTs)*

ICTs offer a medium that facilitates the acquisition and transmission of information in a cost effective way with minimized obstacles of distance and time (Ayo, 2009).

It refers to all electronic devices prefixed 'e' for both wired and wireless devices but can further be categorized into mobile, Web or Internet platforms etc. The major classifications include (Ajhoun R., Abik M., 2011):

- **Mobile:** anywhere anytime access. Prefixed 'm'
- **Internet:** transaction via the Net. Prefixed 'i'
- **Television:** transaction via the digital television set. Prefixed 't'.
- **Pervasive:** anywhere, anytime though any mobile/wireless devices. This is the current level of development that stems from the advent of ubiquitous and wearable computing, ambient intelligence and context awareness. Prefixed 'p' or 'u' (ubiquitous).

#### 4. ICTs IN THE 21ST CENTURY

The Internet was pronounced the greatest invention of the 20th Century. Ever since its emergence, it has become a dominant platform for connectivity and business transaction.

Futhermore, the Internet of Things (IoTs) or Internet of Everything (IoE), a super platform for interconnectivity has begun to gain currency and is being considered a platform for citizen engagement, National security, Governance and Business transactions and National development.

With the discovery of the Internet, the information superhighway, there are other discoveries of the century which include Cloud Computing, Big Data and the Internet of Things (IoTs) and Internet of Everything (IoE) amongst others that are radically affecting the future of business transactions and emerging professions (Simplivity, 2016). These technologies are rapidly changing the way we live and the things we do, and they are bound to radically affect our future. A brief overview of these three technologies and their relationships are presented as follows:

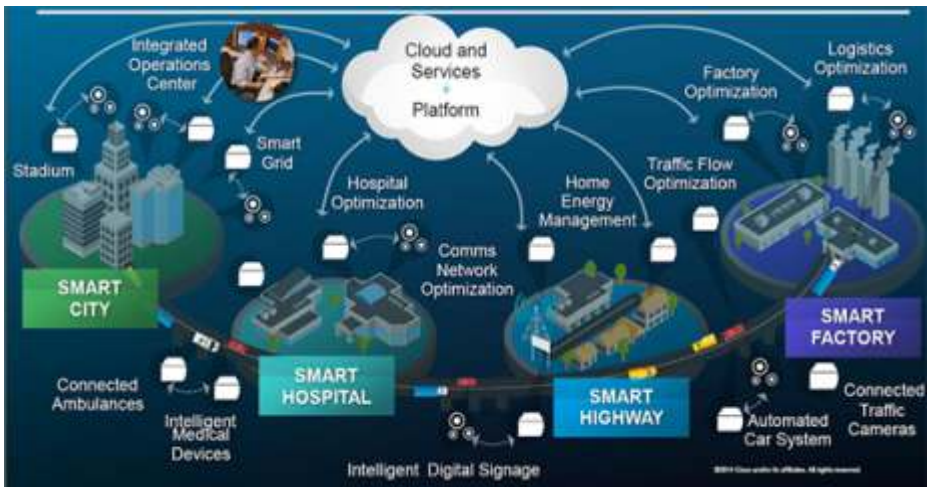


Figure 5. The Cloud, ToTs/E and Big Data

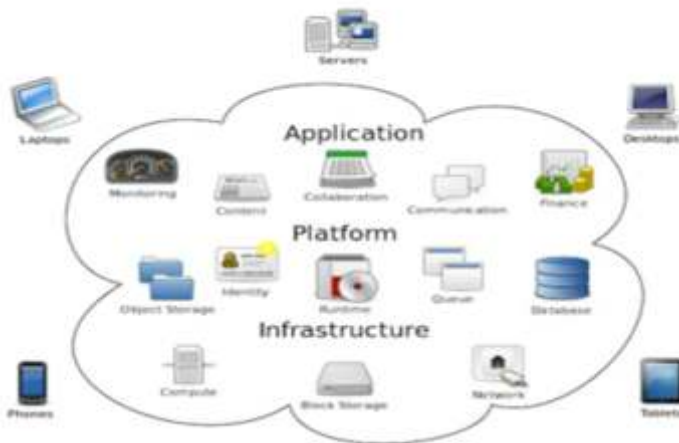
### **4.1 Cloud Computing**

This is a computing paradigm where scalable and elastic IT-enabled capabilities are provided as a service to external customers using the Internet technologies. In other words, it is a model for enabling convenient, on-demand network access to a shared pool of configurable computing resources (e.g. networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction.

It offers a seemingly infinite pool of readily available computing resources, typically housed in a data centre. The Cloud promises to eliminate the necessity of upfront hardware investment and is typically available on a short-term, pay-as-you-go basis.

For simplicity:

- it is an Internet-based computing technology;
- it is a virtual network of both services and infrastructure;
- it can be accessed from anywhere, to anywhere, at anytime; and
- it is the outsourcing of your data center.



*Figure 6: Cloud Computing*

According to Mell and Grance (2011), the key characteristics of cloud computing include:

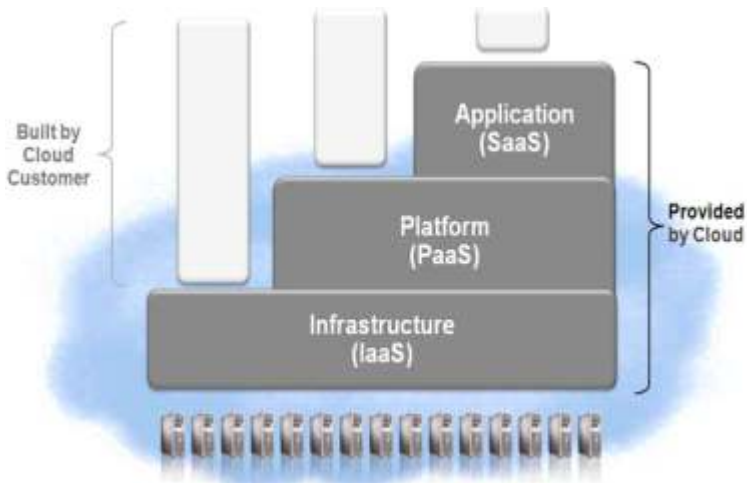
- **Broad network access:** Cloud computing enables access to services via the Internet or other extensive networks using a standard protocol such as HTTP, WAP, etc., which does not depend on the end user device.
- **On-demand provisioning:** It ensures that users are automatically provided with what they need on request without manual intervention.
- **Elasticity:** This means the services are scalable, growing or shrinking dynamically based on the emerging customer resource requirements.
- **Metering:** This means that the services rendered to customers are measured and the customers pay for provided services based to their level of consumption.
- **Resource pooling:** This means computing resources provided for multiple consumers using technologies such as virtualization and multi-tenancy resulting in cost saving for the consumers.

### **The Cloud Business Model**

Cloud computing offers different service models depending on the focus of the cloud service provider. However, available service models can be classified into the following:

- **Software as a Service (SaaS):** This is the service model where the provider makes software applications and services available to the customers on a pay-per-use basis. Examples of SaaS include Sales force, Cloud9 Analytics, CloudSwitch and Google.
- **Platform as a Service (PaaS):** This is the service model where the provider allows customers to develop Web applications easily without the burden of buying and maintaining the underlying software development environment and cloud

- infrastructure. Examples of PaaS include Apprenda, Google Apps Engine, Engine Yard, Microsoft Azure and Cloudscale.
- **Infrastructure as a Service (IaaS):** This is a service model where the cloud service provider makes high-end hardware resources available for users. The provided hardware resources could be available for processing, storage, networks and other fundamental computing resources to enable end-users' tasks. Examples of IaaS include Amazon EC2, GoGrid and Rackspace.
  - **Network as a Service (NaaS):** This provides virtual network(s) to the users. User can have as many numbers of networks as required, with desired segmentation and policy enforcement. With NaaS, user can also have heterogeneous networks, for example, IPv4 and IPv6 segments working in co-existence or separately (Ma et al., 2012).
  - **Anything as a Services (XaaS):** This is a service model that captures other types of services that can be made available by a cloud service provider to customer.



**Figure 7: Cloud Business Model**

## Types of Cloud

There are four possible deployment models of cloud; they are:

**Private cloud:** This is when the cloud solution is hosted and managed within the same organization without involving an external party.

**Community cloud:** This is when the cloud solution serves the exclusive interest of a community. Members of the community or a third party may provide the service.

**Public cloud:** This is when a single provider makes cloud solutions available for public use. Resource pooling, measured services and scalability are core characteristics of this kind of model.

**Hybrid cloud:** This is when the model of deployment combines the advantages of any of private, public and community clouds. For example, confidential data can reside in a private cloud, whereas less sensitive data can be available on the public cloud.

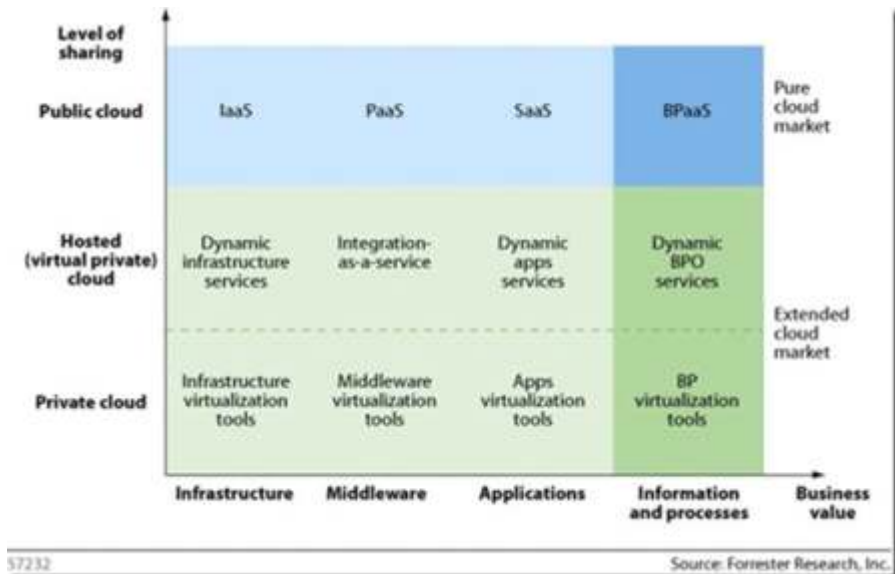


Figure 8: Forrester's Cloud Computing Taxonomy



## Cloud Vendors

Akamai

Amazon

Areti

Enki

Fortress

Joyent

Layered Technologies

Rackspace

Salesforce.com

Teremark

Xcalibre

Others in the space include: Dell, Flexi-Scale, IBM, Microsoft, Mosso, Slice-Host, and Sun

### Table 1: Advantages of Cloud Computing

<b>Advantages</b>	<b>Disadvantages</b>
1. Fast start-up	1. Bandwidth could bust your budget
2. Scalability	2. Application performance could suffer
3. Business agility	3. Your data is not cloud-worthy
4. Faster product development	4. You are already too big to scale
5. No capital expenditures	5. Your human capital is lacking

## 4.2 Internet of Things (IoTs)

The world of smart devices talking to one another – Machine-to-Machine (M2M), and to us, has come to stay. Thus, to connect all the things/everything together calls for a redesign and rebuilt network infrastructures in order to reap the business reward. IoTs refer to the set of technologies (devices and systems) that interconnect real-world sensors and actuators to the Internet (F5, 2015).

