

# Adoption of Cloud Computing in Government Institutions in Nigeria

Yusuf Jibrin Oyoyo \*, Prof. Rehema Baguma \*\*

\* School Of Computing And Engineering, Uganda Technology And Management University, Supervisor

\*\* A Research Dissertation Submitted To The School Of Computing And Engineering

In Partial Fulfillment Of The Requirements For The Award Of The Masters Of Science In Computing (Information Technology) At  
Uganda Technology And Management University (Utamu)  
Kampala Uganda

DOI: 10.29322/IJSRP.9.08.2019.p92102

<http://dx.doi.org/10.29322/IJSRP.9.08.2019.p92102>

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I Yusuf Jibrin Oyoyo declare that this Dissertation is my original work and has not been published or submitted for any other degree award to any other institution.

Signed: ..... Date: .....

YUSUF JIBBIN OYOYO (MSc. Comp IT)

SCHOOL OF COMPUTING AND ENGINEERING

UGANDA TECHNOLOGY AND MANAGEMENT UNIVERSITY

## APPROVAL

This Dissertation has been submitted for the approval from the following supervisor.

Signed: ..... Date: .....

Prof. Rehema Baguma (PHD)

SCHOOL OF COMPUTING AND ENGINEERING

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**Abstract-** The study is on how to increase uptake of cloud computing in government institutions in Nigeria. The study sought to answer three research questions for this study:

1. What are the requirements for increasing the uptake of cloud computing in government institutions in developing countries?
2. How can the requirements for increasing the uptake of cloud computing in government institutions in developing countries be realized?
3. How can improvement in the uptake of cloud computing in government institutions in developing countries be tested and validated?

Cloud computing is changing how technology as we know it. It is changing the way that organizations operate. It gives institutions small access to the best technology without having to invest much in it. It solves the problems related with the traditional computing. Cloud computing has opened new ways of using computing resources and capabilities.

The research was aimed at finding out uptake of the cloud computing within government institutions in Nigeria, the expected benefits, challenges faced when implementing the technology and the solutions to these problems. Primary data was collected from institutions that use cloud technology. The data collected was analyzed and collaborated against the secondary literature.

Though cloud computing solves problem of owning your own infrastructure but Internet connection is needed to have access to the intended service. In Nigeria, the communication infrastructure is a major challenge and it hinders the growth of the technology. Lack of stable power, wreckage of infrastructure, insecurity and lack of awareness are among the challenges that were highlighted as the major problems. These problems can be addressed by having qualified personnel to handle security challenges, investing more on communication infrastructure and awareness on what the technology is about among others. The future of cloud computing in Nigeria is bright

**Index Terms-** Cloud Computing, Cloud Service Providers, Government institutions, Private institutions, Nigeria

**Acknowledgements :** My special appreciation goes to my supervisor, Professor Rehema Baguma of Uganda Technology and Management University (UTAMU) without her guidance and support; this work would not have been successfully accomplished. She demanded excellence data's at every step of the study and without this the concept would not have grown to become a project.

I am particularly indebted to H.E Dr. Rabi Musa Kwankwaso, Hassan Alwi, and my Father Alh. Ubale Sarki, my Mother Maryam Ahmad Yakasai and my sisters, brothers and my friends for their supports and prayers, these peoples deserve my special recommendation for their contribution in the realization of this research project.

Finally I thank all those- lecturers, classmates, and colleagues at Utamu community- who in one way or another supported my cause; May you all be blessed.

**DEDICATION:** This project is dedicated to my wonderful friend Hassan Alwi (Resident Director IUEA) and former minister of defense of federal republic of Nigeria and two-time governor of Kano state H.E Dr. Rabi Musa Kwankwaso. There is not a doubt in my mind that without your support- materially, emotionally and spiritually- I would not have managed to complete my MSC COMPUTING.

My amazing Father Alh. Ubale Sarki Hotoro and my amazing mother Maryam Ahmad Yakasai; for the material and emotional support, thanks for all the entire family friends, brothers and sisters and the tough love that kept me focused to the very end.

#### LIST OF ACRYOMS

BCX	Business Connexion Limited
CEO	Chief Executive Officer
DIT	Diffusion of Innovation theory
Dr	Doctor
EC	Compute Cloud
ICT	Information Communication Technology
IDC	International Data Corporation
IPPIS	Integrated Payroll and Personnel Information System
IT	Information Technology
MSc. Comp IT	Masters In Computer Information Technology
MTN	Mobile Telephone Network
NCC	Nigeria Communication Commission.
NIST	National Institute of Standards and Technology
NITDA	National Information Technology Development Agency
PC	Personal Computer
PHD	A Doctor of Philosophy
Prof	Professor
SMEs	Small and Medium Enterprises
UTAMU	Uganda Technology And Management University
UTAUT	Unified Theory of Acceptance and Use of technology Theory
FIRS	Federal Inland Revenue Services
CSP	Cloud Service Providers
UTAUT	Unified Theory acceptance of use technology
EC2	Elastic Compute Cloud
SaaS	Software as services
Paas	Platform as services
IaaS	Infrastructure as services
AWS	Amazon web services
Maas	Messaging as a service
Spaas	sharepoints as a services
Laas	Linc as a service
GBB	Galaxy backbone

## I. INTRODUCTION

### A 1.1 BACKGROUND

Availability of quality IT infrastructure in developing countries is still a problem. Cloud computing as a new computing paradigm can now provide remote access to these resources. According to Greengard (2010), the emergence of cloud computing will change the stakes for entrepreneurs, small and large businesses, and researchers and governments. The 2013 IDC research established that worldwide spending on the growth is related to the countless benefits of the technology such as cost effectiveness. According to Haag and Cumming (Haag and Cumming, 2010), "cloud computing is a technology model in which any and all resources-application software,

processing power, data storage, backup facilities, development tool-, literally everything in the computing context are delivered as a set of services via the Internet". IDC estimated that the cloud market could reach \$150 billion in 2013 (IDC, 2009). However, some companies are skeptical about moving to the cloud but most of them believe that it is just a matter of time before they move to cloud because the benefits that the technology offers are too great (Andrew, 2013).

Gartner (2012) predicts that \$670 billion will be spent on cloud computing from 2013 to 2016, \$310 billion of this will be spent on the cloud technology. Ahmed Adesanya, Managing Director, Petrovice Resources International said, cloud computing is the next major driver of business innovation because it will transform the provision of IT services across all industries (Punch, 2013).

Cloud computing improves productivity as staff are not confined to the four walls of their office but rather they can work from anywhere over the Web, with the help of an Internet enabled computer device. Additionally, it enables access to the organization's services at anytime and anywhere instead of when the infrastructure is in house which limits staff access when the office closes. Furthermore, the cost of cloud computing is lower compared to the traditional environment (The Punch, 2013).

However, there are still concerns associated with use of cloud technology, chief of these is a security of an organization's data since with cloud computing such data is kept by a third party. Therefore, grounding in data security, safety and privacy is key when choosing a provider. Additionally, Laws and regulations that will protect the users on their outsourced data need to be enacted (The Punch, 2013). Cloud Computing is new in Nigeria and Africa as a whole. The Director General of National Information Technology Development Agency (NITDA), Prof. Cleopas Angaye said Nigeria is yet to tap into the benefits of this technology because of the number of challenges facing and confronting the nation's IT industry.

Business Connexion Limited (BCX), provider of Data Centre and Cloud Services in Africa recently launched its cloud computing services in Lagos (Eze, 2013). With a data center based in Ikeja, Lagos, it will offer Infrastructure as a Service (IaaS) Messaging as a Service (MaaS), SharePoint as a Service (SPaaS), Lync as a Service (LaaS) and Private Cloud to Enterprises and Government (Eze, 2013). Having the data center locally is expected to reduce the security concern customers have over the services and will keep the bandwidth costs at a minimum (Eze, 2013).