The IoTs create a convergence of the digital and physical worlds, where objects ('things') become part of the Internet, and accessible to

the network, its position and state known, where different kinds of services and intelligent agents are added to the expanded Internet, ultimately impacting on our professional, personal and social environment (Fleisch, 2010; Coetzee and Eksteen, 2011).

In IoTs, 'things' refer to any physical object that exists, whether such an object has the ability to communicate or not. IoTs also include smart objects and metres, mobile phones, wearable devices – clothing, health care implants, smart watches and fitness devices; Internet connected automobiles, home automation systems – thermostats, lighting, and home security; other measuring sensors for weather, traffic, ocean tides, road signal and others (Aazam et al., 2014).

IoT has been predicted to have about 25bn things and about 40Zb (1021) of data by 2020. The way the business providers respond to this will determine who gets what from the projected \$7.1tn revenue.



Figure 9: Internet of Things

Internet of Everything (IoE), according to CISCO, is defined as bringing together people, process, data, and things to make networked connections more relevant and valuable than ever before - turning information into actions that create new capabilities, richer experiences, and unprecedented economic opportunity for businesses, individuals, and countries.



*Figure 10: Internet of Everything*

The goal of IoTs is to facilitate anytime, and anywhere connectivity of 'things' be it data, services, software agents, and physical objects. The idea is that when these uniquely identifiable physical objects are plugged into the IoTs network, they will make more smart processes and services that can support human lives, and our environment possible. The practical applications of the IoT include smart cities, smart grid, smart agriculture, smart hospitals and smart transportation.

### Architecture of the IoTs

The IoTs has a five-layer architecture: Perception layer, Network layer, and Application layer, Middleware layer and Business layer (Wu et al, 2011, Khan et al., 2012). This five-layer architecture is described in figure 11.

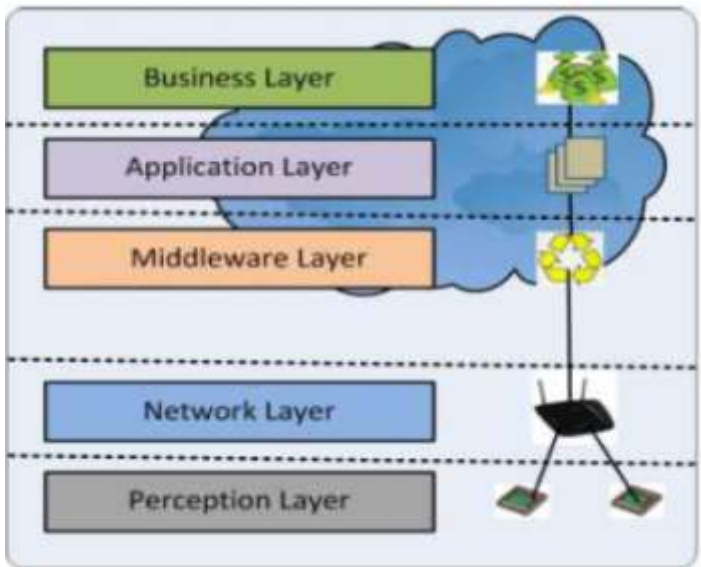


Figure 11: Layers of the Internet of Things (Source: Aazam, 2014)

**Perception Layer:** This is the lowest layer in the IoTs architecture, with the main purpose of identifying objects/things and data gathering. This layer perceives the data from the environment, and handles data collection and data sensing. Sensors, bar code labels, RFID tags, GPS, and camera, form part of this layer (Uckelamann et al., 2011).

**Network layer:** This layer feeds on the data received from the Perception layer and sends to the Internet. Network layer is like the Network and Transport layer of OSI model. Network layer may only

include a gateway, having one interface connected to the sensor network and another to the Internet. It may also contain a network management centre or information processing centre in certain cases (Aazam et al., 2014).

**Middleware layer:** This layer receives data from Network layer and performs information processing. It handles service management and storage of data. Its output is sent to the Application layer (Khan et al., 2012).

**Application layer:** This performs the final presentation of data. It presents the data in the form of smart city, smart home, smart transportation, vehicle tracking, smart farming, smart health and other kinds of applications. Application layer receives information from the Middleware layer and provides global management of the application presenting that information, based on the information processed by Middleware layer (Khan et al., 2012).

**Business layer:** This enables monetary returns from provided services. Data received at the application layer is transformed into a meaningful service and then further services are created from those existing services, which can generate a good amount of revenue for the service provider (Aazam et al., 2014).

### **Means of Connectivity**

The means of connectivity of these multifaceted devices to the Internet include:

- short-range Bluetooth low energy;
- short-range Near Field Communication (NFC);
- medium-range radio networks;
- long-range WiFi/Ethernet using IP protocols including cellular;

- direct communication through IoT protocols such as Message Queue Telemetry Transport (MQTT) and Constraint Application Protocol.

MQTT is a “subscribe and publish” messaging protocol designed for lightweight M2M communications (F5, 2015).

### 4.3 Big Data

The advent of the Internet, social media, and advances in digital sensors, communications, computation, and storage have created huge volumes of data. Today, people contend with data overload due to the exponential rate of data generation over the Internet and millions of connected devices. The scale of data is now measured in terms of exabytes ( $10^{18}$ ) and zettabytes ( $10^{21}$ ). By 2025, the forecast is that the Internet will exceed the brain capacity of everyone living in the whole world (Davis and Patterson, 2012). Roger Magoulas first used the term Big Data to describe this phenomenon (Halevi and Moed, 2012).

The term Big Data refers to datasets whose size is beyond the ability of typical database software tools to capture, store, manage, and analyze (Manyika et al. , 2011). Big data is data that is too big to be handled and analyzed by traditional database protocols such as SQL (Davis and Patterson, 2012). It is also used to refer to data that is too big, moves too fast, or does not fit the strictures of conventional database architectures (O'Reilly Media, 2014);

#### Characteristics of Big Data (7 Vs)

Typically, Big Data are digitally generated, passively produced, can be automatically collected, are geographically or temporally trackable, and can be continuously analysed (see Figure 2). The characteristics of Big Data include the following (Emani et al., 2015):

- **Volume (Data in rest):** There exist various sorts of data in huge volume in the order of zettabytes.

- **Variety (Data in many forms):** Data exist in many forms, without a fixed structure including: structured (data in relational databases), semi-structured (web logs, social media feeds, raw feed directly from a sensor source, email, etc.), unstructured (video, still images, audio, tweets, clicks).
- **Variability (Data with diverse meanings):** This refers to the varying semantic connotations and contexts of data.
- **Velocity (Data in motion):** The data are streaming. Data are in motion. It is being created, stored and analysed at increasing speed. It is torrential data
- **Veracity (Data in doubt):** It is essential that the data are accurate, so that the result of big data analysis can be of credible value.
- **Value (Data in highlight):** The data contain enormous values that can be drawn to advantage.
- **Visualisation (Data in visuals):** There must be a way of presenting the data in a manner that is readable and accessible.

Hence, dealing effectively with Big Data requires handling the seven V's, which is to create value against the volume, variety and veracity and variability of data, while it is still in motion (velocity), not just after it is at rest (volume).



*Figure 12: Sources of Big Data*



Figure 13: What happens online in 60 seconds? (Dominatem, 2016)

### Big Data Management and Analysis

Big Data analysis can be broadly classified into four steps, which are Acquisition or Access, Assembly or Organization, Analyze and Action or Decision.

**Acquisition:** Big Data architecture has to acquire high-speed data from a variety of sources (web, DBMS using online transaction processing (OLTP), NoSQL - a technology for handling unstructured data and Hadoop Distributed File System (HDFS) and has to deal with diverse access protocols.

**Organisation:** This performs ETL (extract, transform and load) operations on data. Organisation entails dealing with various data formats (texts format, compressed files, variously delimited, etc.). It involves being able to parse them and extract the actual information like named entities, relation between them. It also involves data cleaning, putting data in a computable mode, structured or semi-structured, integrated and storing them in the right location (existing



data warehouse, data marts, Operational Data Store, Complex Event Processing engine, NoSQL database)

**Analyse:** This involves running queries, modelling, and building algorithms to find new insights from data. It is essential data mining using various deep learning and analysis methods such as association rule mining, sentiment analysis, opinion mining, predictive analytics, supervised and unsupervised learning, and visualization.

**Decision:** This entails making the right decision after interpreting results from analyses efficiently. Consequently it is very important for the user to “understand and verify” outputs.

Generally, Big Data analytics consists of two procedures, which are Big Data Management and Deep Analysis to derive value from the Big Data. The schematic view of the procedure for Big Data analytics is shown in Figure 3.