The CEO of BCX Benjamin Mophatlane, said that traditional Web hosting makes customers pay for fixed storage space and fixed amount of bandwidth when traffic to websites varies and bandwidth and storage needs fluctuate over time. With cloud computing, an organization will only pay for the storage and bandwidth used and not a fixed amount.

According to a recent survey by Symantec (2013), entitled avoiding the Hidden Costs of Cloud, a lot of companies are moving to the cloud to gain various advantages like speed and flexibility. The report also stated that nine out of ten enterprises in South Africa are using cloud computing.

According to Essien (2011), the ever growing IT needs of Digitized Nigerian businesses is the reason why companies are beginning to offer cloud computing services in Nigeria.

Globacom, MTN and Etisalat Telecommunication companies in Nigeria are in final stages of starting to offer cloud computing services. The Nigerian Government through the Galaxy Backbone, a government parastatal is offering cloud services to the government Ministries, Departments and Agencies (MDAs) as well as the private sector. They offer different services ranging from backup as a service, managed services to full cloud solutions (Galaxy Backbone, 2015). They offer different services ranging from backup as a service, managed services to full cloud solutions (Galaxy Backbone).

## 1.2 PROBLEM DEFINITION

There is need for guidance on how to systematically increase the uptake of cloud computing in developing countries given the enormous benefits of the technology.

Use of cloud computing is growing day by day at the expense of traditional IT service providers (Linthicum, 2013). The major drawback of the traditional IT environment is ease of scalability because IT staffs have to estimate the organization's needs, which may not be accurate (Goodenough, 2013). Therefore, an organization may end up with too much IT resources such as storage or not enough storage. Cloud computing solves this problem since you only pay for what you need and scaling up or down is very easy (Goodenough, 2013). As a result, investment in traditional IT environments is decreasing as cloud computing gets more popular due to the benefits it offers businesses and organizations. However, although cloud computing can greatly benefit government institutions both in developed and developing countries, its adoption in developing countries is still very low. Some of the key reasons given for the low adoption in developing countries include: unreliable power supply, lack of political will to support the growth of the ICT sector, corruption, poor Internet connectivity, limited required expertise, security concerns, lack of relevant policies, etc. (Mujinga and Chipangura, 2011; Mugeni, 2015). Nevertheless, most research today has mainly focused on benefits and challenges of cloud computing adoption in developing countries such as (Mujinga and Chipangura, 2011; Mugeni, 2015; Ahmad and Waheed, 2015; Omwensa, Waema and Omwenga, 2014; Mohammed, Zaharaddeen, Rumana and Taraki, 2015; Ilias, 2013). Not much has been studied about solutions for these challenges and or more importantly how adoption of cloud computing can be adapted in developing countries. The aim of this research is to examine the extent of cloud computing adaptation in government institutions in developing countries with the case study of Nigeria, and how this can be improved for the government and individual institutions to benefit more from the advantages of cloud computing.

## 1.3 SCOPE OF STUDY

The research is intended to examine the state of cloud computing in developing countries using Nigeria as case study and how its uptake can be increased in such countries in order for them to benefit more from the advantages cloud computing offers.

## 1.4 AIMS AND OBJECTIVES

The research is aimed at examining how the uptake of cloud computing can be increased in government institutions in developing countries, the specific objectives of the study are:

1. To collect requirements for increasing the uptake of cloud computing in developing countries like Nigeria
2. To design a model that provides guidance on how to increase uptake of cloud computing in developing countries.
3. To validate how use of cloud computing in developing countries like Nigeria can be increased?

## 1.6

## 1.7 RESEARCH QUESTIONS

The research questions for this study include:

1. What are the requirements for increasing the uptake of cloud computing in government institutions in developing countries?
2. How can the requirements for increasing the uptake of cloud computing in government institutions in developing countries be realized
3. How can improvement in the uptake of cloud computing in government institutions in developing countries be validated?

## 1.6 JUSTIFICATION

This study will provide an understanding of the benefits, status, and need on how the uptake of cloud computing in government institutions in developing countries can be increased. This will benefit both potential consumers and providers of cloud computing services as well as the general IT and research community.

he results will also be useful to the governments in developing countries that may have plans of rolling out Cloud Computing infrastructure and or services. It will also benefit government institutions responsible for formulating policies regarding technology innovations and adoption.

## II. LITERATURE REVIEW

This chapter covers a brief history of cloud computing and its paradigm, background of what cloud computing is, its models, characteristics, advantages and disadvantages and all the theoretical aspects with briefly talk about the state of cloud computing in Nigeria. It will also cover cloud computing adoption challenges, proposed solution and the extent the proposed solution can or cannot work for Nigeria.

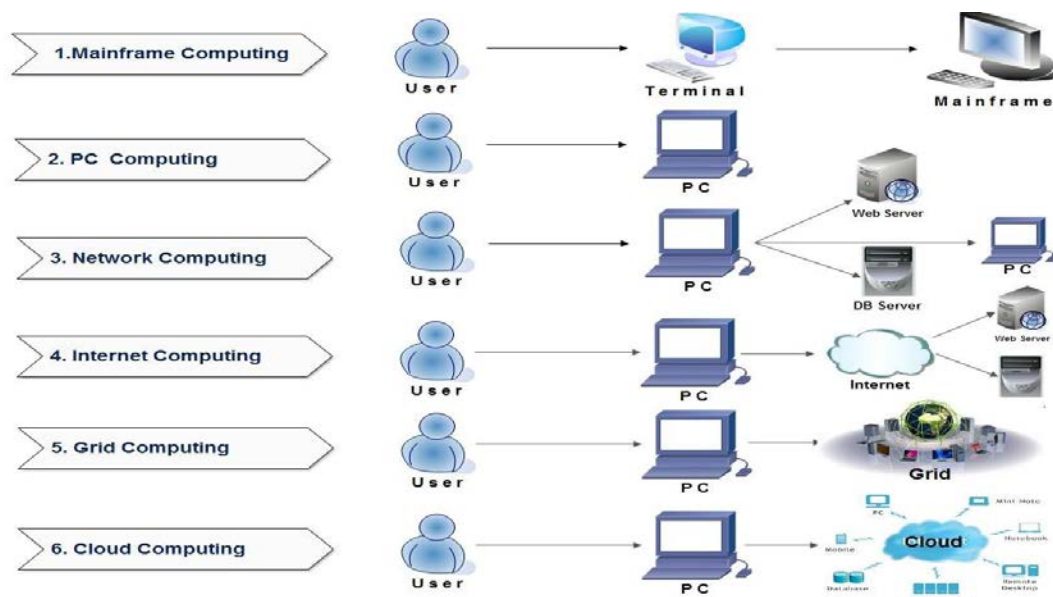


Figure 2.1: Six computing paradigm (Voas and Zhang, 2009).

## 2.1 EVOLUTION OF CLOUD COMPUTING

Cloud computing is not new to the IT world; it can be discovered back to the 1960s when it was identified or known as “Utility Computing”. The understanding of the technology and different ways of its application is what has changed over the decades. John McCarthy MIT computer scientist introduced the terminology, the concept was that computing will one day be a metered service as you pay for what you use only (Cornerstone Guide to Cloud Computing Best Practices, n.d.).

Amazon also played a key role in development of cloud computing by improving their data center. Amazon Web Service (AWS) was launched in 2002 and in 2006 Amazon’s S3 and Elastic Compute Cloud (EC2) were launched with the later been a web service that

admit and allows SMEs and individuals to use Amazon's computers to run their own applications and the former pricing model been pay-per-use (Shamelle, 2013).