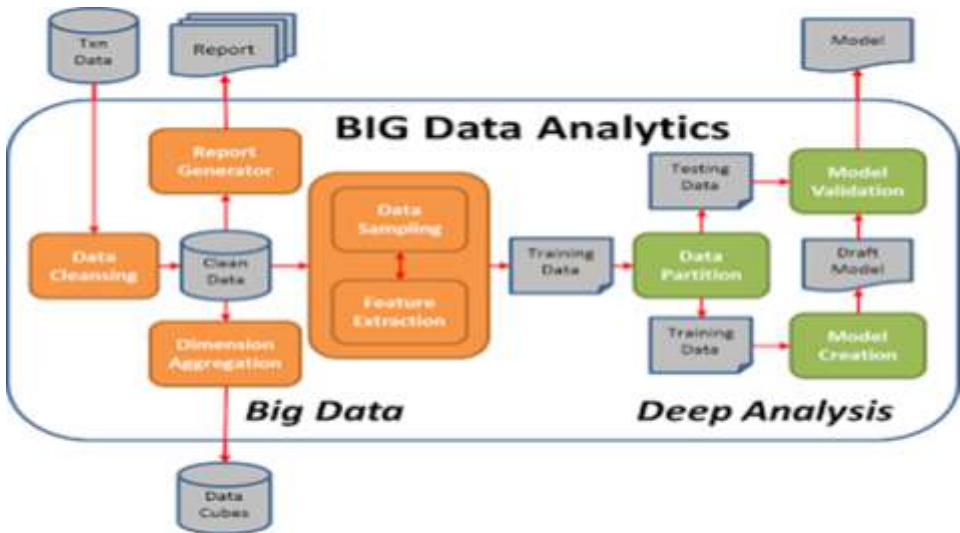


Figure 14: Big Data Analysis Process (Ho, 2012)

## Big Data Technologies and Tools

Big Data technologies are the set of tools that are used to facilitate the Big Data processing and management, and Big Data analytics. An overview of the interaction of various Big Data technologies is shown in Figure 4.

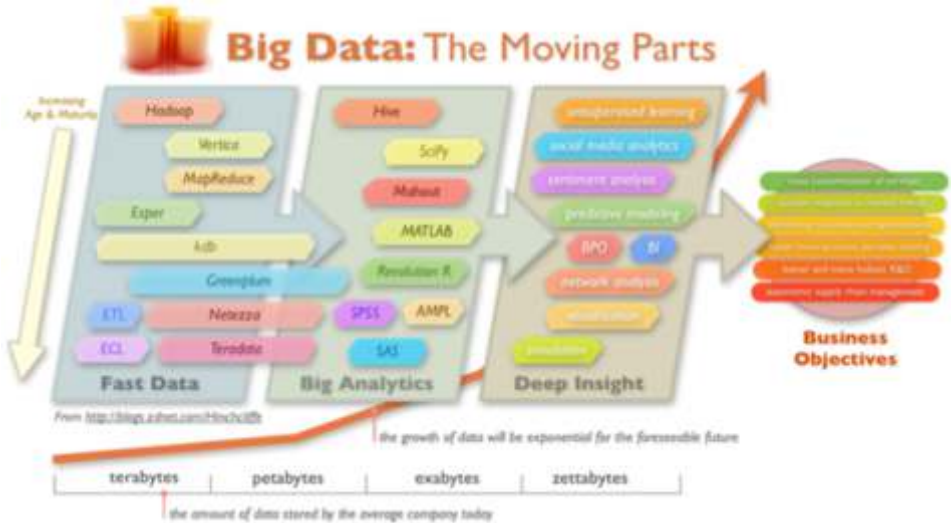


Figure 15: Example of Big Data Technologies (Source: <http://www.zdnet.com/article/the-enterprise-opportunity-of-big-data-closing-the-clue-gap/>)

## Some Big Data Tools

**Apache Hadoop:** This is an open-source software framework written in Java for distributed storage and distributed processing of very large data sets on computer clusters built from commodity hardware. The core of Apache Hadoop consists of a storage part Hadoop Distributed File System (HDFS) and a processing part (MapReduce). Hadoop splits files into large blocks and distributes them amongst the nodes in the cluster. To process the data, Hadoop MapReduce transfers packaged code for nodes to process in parallel, based on the data each node needs to process.

**MapReduce:** This is a programming model and an associated implementation for processing and generating large data sets with a parallel, distributed algorithm on a cluster. A MapReduce programme is composed of a Map() procedure(method) that performs filtering and sorting and a Reduce() method that performs a summary operation.

**Apache Hive:** This is a data warehouse infrastructure built on top of Hadoop for providing data summarization, query, and analysis. While initially developed by Facebook, Apache Hive is now used and developed by other companies such as Netflix.

**Esper:** This is an open-source Java-based software product for Complex event processing (CEP) and Event stream processing (ESP), which analyzes series of events for deriving conclusions from them.

Some specific tools and products for Big Data Analytics are show in Figure 16.

<p><b>Hadoop</b></p> <ul style="list-style-type: none"><li>• Java MapReduce</li><li>• Streaming MapReduce</li><li>• SQL on Hadoop, Pig, Hive</li></ul> <p><b>NoSQL Databases</b></p> <ul style="list-style-type: none"><li>• HBase/Accumulo</li><li>• Elasticsearch</li><li>• Cassandra, MongoDB</li></ul> <p><b>Stream Processing, Message Queues</b></p> <ul style="list-style-type: none"><li>• Storm</li><li>• Kafka</li></ul>	<p><b>Hadoop interfaces</b></p> <ul style="list-style-type: none"><li>• Hue</li><li>• Command Line</li></ul> <p><b>Statistical tools</b></p> <ul style="list-style-type: none"><li>• R, SAS, SPSS</li></ul> <p><b>Business intelligence and data viz</b></p> <ul style="list-style-type: none"><li>• Legacy: IBM Cognos, Biz Objects, OBIEE, Microsoft BI</li><li>• New Gen: Tableau, Qlikview, SiSense, Kibana</li></ul>
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*Figure 16: Examples of tools for Big Data analytics*

In summary, the emergence of the trio of Cloud computing, IoTs/E and Big data promises smart facilities for efficient management of resources. However, it places great demands on us all.

What does the future hold for us?



*Figure 17: A Visualized Ikeja Business District for 2030/2050  
[Source: Adapted from Shaba, 2009]*

### **Food for thought**

1. How prepared are we for the imminent change?
2. What are the implications for the current Curricula?  
Engineering, IT, Architecture, business and health.
3. Are there security breaches? YES! In its superlative form.  
Hyper-connectedness will lead to enhanced Cyber crime and  
Cyber terrorism

### **5. MY SOJOURN IN THE ACADEMIA**

This is my 32nd year after my first degree from ABU and I have remained ever since in this noble profession of chalk and duster. I have about 190 publications in Journals, Conference proceedings, Books

and Book Chapters and Edited Books. My current Citation in Google Scholar is 716, h-index is 13 and i10-index is 17.

I have carved a niche for myself in the area of electronic/information technologies, particularly eGovernment, eDemocracy, eVoting, eCommerce, ePayment, eLearning and eHealth amongst others where I am being referenced and consulted all over the world.

In Covenant University, I have supervised 12 Ph.D students. One of them is a Professor and Dean, CST, Prof. Omoregbe, two of them are Associate Professors, the current Director of Academic Planning, Dr. Daramola and the former HOD, Computer and information Sciences, Dr. Adebisi; and several others as Senior Lecturers and Lecturer 1. Most of them have international exposures.

Some of my contributions are presented hereunder not following a particular order.

## **5.1 eBusiness & Commerce, eBanking, ePayment and eIdentity**

### **E-Business**

eBusiness is not just restricted to buying and selling on the Internet like eCommerce, rather it provides secured transaction information among all the parties involved such as the vendors, customers, partners and companies that enhance informed decisions that impact on the bottom line. Specifically, eBusiness is an embodiment of electronic data interchange (EDI), enterprise resource planning (ERP), manufacturing supply chains, customer resource management (CRM), health care billing, automotive supply, global customer support, ubiquitous banking and brokerage, and business-to-business integration (Ayo, 2009).

### **E-COMMERCE**

Electronic commerce (eCommerce) refers to the process of buying

and selling goods and services, and settlement of transactions through the electronic media such as the Internet, networks and other digital devices (PC, telephone, etc).

The eCommerce models include:

1. Business to Business (B2B): A business transaction between two or more business organizations.
2. Business to Consumer (B2C): A business transaction among several business organizations and its numerous consumers.
3. Customer to Customer (C2C): A business transaction between consumers.
4. Consumer to Business (C2B): A business transaction between consumers and organizations.
5. Government to Citizen (G2C): This model makes information and services available online from government to citizens.
6. Business to Government (B2G): This is similar to G2C. In this case, it offers business opportunities between companies and the different levels of government.
7. Business to Employee (B2E): This involves online presentation of information to the employees of the firm. Such information includes: vacant posts, recruitments, promotions, seminars and trainings etc.



Figure 18: eBusiness & eCommerce interrelationship

There were a lot of research efforts aimed at reviewing the current state of developments in the areas of eBanking, eCommerce, eBusiness and ePayment in Nigeria. Chiemeké (2006), presented the problems inhibiting the growth of Internet banking in Nigeria as insecurity, inadequate operational facilities such as telecommunications and electricity supply.

In a similar research that evaluated the prospects of eCommerce in Nigeria, it was observed that virtually all the companies assessed in Nigeria had online presence but with little or no commercial activities taking place (Ayo, 2006). That is, there were enormous motivations and opportunities for eCommerce implementation but the ability of the populace to participate in it was very low because of the low level of ePayment infrastructure.

Ojo (2004) and Ovia (2003) reported the state of ePayment in Nigeria; that the economy was described as largely cash-based with over 90% of cash in circulation as against the developed world which is about 7%. However, in spite of the recent efforts of government to fast-track e-Commerce and e-Payment developments in Nigeria, the amount of cash in circulation is still on the increase (CBN Report, 2006).

Furthermore, Ayo et al. (2016) listed the factors that influence customer satisfaction as the quality of e-service, as well as the competence of eService support staff, system availability, service portfolio, responsiveness and reliability, in that order, were found to be most significant in rating eService quality.

Major challenges identified by respondents as impediment to B2C eCommerce acceptance include high tendency of Internet fraud, reliability of payment instrument, and cost of accessing the Internet especially those who use public café. Also, perceived eService quality has a strong influence on customer satisfaction and use of eServices (Ayo et al., 2008).

Below are some payment platforms:

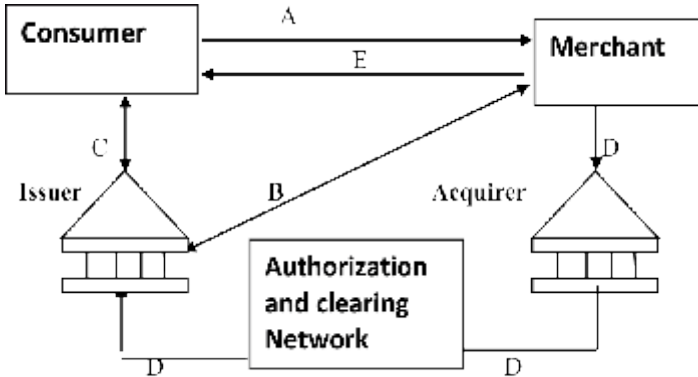


Figure 19: Mobile Payment Forum Architecture

- A. Models an intention to procure goods/services. Release of personal and payment card information.
- B. A merchant initiates a control session with the issuer based on available information to authenticate the consumer.
- C. A consumer clarifies issues with the issuer. This concludes process
- D. A merchant initiates purchase authorization and clearing process.
- E. A merchant provides receipt to user.

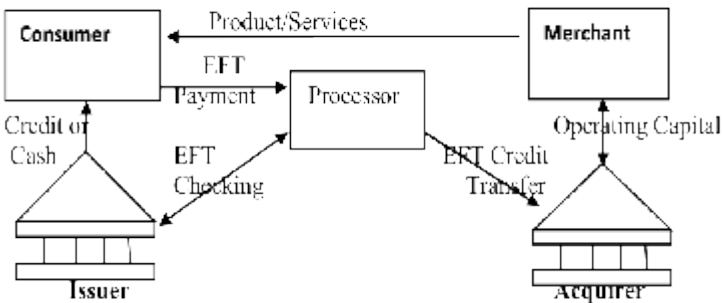


Figure 20: Online Payment System



### A Proposed Payment System

The architecture is composed of three modules: the Customer, the Merchant, and the Central Hub. The Central Hub module is the only modification to the existing ePayment configurations and it is introduced because of the peculiar level of fraud perpetrated in some nations of the world. Therefore, this architecture is designed having the Nigerian situation in mind. The architecture is people-oriented, as stakeholders are placed at the centre of the design.

The Central Hub module is based on private, public partnership (PPP) implementation. It is composed of the banks (the issuers and the acquirers), the switching company, the national data bank (NDB), and the stakeholders. A smartcard-based payment card with fingerprint scanner is proposed, which is based on a two-factor authentication (PIN and Fingerprint), but primarily fingerprint activated. The NDB contains the biodata of the citizenry and is maintained by the government. The stakeholders include: Central Bank, Card manufacturers, IT professionals, Government officials: the national drug law enforcement agency (NDLEA), the economic and financial crimes commission (EFCC), the national cybercrime working group (NCWG) etc, and Switching/Security firms.

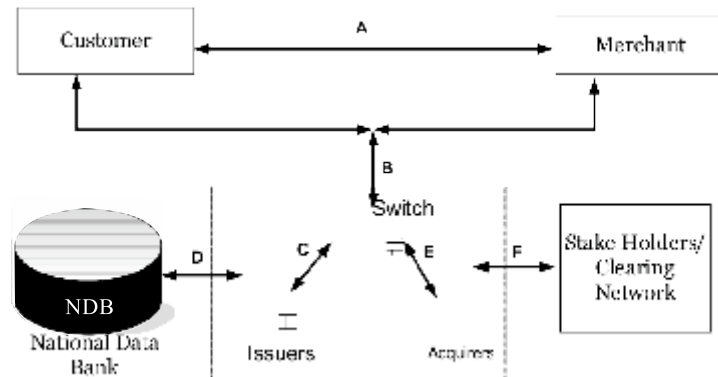


Fig 21: A Secure Payment Architecture

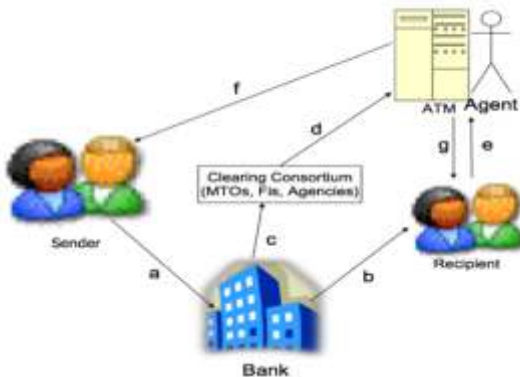
Source: (Ayo and Babajide, 2006)

The activities labeled A to F are described as follows:

- A: The Customer indicates intention to procure goods/services. The Merchant requests for personal and payment card information.
- B: The Merchant embarks on Customer's identity authentication and credit worthiness.
- C: The identity of the Customer is verified and authenticated.
- D: The identity of the client is further clarified with NDB.
- E: The amount of money is set aside, and the acquirer advises the Merchant to proceed with the transaction.
- F: Stakeholders (designated government officials, Card manufacturers, Banks, IT firms, Security agent) manages and controls the activities of the system. They regulate and formulate policies as may be deemed fit.

Furthermore, to further inculcate a cashless culture in Nigerian, the CBN formulated a policy which is yet to yield the required results, particularly at the grassroot for obvious reasons: infrastructural deficiencies (power, pos, connectivity, etc.) besides other social issues such as trust, security, literacy amongst others.

### **Mobile Money Implementation Model**



*Figure 22: Mobile Money Implementation Model (Ayo, C. K. et al., AJBM, 2012)*

The model has 7 activities labeled a, b, c, d, e, f, and g (Figure 3).

**Activity a:** The sender sends money by filling a prescribed form on his phone and sends same to his banker.

**Activity b:** The banker verifies the details of the account and if satisfactory notifies the recipient via sms of the transfer and the sender's account debited.

**Activity c:** The bank also notifies the consortium (clearing house) of the transfer. The clearing house serves as the link between the various participating banks and MTOs in Nigeria.

**Activity d:** The consortium sends notification to the agents at the rural locations so that adequate fund can be made available for disbursement.

**Activity e:** The recipient proceeds to the nearest ATM in the rural location for disbursement under the supervision of the agent to authenticate the recipient and offer assistance.

**Activity f and g:** The ATM sends notifications to the sender and recipient respectively, of the transfer.

One of my major contributions to the eBusiness platform is:

### **The Development of a Unified Payment System**

There were issues of:

1. Interoperability among ATM systems (a card of one bank not accepted on another)
2. Carrying multiple cards for several transactions
3. Identity theft
4. Card fraud

The system is modelled as shown below:

A typical ATM has a keypad that is composed of:

1. Numeric Keys (0-9)
2. Character Keys (A–Z)
3. Operational buttons (Accept, Correction, Cancel)

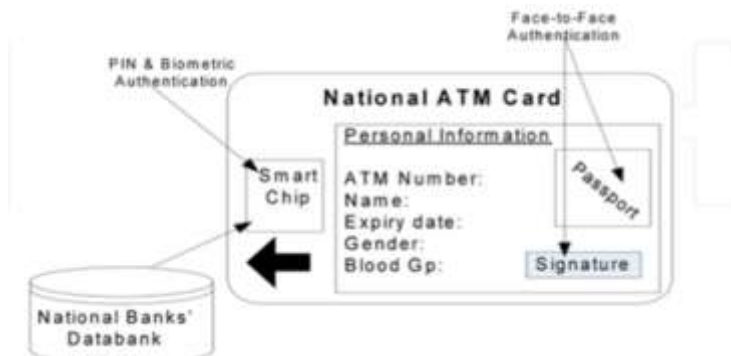
The screen has eight (8) buttons arranged at the two sides (4 at each side). The features of the ATM are presented in table 6 and a typical

**Table 2: Features of ATM Cards**

Bank	Features		
	Numeric Keys • (0-9)	Character Keys • (A-Z, *, #, -, +)	Operation buttons • OK/Enter/ Accept • Cancel • Correction/Change/Clear/Blank
UBA	Yes	Yes	OK, Change, Cancel and Blank
Oceanic	Yes	Yes	Accept, Correction, Cancel and Blank
InterContinental	Yes	Yes	Accept, Correction, Cancel and Blank
CMFB	Yes	No	Enter, Clear, Cancel and Blank



*Figure 23: A Typical ATM Machine*



*Figure 24: A Smart Card-based National Identity*

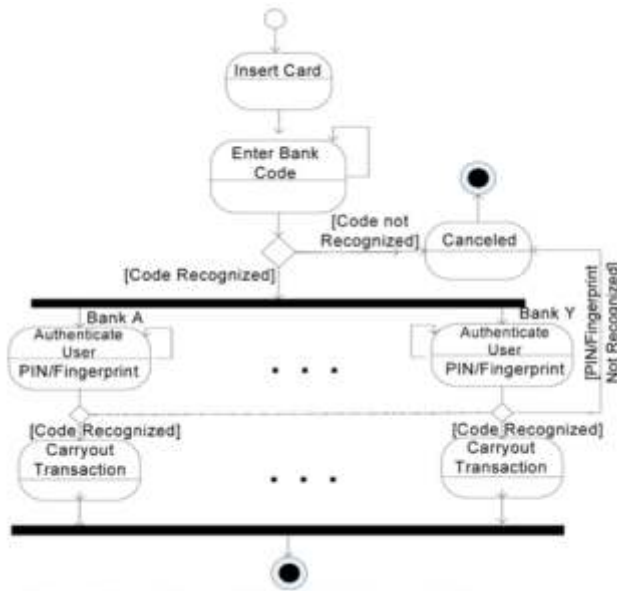


Figure 25: Activity Diagram of the Proposed System.