Figure 2:2 shows the evolution of cloud computing over the years. In the 1990s, significant infrastructure is required and there is CAPEX and in 1999 SaaS vendors (Salesforce.com) is emerge as enabling broader adoption of the technology. Later Cloud Connected Data Management evolved we are now presently in a time of pure cloud applications and infrastructure services.

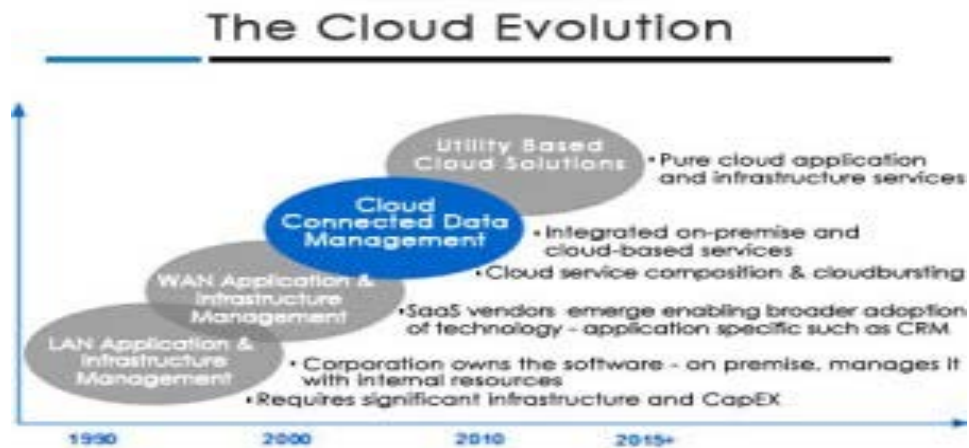


Figure 2:2 Evolution of Cloud Computing (Shamelle, 2011)

## 2.2 DEFINITION OF CLOUD COMPUTING

Cloud computing has many definitions; different organizations have their own ways of defining the technology. Below are some of these different definitions:

One of the most used definition of cloud computing is the definition of National Institute of Standards and Technology (NIST). They define cloud computing as: "Cloud computing is a model for enabling ubiquitous, 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" (Mell and Grance, 2011).

Gartner defines it as: "Cloud computing is a style of computing in which scalable and elastic IT-enabled capabilities are delivered as a service using Internet technologies" (Gartner.com, 2009).

Forrest Researcher definition of cloud computing is: "A standardized IT capability (service, software, or infrastructure) delivered via Internet technologies in a per-pay-use, self-service way" (J. Staten, 2009).

International Data Corporation (IDC) its definition is; "an emerging IT development, deployment and delivery model, enabling real-time delivery of products, services and solutions over the Internet" (Gens. 2008).

Microsoft research refers to it as variety of services available over the Internet that delivers compute functionality on the service provider's infrastructure (Microsoft Research).

Cloud computing it can also be defined as the use of computer technology that harnesses the processing power of many inter-networked computers while concealing the structure that is behind it (Cornerstone Guide to Cloud Computing Best Practices)

## 2.3 CHARACTERISTICS OF CLOUD COMPUTING

**2.3.1 ON-DEMAND SELF SERVICE:** One can easily request a service over the Internet when needed without physical interaction with each other service provider.

**2.3.2 UBIQUITOUS NETWORK ACCESS:** Services are available and can be accessed through a range of devices (phones, tablets, PC etc.) and from anywhere in the world.

**2.3.3 RESOURCE POOLING:** Resources are pooled in order to cater to multiple customers using a multi-tenant model with different physical and virtual resources dynamically allocated and reallocated in respect to the customer requirement. The customer generally has no control or knowledge of the precise location of the resource been provided except when identified at a higher level of abstraction (P. Mell and T. Grance, 2011).

**2.3.4 RAPID ELASTICITY:** Resources can easily be increased or decreased to cater to customer's demand, for a customer the capability appears to be unlimited and it can be appropriated in any quantity and at any given time and place.

**2.3.5 MEASURED SERVICE:** The service been used is measured, resource usage can be controlled, monitored, and reported providing transparency for both the service provider and customer of the utilized service. A customer is charged for what one uses (Mell and Grance, 2011).

**2.4 ARCHITECTURE AND DEPLOYMENT MODELS** Architectures and deployment models for cloud computing can be broadly into the following service models:



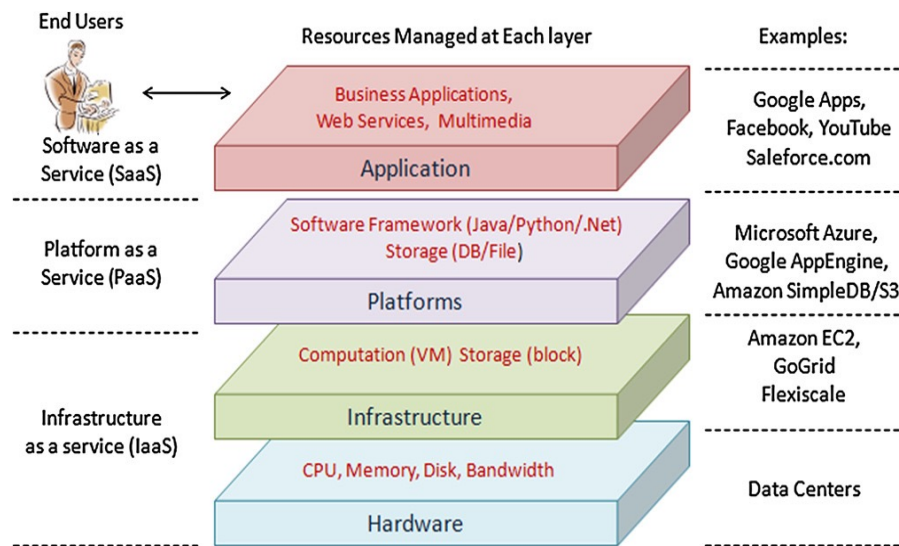


Figure 2:3 Categories of cloud computing services (Hofer & Karagiannis, 2011).

**2.4.1 SOFTWARE AS A SERVICE (SaaS):** This is a type of service provided where a customer uses an application running on a cloud infrastructure. The software can usually be used either through a web browser or a program interface. The customer does not have a say and is not in charge of the underlying infrastructure with the possible exception of limited user specific on application configuration settings (Mell and Grance, 2011).

**2.4.2 PLATFORM AS A SERVICE (PaaS):** The service offered to the customer is to deploy onto the cloud infrastructure the application the customer created using libraries, programming languages, tools and services supported by the cloud provider. The customer does not manage or control the underlying cloud infrastructure but the customer has control over the application deployed and possibly limited control of select networking components (e.g., host firewalls)

**2.4.3 INFRASTRUCTURE AS A SERVICE (IaaS):** The capability offered to the customer is to enable storage, processing, networks and other essential computing resources where the customer is able to deploy and run different software which can include operating system and applications. The customer does not manage or control the underlying infrastructure but has control over operating systems, storage and deployed applications and possibly limited control of networking components (e.g., host firewalls) (Mell and Grance, 2011).

## 2.5 DEPLOYMENT MODELS

Cloud services can be used in the following deployment models;

- 1.5.1 **PRIVATE CLOUD:** It is a type of model where the cloud infrastructure is owned by a particular organization, it may be owned, managed and controlled by the organization or a third party and it can be either on or off premises.

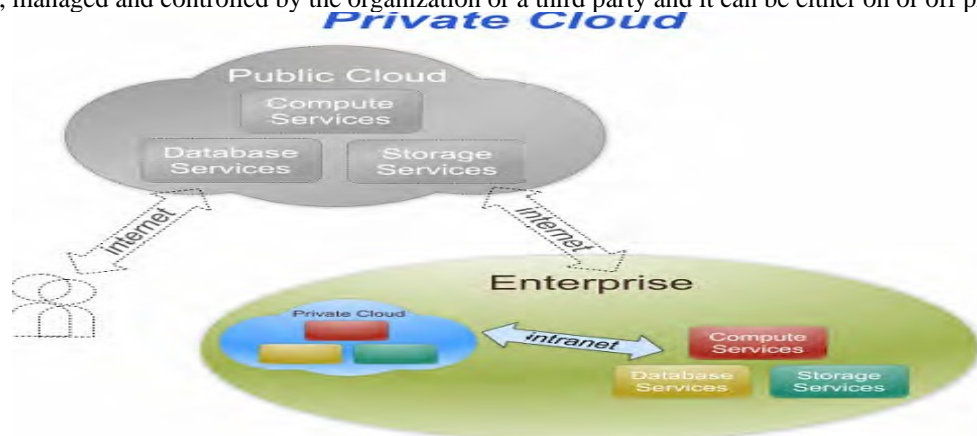


Figure 2:4 Private Cloud (Dustin et al., 2010)

- 1.5.2 **PUBLIC CLOUD:** it is the opposite of private cloud. In public cloud the infrastructure is open to the public, and is been used by individuals, organizations and government. It is owned, managed and controlled by the service provider and it is located on the premises of the provider (Mell and Grance, 2011).

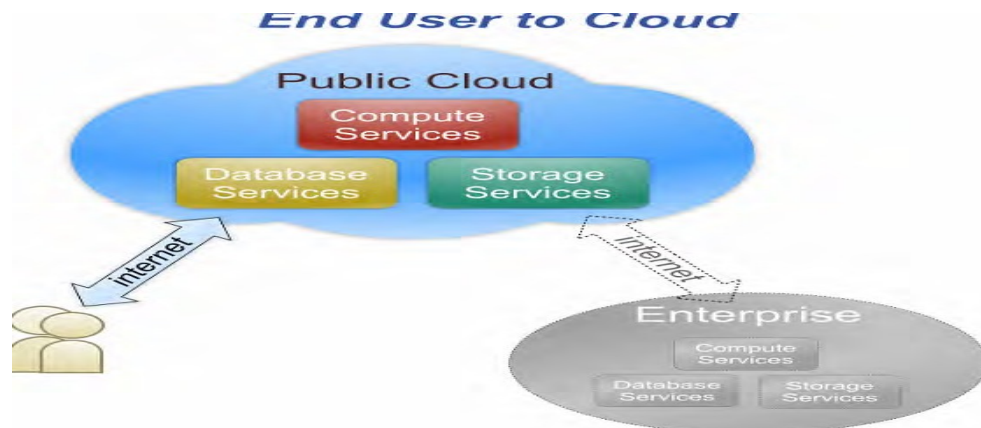


Figure 2:5 Public Cloud (Dustin et al., 2010)<sup>[SEP]</sup>

- 1.5.3 **COMMUNITY CLOUD:** The cloud infrastructure is provisioned for a group of organizations that have similar/shared concern (e.g., mission, policy, compliance considerations and security requirements). It may be owned, managed and controlled by one or more of the organizations or a third party and it may exist on or off premises.



Figure 2:6 a community cloud (Prasad et al., 2013).

- 1.5.4 **HYBRID CLOUD:** The cloud infrastructure is a combination of two or more distinct cloud infrastructures (private, public or community) that remain separate entities but are bound together by a standardized or proprietary technology that allows data and application portability (Mell and Grance, 2011).

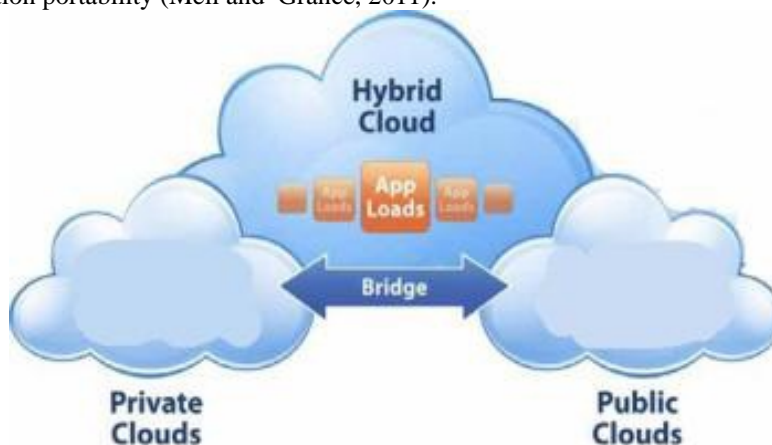
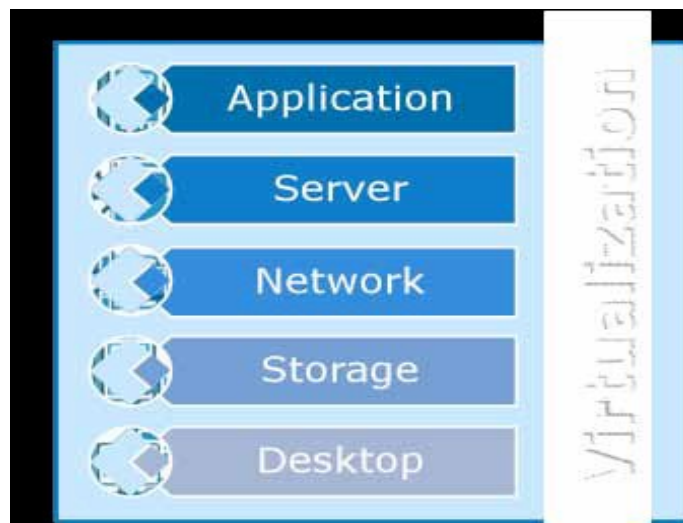


Figure 2:7 Hybrid Cloud (Prasad et al., 2013).

## 2.5.2 VIRTUALIZATION

Apart from computer and an Internet connection, virtualization is the most important technology, which allows Cloud Computing to reach its full potential (Böhm et al, 2009). Thanks to virtualization a physical server can be divided into several virtual servers, this way an entirely new service emerges (Zhang et al, 2010). These virtual servers are called “virtual instances” (Zhang et al, 2010). Accordingly, the IaaS vendor could sell two different basic options: the rent of the physical servers and the rent of these virtual instances (Mazzuco and Dumas, 2011). Although these two options are able to accomplish the same functions, there are some differences, for example the virtual instances are cheaper since it is not necessarily the physical server but they are also seen as less secure than the physical servers (Barnatt, 2010).



*Figure 2:8 Types of Virtualization (Petri, 2010)*

## 2.6 BENEFITS OF CLOUD COMPUTING

Cloud computing offers various advantages both to end users and businesses of all sizes. The obvious huge advantage is that you no more have to support the infrastructure or have the knowledge necessary to develop and maintain the infrastructure, the development environment or application, as were things up until recently. The burden has been lifted and someone else is taking care of all that. Businesses are now able to focus on their fundamental business by outsourcing all the hassle of IT infrastructure ( Ilias, 2013). Here are some of the advantages that cloud computing has to offer.

**2.6.1 COST EFFECTIVENESS:** The main and one of the most important advantages of cloud computing is that it eliminates the cost of owning the infrastructure needed to run the organization. Licensing fees, cost of maintenance, software update etc. is saved as well as it is better and cheaper than the traditional approach; it is easily scalable and allows organizations to concentrate on their core business function to add value (Ilias, 2013).