Therefore, the introduction of a smart card-based ATM with biometric authentication will ameliorate these challenges and is cost-effective and secure. No special design is required as the current system can accommodate the proposed features at minimal cost.

The fingerprint scanner can be accommodated on the keypad while a slight software redesign is required to accommodate a layer of service that will enable the user to select a bank of his/her choice. Most importantly, the number of ATM required is drastically reduced, which reduces the cost of production and renewal, and there is enhanced safety, security, and privacy. Furthermore, the fingerprint authentication will be a cheaper alternative than to relocate all ATMs in Nigeria (several thousands of them), to safer premises and the inclusion of security camera at each location.

## **5.2 eLearning**

The Nigerian Education System has the challenge of Access, Quality and Relevance. What a pity! On access, only about 30% of applicants seeking admission into the tertiary institutions has a space. On quality, our graduates are pronounced unemployable (First Bank chief, 2005). Thus, they are incapable of competing on the global landscape because of the required skillset.

On relevance, it is disheartening that since independence, our education has not translated to nation building in terms of peaceful coexistence, economic and infrastructural development.

The country is not able to transform her abundant natural resources to finished products and, worst still, we cannot feed ourselves. Consequently, Nigeria loses an enormous amount of money (N1.5tn) annually to education tourism. For example, N160b to Ghana, N80b to UK etc.

### **How Did we Get Here?**

In the beginning, the first generation of universities such as University of Ibadan, University of Nigeria, Nsukka, Ahmadu Bello University Zaria etc. produced graduates that were sought after for postgraduate studies abroad and within by both local and foreign companies (Obasanjo, 2012). Then, there were no questions of access, quality and employability. Today, the story is different, as all these have manifested as challenges alongside other social vices like cultism, and examination malpractice amongst others. Our education system is in a shambles and only a radical approach is required at this point to rescue this country from doom.

For several decades, the Nigerian education sector has suffered from systemic dysfunction at all levels and government appears helpless in finding a more lasting and enduring solution to the challenges. The decay in the ivory tower is exemplified by cultism, examination

malpractices, system abuse and corruption. Consequently, according to Ezekwesili (2006), “the country is producing less leaders, managers, teachers and other professionals but mass-producing miscreants, the disaffected and the rejected, the misdirected, the unlearned, the angry, the wronged, the agitated and the hopeless”.

Okebukola (2014) presented other problems as: inadequate quantity and quality of teachers, inadequate funding, inadequate infrastructural facilities, old and obsolete curricular, poor curriculum delivery, and poor reading culture.

However, he listed the redemption plan, which includes: curriculum redesign for relevance and national development, incorporation of entrepreneurial education, retraining of faculty, proper funding, improved research facilities, improved teaching facilities, phased development of public schools, Provision of an enabling environment for the use of ICT, planned access higher education (massive upgrade of facilities, massive staff recruitment), establishment of National Quality Assurance system, massive improvement of the reading culture.

## **Trends**

**Table 3: Distribution of Universities in Nigeria**

S/N	Ownership of School	Number
1	Federal universities	40
2	State universities	42
3	Private universities	61
	Total	143

*source: www.nuc.edu.ng*

**Table 4: Nigerian Universities Total Enrolment and Output of Staff (Selected Years)**

Year	Total Enrolment	Academic Staff	Staff/Student Ratio	Total Output
1963/1964	3,646	680	1:5	425
1969/70	9,695	1,475	1:7	2,175
1974/75	26,448	3,584	1:7	4,474
1979/80	57,742	5,840	1:10	13,562
1984/85	126,285	10,038	1:13	27,550
....	....	....	....	....

*Source: Ogunu (2015)*

Table 4 corroborates the position of Chief Obasanjo. The above statistics depicts current features of Most World Class Universities. It should be noted that our founding fathers committed between 40 – 50% of the budget to Education. What we have now is less than 10%. This is gross negligence and misplacement of priorities. It should be noted that education is basic to peaceful coexistence, human capital development and national development.

**Table 5: Total Number of Universities, Applications and Admission Between 1999 – 2014**

S/N	YEAR	NO OF UNIVERSITIES	NO OF APPLICATIONS	NO ADMITTED	NO NOT ADMITTED
1.	1999/2000	45	417,773	78,550	339,223
2.	2000/2001	46	467,490	50,277	417,213
3.	2001/2002	52	550,399	60,718	544,321
4.	2002/2003	53	994,380	51,845	942,535
5.	2003/2004	54	1,046,950	105,157	941,793
6.	2004/2005	56	841,878	122,492	719,386
7.	2005/2006	75	916,371	N/A	N/A
8.	2006/2007	76	803,472	123,626	679,846
9.	2007/2008	94	1,054,053	194,521	859,532
10.	2008/2009	95	1,182,381	N/A	N/A
..	...	...	...	....	....
X	2012/2013	122	1,503,933	500,000	1,003,933
X	2013/2014	129	1,735,729	520,000	1,215,729
X	2014/2015	129	1,606,753	684,506	922,247

Source: (Ajadi, 2010)

**Table 6: Higher Institutions in Some Selected Countries**

S/N	Countries	Population	No of HEIs	Enrolment Post Secondary
1	China	1.39b	1183	11.6m
2	India	1.27b	1636	NA
3	USA	0.32b	3263	20.5m
4	Nigeria	0.18b	130	1.7m
5	UK	0.06b	313	3.7m
6	Germany	0.08b	407	NA
7	Malaysia	0.03b	80	NA

Sources:

[http://www.webometrics.info/en/About\\_Us](http://www.webometrics.info/en/About_Us)

<http://www.worldometers.info/world-population/population-by-country/>



From the above table, Nigeria may continue to patronize them for:

- education & health tourisms;
- importation of food;
- exportation of raw materials;
- importation of expertise;
- importation of technology; etc.

Table 7: System of Education in Some Selected Countries

S/N	Countries	System of Education	Funding	Focus
1	China	Junior & Senior Middle School Secondary Agricultural Vocational Secondary Technical Regular Secondary School Secondary Teachers- Schools Secondary Professional Universities Professional Colleges Short Term Vocational Universities	<ul style="list-style-type: none"> <li>➤ Largely Government Public</li> <li>➤ Free at Primary and Secondary</li> </ul>	Degree and Vocation  Based on Needs
2	India	Pre-Primary (1-5years) Primary (6-10 years) Secondary (11-15 years) Higher Secondary (16-17years)	<ul style="list-style-type: none"> <li>➤ Largely Public Funded</li> <li>➤ Free at Primary and Secondary</li> </ul>	Degree and Vocation  Based on Needs
3	USA	Pre-School (Nursery) Primary Secondary College or University	<ul style="list-style-type: none"> <li>➤ (No Child Left Back Act)</li> <li>➤ Free at Primary and Secondary</li> </ul>	Degree and Vocation  Based on Needs
4	UK	Nursery (Age 3) Infant School (Age 4-6) Junior School (Age 7-10) Secondary School (Age 11-15) Six Form (Age 16-17) Higher Education (Age 17-18)	<ul style="list-style-type: none"> <li>➤ Largely Public Funded</li> <li>➤ Free at Primary and Secondary</li> </ul>	Degree and Vocation  Based on Needs
5	Germany	Kindergarten, Primary School, Secondary School, Vocational School and University.	<ul style="list-style-type: none"> <li>➤ Largely Public Funded</li> <li>➤ Free at all levels</li> </ul>	Degree and Vocation  Based on Needs
6	Malaysia	Pre-School (3-6) Primary Education (7-12) Middle Sch. (13-15) Secondary (16-17) Secondary Education Tertiary Education	<ul style="list-style-type: none"> <li>➤ Largely Public Funded</li> <li>➤ Free at Primary and Secondary</li> </ul>	Degree and Vocation  Based on Needs

Charles K. Ayo

Sources:

<http://www.chinaeducenter.com/en/cedu.php>

<http://www.ukgermanconnection.org/german-school-system>

[http://www.internationalstudent.com/study\\_usa/choosing-the-usa/usa-education-system/](http://www.internationalstudent.com/study_usa/choosing-the-usa/usa-education-system/)

<https://eal.britishcouncil.org/eal-sector/education-systems-overview>

From the above, it is obvious that nothing is wrong with our education system but the commitment to implementation strategy and funding.

Of particular importance to me is the German System of Education, which is categorized into three aspects:

- The *Hauptschule* (grades 5-9 in most states) leads to the receipt of the *Hauptschule* certificate and then to part-time enrollment in a vocational school combined with apprenticeship training until the age of 18.
- The *Realschule* (grades 5-10 in most states) leads to the receipt of the *Realschule* certificate and then to part-time vocational schools, higher vocational schools or continuation of study at a *Gymnasium*.
- The *Gymnasium* (grades 5-13 in most states) leads to the Abitur and prepares students for university study or for a dual academic and vocational credential.

Although it is possible for students to switch to a higher-level school form with improved performance, it is not a frequent occurrence. It is more common that a student will move to a less rigorous school if they cannot meet their school's performance standards.

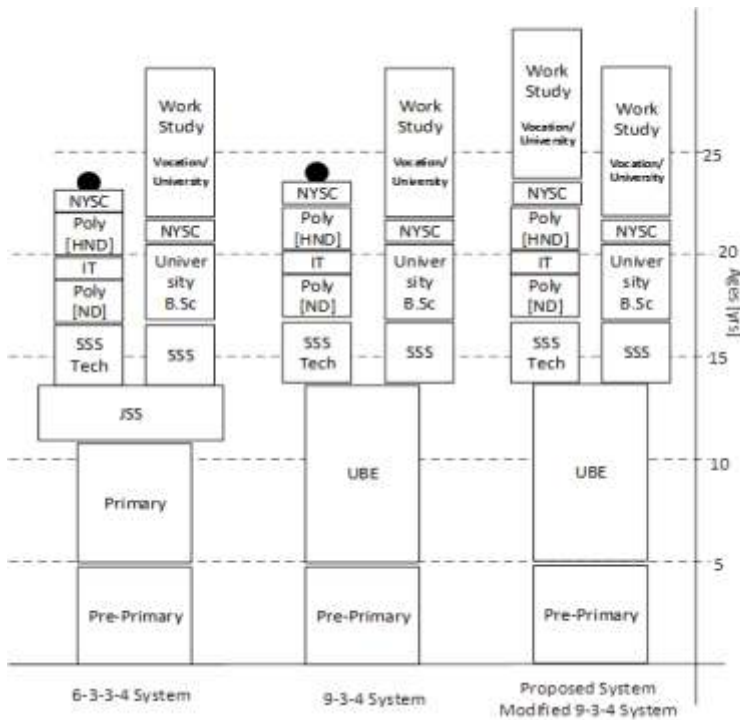
## **My Contributions/Interventions**

### **1. A reformed Education System**

A reformed Education system that solves the challenge of parity between HND and Degree holders. The two categories of institutions were set up for different purposes. Polytechnic Education was designed to produce middle-level manpower for the technological

transformation of the country. This aim has not been accomplished, not because of the system of education but lack of commitment and funding on the part of government.