**2.6.2 CONVENIENCE AND CONTINUOUS AVAILABILITY:** Public clouds offer services that are available wherever the end user might be located. This approach allows easy access to information and accommodates the needs of users in different geographic locations. As a side benefit, collaboration booms since it is now easier than ever to access, view and modify shared the documents and files.

Furthermore, service uptime is in most cases guaranteed, providing in that way continuous availability of resources. The different cloud vendors typically use multiple servers for maximum redundancy. In case of a system failure, alternative instances are automatically spawned on other machines.

**2.6.3 BACKUP AND RECOVERY:** Is the process of backing up and recovering data that is simplified since those now reside on the cloud and not on a physical device. The various cloud providers offer reliable and flexible backup/recovery solutions. In some cases, the cloud itself is also used solely as a backup repository of the data located in local computers (Ilias, 2013).

**2.6.4 RESILIENCY AND REDUNDANCY:** A cloud deployment is usually built on a robust architecture, even though it providing resiliency and redundancy to its users. The cloud offers automatic failover between hardware platforms out of the box, while disaster recovery services are also often included.

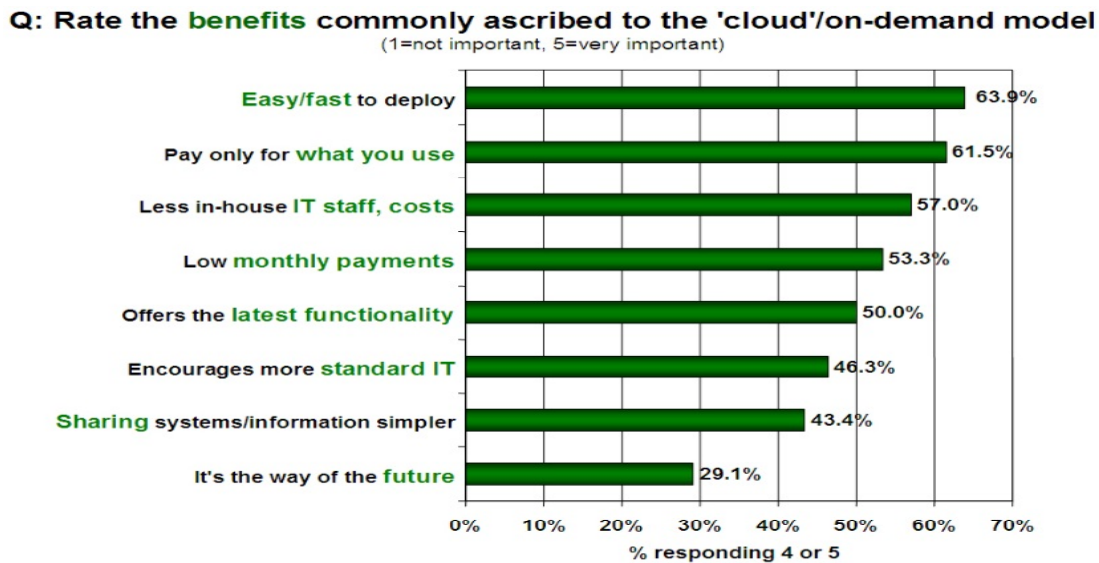
**2.6.5 SCALABILITY:** The Scalability is built in feature for cloud deployments. Cloud instances are deployed automatically only when needed and as a result, you pay only for the applications and data storage you need. Hand in hand, it also comes elasticity, since clouds can be scaled to meet your changing IT system demands.

**2.6.6 QUICK DEPLOYMENT AND EASE OF INTEGRATION:** The cloud system can be up and running in a very short period, making quick deployment a key benefit. On the same aspect, the introduction of a new user in the system happens instantaneously, it eliminates waiting periods.

Furthermore, software integration occurs automatically and organically in cloud installations. A business is allowed to choose the services and applications that is best and suit their preferences, while there is minimum effort in customizing and integrating those applications (Ilias, 2013).

shows the rate of benefits of cloud based on a survey conducted by International Data Corporation in 2009. It shows that the easiness and fast deployment of cloud services is ranked as the biggest benefit of the technology followed by you pay for what you use. While “sharing system/information simpler” and “it’s the way of the future” got the least rating among the benefits of the technology.





*Figure 2:9 Benefits of Cloud/On-Demand Model (IDC, 2009)*

## 2.7 CHALLENGES OF CLOUD COMPUTING

Despite its numerous advantages mentioned above, it also has some disadvantages and some of these challenges are as follows

**2.7.1 SECURITY AND PRIVACY:** Security is the biggest concern when it comes to cloud computing. By leveraging a remote cloud based infrastructure, a company essentially gives away private data and information and things that might be sensitive and confidential. It is then up to the cloud service provider to manage, protect and retain them, thus the provider's reliability is very critical. A company's existence might be put in risk; so all possible alternatives should be explored before a decision. On the same note, even end users might feel uncomfortable for surrendering their data to a third party.

Similarly, privacy in the cloud is another huge issue. Companies and users have to trust their cloud service vendors that they will protect their data from unauthorized users. The various stories of password leakage and data loss in the media don't help to reassure some of the most concerned users (Ilias, 2013).

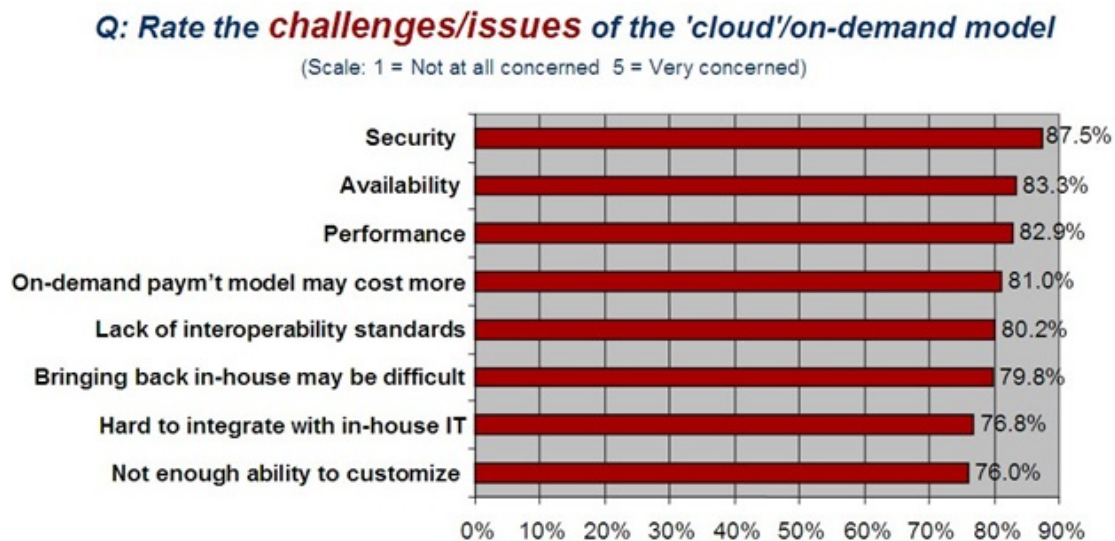
**2.7.2 DEPENDENCY AND VENDOR LOCK-IN:** One of the main disadvantages of cloud computing is the implicit dependency on the provider. This is what is called "vendor lock-in" since it is difficult, and sometimes impossible, to migrate from a provider once you have rolled with him. If a user needs to switch to some other provider, then it can be really painful and cumbersome to transfer huge data from the old service provider to the new one.

**2.7.3 TECHNICAL DIFFICULTIES AND DOWNTIME:** Certainly the smaller business will enjoy not having to deal with the daily technical issues and will prefer handing those to an established Information Technology companies, however one should keep in mind that all systems might face dysfunctions from time to time. Outage and downtime is possible even to the best cloud service providers, as the past has shown. Furthermore, one should remember that the whole setup is dependent on Internet access, thus any network or connectivity problems will render the setup useless (Ilias, 2013).