Polytechnic graduates should be respected in their own rights as the technocrats and technopreneurs needed for the technological development of this nation. Their failure in this area is responsible for the challenges of this country, particularly overdependence on the importation of all kinds of goods.



**Figure 26: Modified System of Education**  
(Source: Ayo & ASdebiyi, 2008)

There should not be any limitation to the height they can attain academically based on strength and there should be better interaction

between them and the university system otherwise we will have pure theoreticians.

## 2. Adoption of Social medial-based e-Learning (mLearning in Covenant University)

The Social Networking platforms such as Twitter, YouTube, MySpace, Linkedin and Facebook, amongst others, have enjoyed monumental growth from the entire populace of the world, including the young and the old. The attraction to the social media was noted to have affected the attention of most students in the world. Consequently, some countries have taken drastic measures to address the ugly trend, which ranged from restricted access to outright ban of access to the sites. The system will turn learning to fun by having a good blend of learning and social activities (in restricted form) combined together. Students will have access to a wide range of learning resources and faculty outside their immediate environments. Furthermore, students will be involved in academic discourse and collaboration with their peers instead of the restriction to the social interactions enjoyed on the social media.

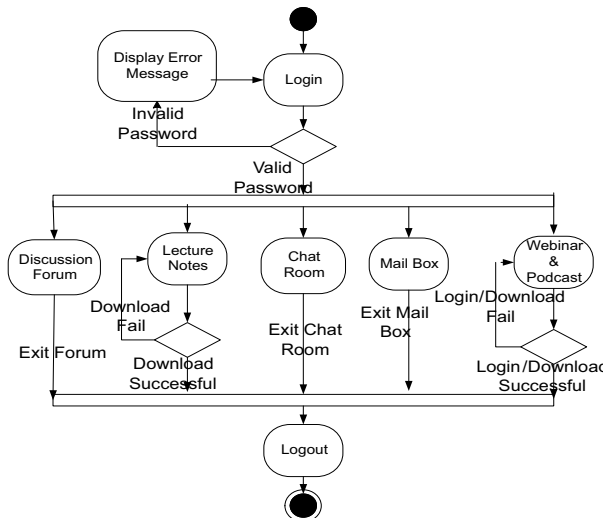


Figure 27: The Activity Diagram of the System.

## **Findings**

With a social e-learning system in place, the Web is being transformed to a platform where content is created, shared, remixed, repurposed and passed along as against a Web for exchange of mails, pictures and social interactions. Thus, a community of practice is envisaged where members interact and learn together, develop a shared repository of researchers and socialize online but on a limited scale Ayo et al., 2011). The accessibility to the portal through the Web and mobile phones will enhance the reach, as well as aid learning anywhere and anytime with the resultant effect of getting the students engaged in meaningful usage of ICT as against the level of abuse witnessed currently on social networking sites.



*Figure 28: The Launch of Mobile Learning in Covenant University*

### **3. Development of Afroscholar**

Afroscholar is a social media-based educational platform for academics, students, industry experts and employers to share resources, learn across borders, connect socially and collaborate on

impact-focused projects. It offers a one-stop shop for all educational resources about Africa and African Institutions, which, hitherto has been a challenge.

**Objectives:**

The objectives are to:

- contribute to learning and development in Africa by enabling mutual sharing of learning resources and collaborations;
- facilitate project-based learning that is supported by all stakeholders in the education sector;
- create a 1-stop shop platform for African Higher Education landscape;
- create an avenue for Africans, Africans in the Diaspora and other nationals to contribute resources to the development of Africa;
- create an avenue for Africans to learn by using the newest approaches, and provide access to state-of-the art learning resources across the globe; and
- foster intellectual engagements and development in Africa through the social media platforms, etc.

**Benefits:**

- It provides opportunities for academics and researchers to stretch their influence beyond their local, regional or national borders, thereby imparting more students other than the ones in their own immediate environments.
- It offers a one-stop shop to access valuable knowledge resources that are available within the African continent and in the custody of the friends of Africa in the Diaspora.



*Figure 28: Afroscholar Web Site*

This is still research in progress. Its advocacy will comment as soon as possible.

## **5.4 eHealth**

The Nigerian Health System has been moribund for decades, perhaps, as a by-product of a moribund education system. Just like our experience with education tourism, there is medical tourism with almost the same magnitude.

The health sector has been grossly underfunded with virtually inadequate medical facilities both in quality and quantity. There is an average of 1,700 persons per hospital bed and the ratio of physician to the populace is about 1:6000. It is not surprising that the WHO organization categorized Nigeria amongst the dead zones of the world (Ayo, 2011 in Yusuf, 2008). Also, Nigeria is listed among the poorest nations of the world in virtually all the indices of development.

### eHealth Applications

ICTs have played a critical role in improving health care for individuals and communities, particularly for nationals of low resourced countries. ICTs provide new and more efficient ways of accessing, communicating, and storing information (Ayo, 2009 & Ayo, 2015).

mTechnology refers to technology that is portable. Mobile devices, especially cell phones, represent the most common and widely used mTechnology today and they are widely used for medication adherence in chronic care models is its ability to create a multi-way interaction between patient and healthcare provider(s) (Kaplan, 2006 and Cunha et al., 2010).

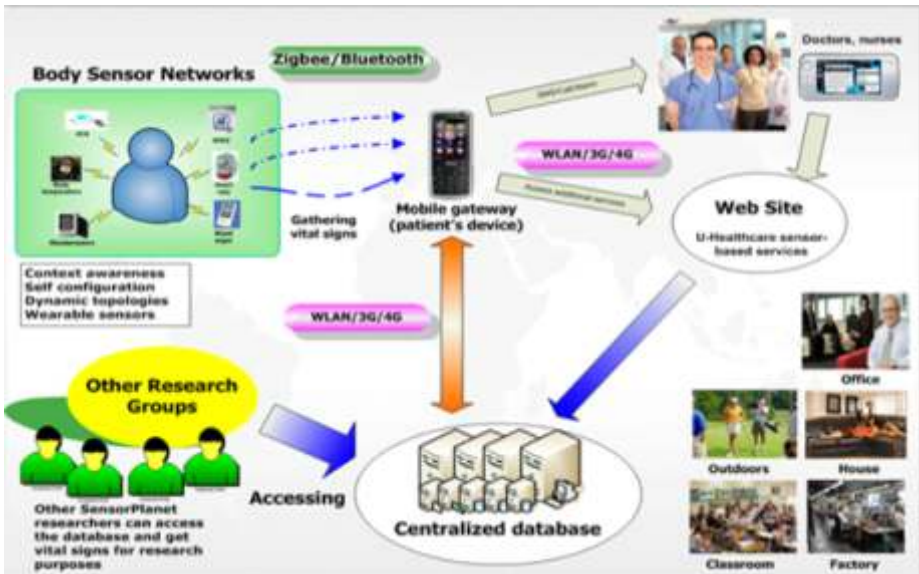


Figure 29: Overview of eHealth Implementation with mTechnology  
[Source: <https://hchen84.wordpress.com/page/2/>]



Table 8: Some of Existing e-Health Initiatives

<b>Technology</b>	<b>Description/Application</b>	<b>Country</b>
<b>CliniPAK360</b>	Provides on-demand reporting, enabling health care administrators to increase productivity and streamline the clinical experience while creating a long-term impact on patient health management.	Nigeria
<b>Gist-A-Doctor</b>	Offers a wide range of services—from First - aid to counselling to medical referral. A user sends SMS to complain about persistent issues	Nigeria
<b>Project Mwana</b>	To improve early infant diagnoses of HIV.	Zambia
<b>WelTel</b>	Used in Kenya to improve patients’ adherence to antiretroviral (HIV) therapy.	Kenya
<b>Project Masilukeke</b>	To provide HIV/AIDS education and awareness and to encourage people to get tested	South Africa
<b>Mobile Midwife</b>	To deliver targeted, time -specific, evidence-based voice messages to pregnant women and new parents in their local languages. Users pay for the service. SMS based.	Ghana and Nigeria
<b>Mobile Alliance for Maternal Action (MAMA)</b>	To provide <b>topic-based messages</b> including the prevention of mother-to-child transmission of HIV, infant feeding, and post-partum family planning. SMS based.	Bangladesh, India and South Africa
<b>Text4Baby</b>	To provide free text messages on parental care, baby health, parenting etc. SMS based	US
<b>M4change</b>	To improve quality of antenatal care services. It is SMS based.	Nigeria

## My interventions

We have developed a few eHealth systems. Taking cognizance of the proliferation of the mobile technologies with about 7.29b subscribers in a world population of 7.45b. It is one thing to create a platform, it's another for the world poor to be able to access the facilities.



*Figure 30. The Covenant University eHealth System.*

CUHEALTH is an eHealth interactive platform for Covenant University, Ota, Nigeria. We hope to uniquely engage the public, health professionals and health care providers on key health issues globally and within the African region.

We have innovatively developed an online forum to provide current health news from the World Health Organization, healthcare solutions, health promotion options, emergency services through our partners, live consultations and chats with verified medical practitioners, and online directory of registered health centres.

Our free online course on Public Health and Informatics will further help advance the knowledge of the public on the spectrum of public

health issues geared towards improving information flow and patient outcomes. Our research repository and blog offer evidence-based findings on several health issues that can inform equitable public health and policy decisions. We are committed to improving health systems and health service delivery.