**2.7.4 LIMITED CONTROL AND FLEXIBILITY:** Since the applications and services run on remote, third party virtual environments, companies and users have a limited control over the function and execution of the software and hardware.

**2.7.5-INCREASED VULNERABILITY:** Related to the security and privacy mentioned before, note that cloud-based solutions are exposed on the public Internet and thus are more vulnerable target for malicious users and hackers. Nothing on the Internet is completely secured and even the biggest companies suffer from a serious attacks and security breaches. Due to the interdependency of the system, if there is a compromise one of the machines that data is stored, there might be a leakage of personal information to the world (Ilias, 2013).

shows the rate of challenges of cloud based on a survey conducted by IDC. It shows that security concern is the issue that the participants are most concerned about it and then followed by availability, which is the second problem that is of concern. While "hard to integrate with in-house IT" and "not enough ability to customize" are of least concern as compared to other challenges.



*Figure 2:10 Challenges of Cloud/On-Demand Model (IDC, 2009)*

## 2.8 CLOUD COMPUTING IN DEVELOPING NATIONS

Despite all the benefits and growth of cloud computing over the year, the same cannot be said in the developing world. Very few companies and organizations are rushing to use cloud computing despite its several benefits in the developing world. Cloud computing is one of the most fascinating technologies around today but is it also the most alarming. Though the benefits of cloud computing are clear, many individuals and companies have their doubts and concerns about this form of computing. On top of these doubts about cloud computing is about security concern (Ume and Bassey et al., 2012).

Users feel that they are not been given any guarantee on safety of cloud computing. Cloud platforms that can meet their requirements need to be even more credible and convincingly safe (Kuyoro and Ibikunle et al., 2011 cited in Ume and Bassey et al., 2012).

However, cloud computing is safe and the misconception that it is not is due to ignorance and lack of a general understanding of what cloud computing is. The term by itself does not really explain what it actually is and people do not explain it well as so people misunderstand what it is and develop fear of the unknown. For example Microsoft have multiple data centers across the globe and they all back up one another, so on the possibility of something happening to one of the data centers, the data is replicated across the globe. Microsoft is so certain of their systems that they pledge a 99.9% financially backed uptime for all their customers, so most of concern about cloud computing are due to people's misunderstanding of the technology (Ana, 2011).

### 2.8.1 CLOUD COMPUTING IN AFRICA

Cloud computing has the ability to solve Africa's problem of lack of IT infrastructure that can cater for the needs of the population. The technology is suited for the continent because you do not have to own, manage and maintain the infrastructure; one can just rent it as a service. This can easily been achieved though only if two problems that hinder the growth of cloud computing across the continent are addressed. The two main concerns are lack of e-communication infrastructures (network coverage) and lack of stable power supply (Cloud Computing in Africa Situation and Perspective, 2012).

The Hedera Technology Consultancy firm report on the state of Internet in Africa identified lack of required investment in communication networks as the root reason why Africa has a poor network quality, because it is hard to follow the clauses that ensure quality levels and access speeds for cloud services. However, ICT usage across the continent is growing and aiding the growth of the economies, therefore the needed investment will be made to ensure the sector provides the benefits it has to offer (Cloud Computing in Africa Situation and Perspective, 2012).

Web traffic in Africa comes mostly from mobile phones compared to fixed lines. Africa has the highest number of web traffic that comes from mobile than fixed line in the world. According to Stat counter (2012), in Nigeria 57.9% of web traffic comes from mobile technology while Zimbabwe 58.1% and Zambia 44% as compared to 10% average across the globe. This is expected to continue and mobile Internet traffic is expected to grow up to 25 fold over the next four years (Sub-Saharan Africa Mobile Observatory, 2012). In South Africa, what is offered is nothing more than a normal remote hosted service and not really cloud computing as advertised in the market says Grant Vine, Technical Director at Cybervine IT Solutions. Cloud computing has lots of benefits and its cost effective but in the South Africa, hosted services offered are stagnant; a customer signs an agreement with a service provider for a certain service over X years with Y capacity. Whether the customer has used the service up to that capacity or not he pays the same amount which is not cloud computing (Itnewsafrica.com, 2013).

There are serious privacy issues when it comes to cloud computing in the developing world. A company has entrusted its information and as well as data to another company, which has continuous access to the information and data. Accidents can happen or

intentional the tampering of the information may occur and the information may be used for things that haven't been authorized by the users. This is making some people take long to take up cloud computing (Ume and Bassey et al., 2012).

Usually users want to have access to their data whenever they need it. Traditionally, people have flash drives and they move around with it to be able to access their data when they want to by just plugging it into a USB port. In developing countries like Nigeria the issue with data availability is that when there is no Internet connection it is the same as having a denial of service. The continuous problem faced by power failure across the country is not helping matters even among the computer literate people. Despite cloud computing being able to serve as a storage medium with data access from anywhere and anytime, if the network is not assured places like Nigeria will always be left behind as long as the status quo prevails (Ume and Bassey et al., 2012).

#### **2.8.1.1 CLOUD COMPUTING IN NIGERIA**

Nigeria is a developing country with huge resources and is the most populous nation in Africa. Nigeria has a lot of challenges that the researcher believes cloud computing will help solve some of these problems. An example of a problem that cloud technology can help solve is the lack of sound IT infrastructure facing the nation, cloud computing can solve this because with cloud computing, one does not have to buy the infrastructure but rather rent it as a service over the internet.

The Federal Government estimated to have spent N19.4 billion (\$121. 25 million) on data center in 2011 alone according to Omobola Johnson, Minister of Communication Technology. She stated it is not sustainable and ways must be adopted to reduce and manage it better in the face of growing Information Communication Technology usage. She added that the Federal Government plans to adopt cloud computing services in order to cut cost of ICT infrastructure. The government's is building of a cloud infrastructure for Ministries, Departments and Agencies (MDAs) are aimed at not only saving cost but also driving efficiency and productivity across MDAs (Businessdayonline, 2012).

The use of the technology is starting to yield result in the workings of its Integrated Payroll and Personnel Information System (IPPIS). The application is used to manage civil servants' identification and payroll in a cloud, which are more efficient and effective way on and it has saved the federal government a lot as compared to the manual process, used earlier (Businessdayonline, 2012).

EMC Regional Manager for West Africa, Rasheed Jimoh said the time is right for Nigeria to embrace cloud computing (jimoh, 2012).

Telecommunication companies in Nigeria are investing in data center infrastructure to benefit from what a cloud computing will to offer. Globacom, a telecommunication company is planning on building a 40,000 square feet data centre, this comes after completing a 2,000 square feet data center already. MTN Nigeria another telecommunication company has opened a 500 square meters data center, aimed at offering cloud services to small and medium enterprises (SMEs) across the country. For instance, Airtel launched its 1858 square meter data center in 2012 to cater to its subscriber base (BizWatchNigeria.com, 2013).

However, a recent survey of more than 50 chief executives and IT managers of 10 companies conducted in key state capitals in Nigeria showed most of them are unwilling to outsource even the applications that comprise less sensitive information. They still prefer their in-house infrastructure largely due to the fact that they fear not having control of their data and systems. The few that agreed said they will only consider it after a thoroughly analyzing the risk of dealing with the third party and will also do it in phases with one or two application or process to start with. All agreed that fear and the fact that people don't really know what the technology really is; are the main obstacle to the growth and adoption of the technology (Ume and Bassey et al., 2012). Therefore, there is need for sensitization and awareness of institutions and individuals that can benefit from use of cloud computing about what it is, its benefits, potential drawbacks and solutions and ways it can be used.

#### **2.8.1.2 CHALLENGES FACING ADOPTION OF CLOUD COMPUTING IN NIGERIA.**

Status of key infrastructure in Nigeria <sup>[1]</sup>One of the key challenges cloud computing faces in Nigeria is lack of adequate infrastructure on which the cloud services are to run. Major infrastructure that supports cloud services such as electricity; fast, reliable and affordable Internet connectivity; network backbone and so on are very limited in Nigeria. And even when available it is unreliable and present only within major cities leaving many rural areas and smaller cities in the dark. The poor state of electricity in Nigeria is undesirable for data center providers who will rather partner or establish their data centers abroad as this often is cheaper for them than incurring huge cost providing private electricity through generators. And many consumers and third-part vendors in Nigeria are more comfortable buying data center services from data center providers who are either located abroad in countries with more reliable infrastructure or who have their data center backup situated abroad. Ogunraku (2014) reported that even the very few data centers that are located in Nigeria are mainly situated in Lagos which has better network backbone connectivity and closer to the various under sea Internet cables including Main One and GLO 1 cables (Purefoy, & Kermeliotis, 2012). The in-country network backbone connectivity in Nigeria is still very poor implying that most other states in Nigeria lack direct connection to the under sea Internet network.

Backbone networks play major role in the delivery of ICT services including cloud services in all countries. And it contributes a huge portion of the total cost incurred by network providers to their overall cost. And in a country with very vast geographical spread like Nigeria the cost of providing broadband connectivity per subscriber is very high. This cost is much lower per subscriber in cities like Lagos and other densely populated cities compared to rural areas and cities with sparse population (Williams, 2010). As mentioned earlier most of the major broadband infrastructure (WACS, Main-one and Glo 1 fiber optic Cables) are sited in Lagos except for Nigcomsat -1R which is satellite. And these infrastructures are not adequately spread to other cities due to lack of domestic backbone networks. This lack of domestic network infrastructure is the major problem inhibiting the growth of broadband. Some states including the Federal Capital Territory have fiber networks within the state but there are very limited connections between fiber networks from

one state to another. According to the Former Nigeria Minister of Communications Technology, Omobola Johnson, Internet penetration is still very low with broadband penetration even lower (Chidiebere, 2013). And where there is connectivity between states it is only between state capitals. In a nutshell there is the absence of long distance national backbone to carry and distribute the capacities provided by the submarine cables mentioned above to the users in offices, schools, and homes in the hinterland across Nigeria (Olusola & Olajojoyetan, 2013).

Other challenges facing cloud-computing services in Nigeria<sup>[1]</sup> Some of the problems identified as hampering the growth of broadband and by extension cloud computing services in Nigeria is the very high cost of obtaining right of way (inclusive of cost involved in settling government officials, the cost of settling various indigenous owners of the land where the infrastructure will pass through and long delays in procuring the right of way permits). This cost invariably causes the cost of leasing transmission infrastructure to be high. The high cost of investment in last mile broadband infrastructure leads service and infrastructure providers such as the telcos to concentrate only in major cities. Frequent vandalization of broadband infrastructure by hoodlums leaves undesirable financial burden on owners of telecommunication infrastructures. Other challenges include multiple taxation on the part of the federal, state and local governments; weak regulation in some case, incessant disruption due to road works and huge cost of providing alternative electricity to power telecommunication equipment (Olusola & Olajojoyetan 2013).<sup>[2]</sup> Consequently Internet penetration in Nigeria is very poor due to inadequacy of this infrastructure. And where available the cost is quite high. According to the Nigeria Communications Commission there over 85 million Nigerians with access to the Internet as at March 2015. This figure is calculated by adding up all the Internet subscribers per telecommunication operator. This figure may not be very accurate as many Nigerians own more than one phone line, so there may be issues of double counting. The US Census Bureau (2014) suggests that Internet penetration in Nigeria is 33 percent. If this figure by the US Census bureau is correct it means that Internet penetration in Nigeria is low when compared to other African countries especially Morocco, Egypt, Tunisia and South Africa.

The cost of supporting cloud infrastructure and services in Nigeria is still quite high and limited. There are no manufacturing or assembly plants in Nigeria for cloud equipment. This implies that every equipment that is used for cloud deployment is imported from outside the country. It further implies that when a device is faulty it has to be ordered abroad or procured from a vendor who of course buys abroad. Furthermore, there are not many qualified engineers who can install and support cloud infrastructures. For there to be massive deployment and support of cloud services Nigeria will need more trained and qualified engineers that understand how to install, manage and support cloud infrastructures. Presently most of the functional data centers in Nigeria are setup, managed and maintained by expatriates (Dahunsi & Owoseni, 2015).

There is limited investment by both private and public sector investors in ICT infrastructure. Odufuwa (2012) observed a decline in the investment made by some of the telecommunication providers in Nigeria. This is attributable to recent insecurity, which has led to the destruction of many telecommunications infrastructures. Another factor that could have been responsible for this poor level of investment could be recent instability in the political system and furthermore the decline in the price of oil and other economic parameters have not been very encouraging to investors.

Lack of adequate awareness has also been identified by Awosan (2014) as a major issue affecting the adoption of cloud computing in Nigeria. The research carried out by Awosan (2014) revealed that 89.1 percent of the research respondents are of the view that lack of proper awareness of the workings and benefits of cloud computing was responsible for its poor adoption. The people interviewed also corroborated this view. The research also revealed that many small businesses in Nigeria have employees that lack the requisite skills to operate basic ICT tools including cloud applications. And many business owners do not want to invest in upgrading the skills of these personnel for several reasons including cost of training and fear that the employees may end up leaving the organization abruptly (Awosan, 2014). So lack of skills to manage these applications and business owners not seeing real value in automating their processes are huge challenges working against the adoption of cloud based solutions among many Nigeria. Some of these businesses especially the small ones do not have enough sales to justify the use of cloud computing applications as making such a purchase in their view may wipe away their bottom line. And possibly quite a good number of them do not understand how business automation can help make their business more efficient, improve sales, help manage customers and reduce waste. Lack of stability of power supply has been identified as factor that can cause both loss of data and inability to access cloud services. In essence consumers may not be able to access cloud services always and even when they do sudden loss of power supply can cause loss of data (Greengard, 2010). Another major problem limiting the ready adoption of cloud services is the high cost of bandwidth required to transfer data through the Internet especially when working with data intensive applications (Otuka, Preston, & Parmenides, 2014). Furthermore, unreliability of Internet services due to several factors including low bandwidth capacity is also a militating factor (Leavitt, 2009). There is also the lack of confidence on the part of organization on the overall reliability and consistency in the quality of service provided by cloud service providers over a long term (Otuka, Preston, & Parmenides, 2014). Some organizations especially large organizations may not be too comfortable entrusting their IT services to cloud service providers for fear of down time. They may not be sure if the cloud services provider will guarantee optimal performance for their mission's critical business. This view is supported by Carr (2005), who rightly opined that one of the major impediments to the adoption of cloud computing will not be technology but attitude of end-users towards cloud computing. Marston et al., (2011) observed that some applications may not be currently sustainable to be implemented as cloud service but may therefore need to interact with other cloud based applications a process that may pose challenge both in terms of contractual and support issues. Due to the nature of cloud computing services some organizations may be skeptical in adopting the service, as they do not have "control" as such over the information and supporting infrastructure. And some may also be worried about vendor location due to lack of standards or the vendor even completely going out of service.