This system is work-in-progress and in conjunction with the University of Florida and Harvard as well as other health professionals. It is our little contribution to health delivery, advocacy and care for the low-resourced nations of the world.

## **5.5 eGovernment**

### **Leadership Issues in Africa**

Most of the conflicts witnessed all over the world, particularly within the developing nations are preventable if there had been avenues for dialogue, consultation and interaction. Some were politically motivated and caused by leaders out of their selfish interests while others were borne out of anger by the oppressed minority groups because of the unavailability of a forum to be heard. The happenings in Nigeria, Egypt, Liberia, Sudan, Mali, DR Congo etc are a few examples. The colossal waste, cost and wanton destruction of lives and property cannot be quantified (Ayo and Ekong, 2008).

The heart of democracy is the freedom of the people to freely choose those who govern their affairs; the power to renew or change such managers at regular elections; and the right to expect accountability from the elected officers (Gana, 2007). Nwabueze (2003) described the problems of authority in the contemporary African setting as being personal, permanent, mystical and pervasive. Consequently, some African leaders up till the early 1990's held unto power for decades. Examples are Boigny of Cote D'voire (34 years), Eyadema of Togo (31 years), Sekou Toure of Guinea (26 years), Bourguiba of Tunisia (32 years), Muammar al-Gaddafi of Libya (42), Hosni Mubarak of Egypt

(30) etc. All these are symbols of poor leadership and governance.

### **Good Governance**

From the level of social disorder witnessed around the world, it is evident that most nations of the world and not just the African states have leadership challenge. However, on account of poor governance, Africa appears the worst hit going by the current state of disorderliness in countries like Nigeria, Mali, Sudan, Libya, Egypt and Central African Republic amongst others.

President Obama of the United States of America attributed the root cause of the challenges that have befallen Africa to poor governance arising from lack of visible dividend of democracy, lack of attention to unaligned frustrations and corruption (Obama, 2014).

Good governance entails transparent and accountable management of human, economic and financial resources for the purpose of equitable and sustainable development (ADC, 2011). The World Bank defined it as the “manner in which power is exercised in the management of a country's economic and social resources for development” (IFAD, 1999).

Good governance has 8 major characteristics, which are: participatory, consensus oriented, accountable, transparent, responsive, effective and efficient, equitable and inclusive and adherence to the rule of law. It ensures to a large extent that corruption is minimized, the views of minorities are taken into account and that the voices of the most vulnerable in society are heard in decision-making. It is also responsive to the present and future needs of society (UNESCAP, 2014).



*Figure 31: Characteristics of Good Governance*

Consequently, good governance has the potential to foster good leadership and aid the achievement of the Sustainable Development Goals (SDGs) by engendering probity, accountability, transparency, participatory governance and fairness to all (ADC, 2011).

## **eGovernance and eGovernment**

### **1 eGovernance**

eGovernance in the popular parlance refers to the governing of a country/state using ICT. It means the application of ICT to transform the efficiency, effectiveness, transparency and accountability of exchange of information and transaction.

The object of eGovernance is to provide SMARRT Government as described below:

- S - ICT brings  **Simplicity**  to governance through electronic documentation, online submission, online service delivery, etc.

- M - It brings **Morality** to governance as immoralities like bribery, red-tapism, etc. are eliminated. It eliminates the activities of middlemen.
- A – ICT creates **Accountability** in government, as all the data and information of Government are available online for consideration of every citizen, the NGOs and the media.
- R – It creates **Responsive** government as well as an atmosphere of Reduced paperwork, increased communication speed, and decreased communication time.
- R – Application of ICT makes an irresponsible Government **Responsible**; increases access to information and makes more informed citizens.
- T – ICT brings **Transparency** to government through online availability of information and reduced red-tapism thus leaving no room for the Government to conceal any information from the citizens.

## 2 eGovernment

eGovernment is defined as broad based initiatives that leverage the capabilities of ICT to: develop and deliver high quality, seamless, and integrated public services; enable effective constituent relationship management; and support the economic and social development goals of citizens, business, and civil society at local, state, national and international levels (Grant and Chau, 2006).

Generally, eGovernment is about transformation, it is about delivering services effectively and seamlessly, it is about developing new forms of communication between government and the governed, and it's about enhancing quality of lives through economic development and enhancing civil society (Worrall, 2011). It is about increasing transparency, sharpening accountability, increas scrutiny, taking out hierarchies, changing working practices, changing cultures, changing behaviours and about radically changing power structure by making

power more diffused and less concentrated among a small political and administrative elite.

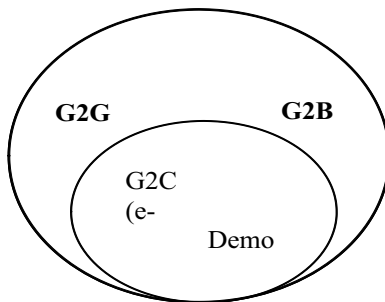
### **Models of eGovernance**

Ayo (2009) & Rabaiah and Vandijet (2011) presented the models of Government as:

- Government to Citizen (G2C),
- Government to Government (G2G),
- Government to Business (G2B),
- Government to Employees (G2E),
- Government to NGOs (G2N), etc.

These models refer to the interaction between Government and the other parties: citizens, government, business, employees and NGOs respectively.

However, the models could just be grouped to three namely G2G, G2B, and G2C because the other ones are mere variants of G2C.



*Figure 32: e-Government Models Relationship*

Brief breakdowns of the models are presented by (PAF 6406, 2012) as:

#### G2C applications

- Information Dissémination
  - Static/ dynamic web pages; documents
  - Online data
- Citizen Services provision
  - Licenses, Government certificates, Taxes, Building, permits

- Direct democracy
  - Communications with officials

G2B applications

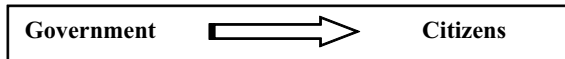
- eProcurements
- Business services provision
  - E-permits

G2G applications

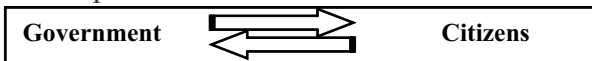
- Human resource management
- Payments and Accounting

eEngagement is considered the aspect of eDemocracy that offers possibilities for enhanced consultation and dialogue between government and citizens. eDemocracy, particularly G2C or C2G will foster good governance and leadership. OECD (2003) presented three levels of engagement as information, consultation and active participation.

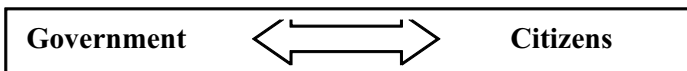
- **Information:** a one-way relation that delivers information from government for the use of citizens.



- **Consultation:** a two-way relation in which citizens provide feedback to government. Citizens' views are sought and feedback provided.



- **Active participation:** a relation based on partnership with government, in which citizens are actively engaged in dialogue and the policy-making process.





### 3. eDemocracy

Democracy can broadly be defined as the use of ICT to increase and enhance citizens' engagement in democratic processes (Akpan-Obong and Alozie, 2016). It fosters good governance by creating a conducive and trusted ambience for participatory governance/democracy for all and sundry. Thus, to evolve a culture of accountability, transparency, responsive and responsible governance all the available Information and Communication Technologies such as the electronic, mobile, Internet and the Social Media should be employed.

Table 5 contains the core eDemocracy tools that can aid genuine Consultation, Interaction, Openness, and Transparency in governance.

Table 9: Core e-Democracy Tools

Tool Category	Brief Description
eParticipation Chat Rooms	Web applications where a chat session takes place in real time, which is especially launched for eParticipation purposes
eParticipation Discussion forum/board	Web applications for online discussion: groups where users, usually with common interests, can exchange open messages on specific eParticipation issues. Users can pick a topic, see a "thread" of messages, reply and post their own message
Decision-making Games	These typically allow users to view and interact with animations that describe, illustrate or simulate relevant aspects of an issue; here with the specific scope of policy decision-making.
Virtual Communities	Web applications in which users with a shared interest can meet in virtual space to communicate and build relationships.
Online Surgeries	Web applications specifically designed to support elected representatives to engage with the citizens they represent
ePanels	Web applications where a 'recruited' set, as opposed to a self-selected set, of participants give their views on a variety of issues at specific intervals over a period of time
ePetitioning	Web applications that host online petitions and allow citizens to sign in for a petition by adding their name and address online
eDeliberative Polling	Web applications which combine deliberation in small group discussions with random sampling to facilitate public engagement on specific issues
eConsultation	Web applications designed for consultations which allow a stakeholder to provide information on an issue and others to answer specific questions and/or submit open comments
eVoting	Remote internet-enabled voting or voting via mobile phone, providing a secure environment for casting a vote and tallying of the votes (other types of electronic voting are available, but for the purposes of this report we focus on internet voting)
Suggestion Tools for (formal) Planning Procedures	Web applications supporting participation in formal planning procedures where citizens' comments are expected to official documents within a restricted period

## A Framework for E-Democracy Implementation

A G2C (eDemocracy) system can be developed and deployed for grass-root mobilization and participation in governance (Ayo, Mbarika and Okunoye, 2013). Deployment of the systems could start from local government, State and National institutions. The models are presented below:

### 1. Local Government Connect

The beauty of an eDemocracy system is to engender grassroots mobilisation and participation. Thus, for efficient result, the implementation and adoption must be bottom-up, from the local government areas, followed by the States and then the nation at large. Figure 10 shows an e-Democracy deployment framework in Ogun State of Nigeria. Ogun State has its headquarters at Abeokuta and the State houses Ado Odo Ota Local Government Area, the pilot local government for e-Democracy implementation, where Covenant University, the home institution of the researcher is located.

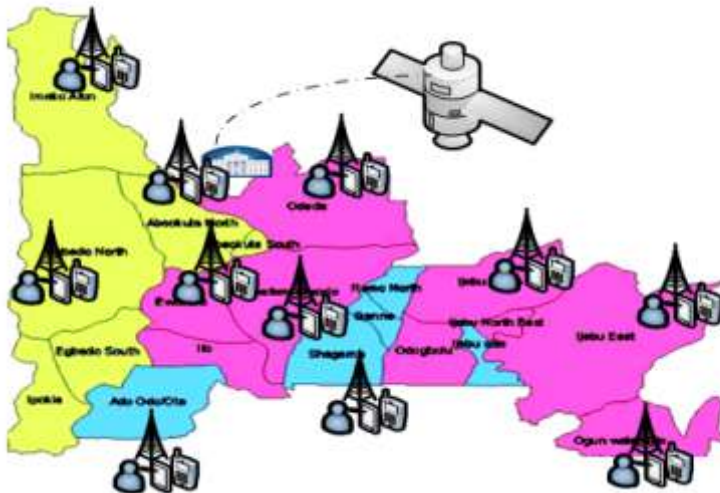
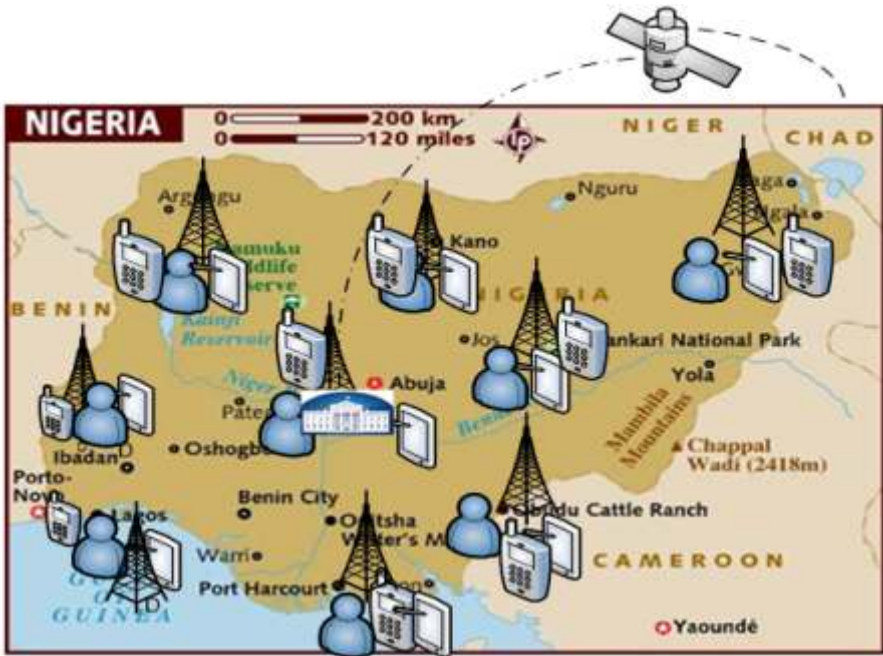


Figure 33: e-Democracy Deployment in Ogun State

## 2. Nigeria Connect

The national capital is Abuja, the seat of power. So, all the 36 states in Nigeria have multi-channel access to their representatives. However, in the local government areas, the various wards enjoy the same access as the local authorities.



*Figure 34: e-Democracy Deployment in Nigeria*

## 3. Africa Connect

With Africa representing the developing nations of the world, figure 11 shows the deployment of the system across the nations in the continent. The headquarters of African Union (AU) is located in Addis Ababa, Ethiopia, African leaders and citizens in general can make contributions to issues that affect the individual nations and the continent at large.



*Figure 35: e-Democracy Deployment in Africa*

Generally in the world, the total mobile-cellular subscriptions reached almost 6 billion by the end of 2011, corresponding to a global penetration of 86%. By the end of 2011, there were 105 countries with more mobile-cellular subscriptions than inhabitants, including African countries such as Botswana, Gabon, Namibia, Seychelles and South Africa (ITU, 2014).

### **My interventions**

1. Development of an ePolling system.  
This is up and running
2. The development of an eDemocracy system  
The site is ready but awaiting adoption.



Figure 36: eDemocracy System

## 6.0 The Future of ICTs

The future is closer than expected and I think it is already here. It is a dynamic one and every onlooker stands the chance of being left behind and becoming stale.

With the emergence of Cloud computing, IoTs/IoE and Big Data will definitely bring a paradigm change in the ways and manner businesses are transacted, the modus operandi of virtually all operations. Thus we should expect platforms and operations where all activities are automated, with human interventions almost non-existent.

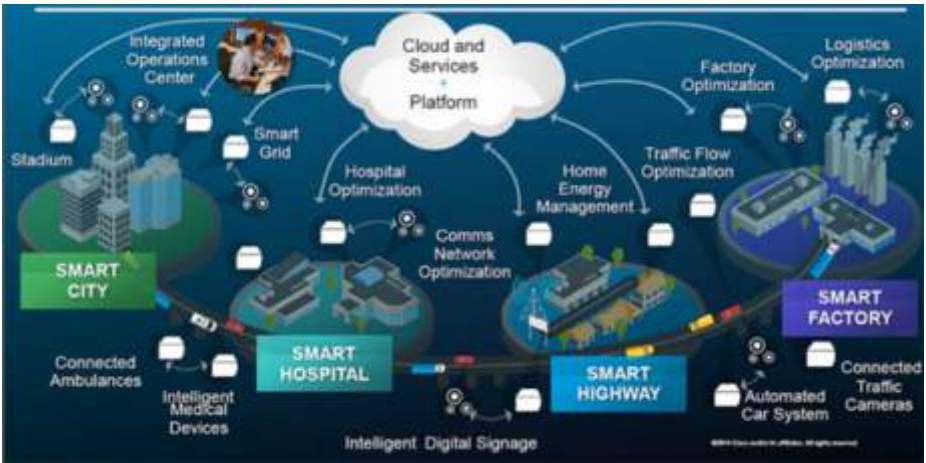


Figure 5. The Cloud, ToTs/E and Big Data

From Figure 5, there are smart cities, hospitals, highways and factories amongst others. There are commonalities, which include efficient and effective management of resources such as energy, traffic, homes, organizations etc.

Think of this!



Figure 17: A Visualized Ikeja Business District for 2030/2050 [Source: Adapted from Shaba, 2009]

How prepared are we as business owners, entrepreneurs, government, individuals, academics and students? By the time we attain this level, there will be no manual processes and everything is expected to run smoothly.

However, the more connected we are or hyper-connected, the more we are exposed we are to cybercrimes and cyber-terrorism. It was reported that within the last minute, there were 45 new viruses developed, 200 malicious web sites opened, 180 personal identities stolen, 5,000 malwares created and \$2m dollars lost (Clinton, 2016). Furthermore, the annual cost of cybercrime is put at \$43.8b (CCRC, 2013).

Cyber-terrorism refers to criminal acts perpetrated through ICTs resulting violent destruction and/or disruption of services. This includes shutting down critical infrastructure such as energy, transportation and government amongst others (Ayo, 2009).

Examples include:

1. An attack on Australian waste management control system that released millions of gallons of raw sewage on a town in year 2000;
2. Hackers took control of the computer system that controlled the flow of natural gas in Russia in year 2000, etc.

Only 5% of cybercriminals are ever caught.

However, all these issues are surmountable on the path of caution as there are available solutions to the various attacks.

## **CONCLUSION**

Ladies and gentlemen, we are convinced beyond reasonable doubt that nations are built by skills and skills are acquired through quality education. Also, looking at our developmental issues as a nation, it is crystal clear that what makes a nation is not the abundance of the natural resources buried under the earth but the abundance of intellectual capital, which is grossly lacking.

Therefore, there is need for increased funding of education for

enhanced research and development. Our system of education is satisfactory but there is need for massive deployment of ICTs in education delivery to solve the problem of access, particularly through the adoption of open and distance learning (ODL) and massive open online course (MOOC). Ten universities in Nigeria could be empowered to handle this and within a year or two, the challenge of access can be solved and we can adopt the German system of education to create room for vocational studies. For ease of implementation, there should be massive deployment of ICT in education delivery, engagement of Private/Public for delivery of educational resources, more commitment to funding by Government, and concerted efforts made by teachers to improve the quality of teaching and research. Let us deconstruct or remodel our national development agenda by refocusing on human capital development. California, one of the states in the US, is a perfect example. California's economy is larger than that of France or Brazil. It could pass for the 6th richest country of the world if it were to be a country. It is better than Texas, the oil rich state of the U.S.

The economy of the state is built around the ivory tower: Stanford University that played host to the Silicon Valley. The Valley houses the best IT firms in the world such as Apple, HP, Google, Facebook, Cisco, eBay, Oracle, Netflix etc. These are multi-billion dollar companies. The Valley can be considered the epicentre of ICT innovations in the world.

Furthermore, the state is the home of Hollywood, a multi-billion movie industry that contributes billions of dollars to the GDP of the State. This is another example of an investment in capital human development.

Suffice to state that where education goes, there civilization goes and by extension, development.

Government should know that further negligence on this sector will further fuel underdevelopment, Boko Haram, Avengers, MASSOB,



Cultism and other social vices that are counterproductive.

As a nation, we should be tired of the status quo. We say ‘n’o to capital flight for the importation of goods because of our inability to transform primary goods to secondary goods (finished goods), we say ‘no’ to the uncontrollable exchange rate because we have nothing to export, we say no to education, health, infrastructure etc tourisms, we say ‘no’ to internal corruption and breakdown of law and order, and we say no to poverty and bad governance amongst others.

Ladies and Gentlemen, with massive engagement of ICTs in all sectors of the economy, we will have:

- Governance – gives good governance and peaceful co-existence
- Education – for gainful employment, productivity and nation building
- Business – for smarter operations for global competitiveness
- Health – for quality health care delivery etc

We do not need rocket science to put Nigeria back on track. All that is necessary now is to capitalize on education and technology to transform the raw materials that are available (what we have) in the country and convert them to the desired products (what we need) for national development.

Ladies and Gentlemen, I want to submit that no nation can develop in an atmosphere that is devoid of peace, probity, accountability, transparency and adherence to the rule of law. Therefore, education and the massive deployment of ICTs in all our operations and services are the antidote to poverty and ignorance, as well as the key to unlock national development.

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