Awosan (2014), Qamar et al (2010) and Otsuka, Preston, & Parmenides, (2014) pointed out that issues of security, privacy and lack of standards are some of the major concern in cloud computing. From the research carried out by Awosan (2014) Chief Information Officers in selected organizations in Nigeria are of the view that cloud service adoption is considered risky due to insecurity and lack of privacy. Likewise the research by Otuka, Preston, & Parmenides (2014) especially from the focus group part discovered that security and privacy issues were seen as major impediments to cloud computing adoption in Nigeria. Furthermore they found out that lack of standards governing ICT use in general in Nigeria is a key problem to the adoption of cloud services by organizations.

The insecurity facing Nigeria presently affects their organization as well; when their infrastructure or that of their providers or partners has been tampered with it affects their ability to provide connectivity services: We do have downtime to deliver connectivity services due to fiber cuts on our networks or our upstream provider said the organization's staff.

### **2.8.1.3 SOLUTION TO THE CHALLENGES**

1. **High Cost of Internet:** The Nigerian Communications Commission, (NCC) has assured that the availability of new infrastructure companies in the telecoms sector would reduce high cost of internet services.

NCC's Director of Public Affairs, Tony Ojobo stated this in Lagos during the 4th edition of Nigerian entertainment conference.

According to him, new players in the industry would provide an enable environment for competition which drastically will reduce price of internet charge.

He said the reason why internet charges are costly was because of the deficit of infrastructures companies.

Ojobo said this informed the commission's commitment to ensure competitive bid for the auction of the 2.6Hz for broadband infrastructure deployment broadband.

He said, "We envisaged that with the licensing of new infrastructure companies fondly called infracos as well as broad band providers, price reduced."

He stated that what determines price in the market is the numbers of competitors of that same good. "Competition drives down price in the market; it is not by regulating price but by introducing more competitors in the market", he said. Ojobo (2016)

### **2.8.1.4 REQUIREMENT FOR THE UPTAKE OF CLOUD COMPUTING IN GOVERNMENT INSTITUTIONS IN NIGERIA**

The requirement to make cloud computing the next big thing in Nigeria can properly be achieved through the active participation of all involved stakeholders. These include the cloud service providers, the government institutions at all levels, telecommunication infrastructure providers, financial institutions among others. Government on its part should put more effort in developing and propagating the adoption of ICT in Nigeria. It should ensure the development of basic infrastructure such as stable electricity supply. This can be achieved in collaboration with private sector investors in the area of electricity generation, transmission and distribution. With such infrastructure in place other investors in the ICT sector will be encouraged to make more tangible investment in cloud computing facilities and indeed other ICT infrastructures that will one way or the other support cloud computing. With stable and efficient power supply, organizations that are into the provision of cloud computing services will invest in the establishment of data centers in Nigeria. This will decrease the cost of accessing cloud services and also improve the speed of access, as the consumers will be able to access the services in country instead of accessing it from a distance country. Furthermore, promoting the establishment of more inclusive and robust network infrastructure will bring about increase in the use of broadband services. The current state of network backbone infrastructure in Nigeria is still very limited not covering most sections of the country thereby making the reach of broadband very poor and where available not adequate. Government either working alone or in partnership with private sector investors by proving the necessary enabling environment should aggressively pursue the extension of current ICT network backbone across the country (Dahunsi & Owoseni, 2015).

The establishment of manufacturing plants for ICT equipment especially the equipment that are used in cloud computing will help reduce the price of these items and invariably the adoption of cloud computing (Dahunsi & Owoseni, 2015). Investment in such manufacturing plants should be embarked upon by private sectors. On government's part it can provide the enabling environment including tax relieves to private sector investors to encourage them to setup such manufacturing plants. The private sector investors should be bold enough to make necessary investments in setting up manufacturing plants. They should take special consideration to the over 100 million prospective consumers and the over 17 million micro businesses that can potentially become small and even medium size enterprises.

There should be increased advocacy on the use and benefits of cloud computing to organisations. Many organisations are not entirely aware of the real effect automation can bring to their bottom line. Letting them know how automation can help improve sales, manage customers; track inventory and so on will surely help encourage the adoption of cloud computing services. Government and cloud computing service providers can also go further to give incentives to organisations that adopt the use of basic cloud computing services in their activities. For instance organisations can be given free tutorial on how to migrate to cloud services and service providers should also consider giving free trial for a given period of time to try out cloud services. Increased availability of more cloud computing service providers will also aid adoption. This will help address the issue of inaccessibility and in the long-term reduce cost and bring about improvement in cloud services due to competition among cloud service providers. Development of innovative cloud solutions that are suitable for government institutions in Nigeria, such as CliniPak (West, 2015) a mobile healthcare solution currently in use in Nigeria will ultimately help improve cloud services adoption. Similar solutions should be developed for the various sectors in Nigeria in simple to use and affordable manner.

More focused research should be geared towards improving cloud computing infrastructure and services. Private sector organizations can sponsor research institutions either through grants, scholarships etcetera to carryout research work that will help

improve cloud-computing services in Nigeria. Such research can include looking at ways of improving present services, manufacturing new hardware equipment and software applications. Dahunsi & Owoseni (2015) suggest that universities can be encouraged to establish cloud network laboratory in their institutions to teach regular students and organizations that may wish to send their employees to learn specific skills on the provision, management, support and deployment of cloud computing services.

Regulation including enforcement of data protection laws and all other intellectual property rights protection regime should be adequately enforced. Nigeria is a member of WIPO and is signatory to all the major IPRs treaties but the problem has always been the enforcement of the relevant laws. Fully enforcing such laws will give users the confidence to adopt cloud computing services including allowing their vital data to be warehoused in a data center knowing that their data will be adequately protected. And where there is a breach they can easily get the relevant government authorities to take necessary action including getting redress from the legal system. Having a sound regulatory system that ensures that service providers keep to their side of the bargain and deliver proper services with minimal downtime will be a huge source of encouragement to organizations to adopt cloud-computing services.

There's a need to increase security in Nigeria which will help the organization as well as their infrastructure or that of their cloud service providers or partners that has been tampered with it affects their ability to provide connectivity services: We do have downtime to deliver connectivity services due to fiber cuts on our networks or our upstream provider said the organization's staff.

### III. METHODOLOGY

#### 3.1 INTRODUCTION

This chapter describes the methodology that will be followed to achieve the objectives of this research.

1. To collect requirements for increasing the uptake of cloud computing in developing countries like Nigeria
2. To design a model that provides guidance on how to increase uptake of cloud computing in developing countries.
3. To validate how use of cloud computing in developing countries like Nigeria can be increased?

The requirements for increasing the uptake of cloud computing in developing countries like Nigeria will be collected through the review of existing research in journals, book chapters and conference proceedings about adoption and adaptation of cloud computing in developing countries, Africa and Nigeria in particular. The aim of the literature review will be to identify what other researchers have established about requirements for increasing uptake of cloud computing in developing countries, Africa and Nigeria in particular. Results from literature review will be supplemented by an administered survey in Nigeria covering government institutions (Ministries, departments and Agencies) and key ICT service providers such as Telecommunication companies to verify the requirements obtained from literature and obtain additional ones.

Objective two i.e. to examine how use of cloud computing by government institutions in developing countries like Nigeria can be increased will be achieved through the design of a model that can guide efforts for increasing the uptake of cloud computing in developing countries like Nigeria. To design the model, we will use principles and constructs of already existing technology adoption and adaptation models such as but not limited to as Diffusion of Innovation theory (DIT) (Rogers, 1995), Unified Theory of Acceptance and Use of Technology Theory (UTAUT) by Venkatesh et al. (2003), various cloud computing adoption models such as Cloud Computing Adoption Model for Governments and Large Enterprises by Trivedi (1999), adoption of cloud computing in education by Sabi, Uzoka, Langmia and Njeh (2015), etc.

The third objective i.e. to validate how use of cloud computing in developing countries like Nigeria can be increased will be achieved

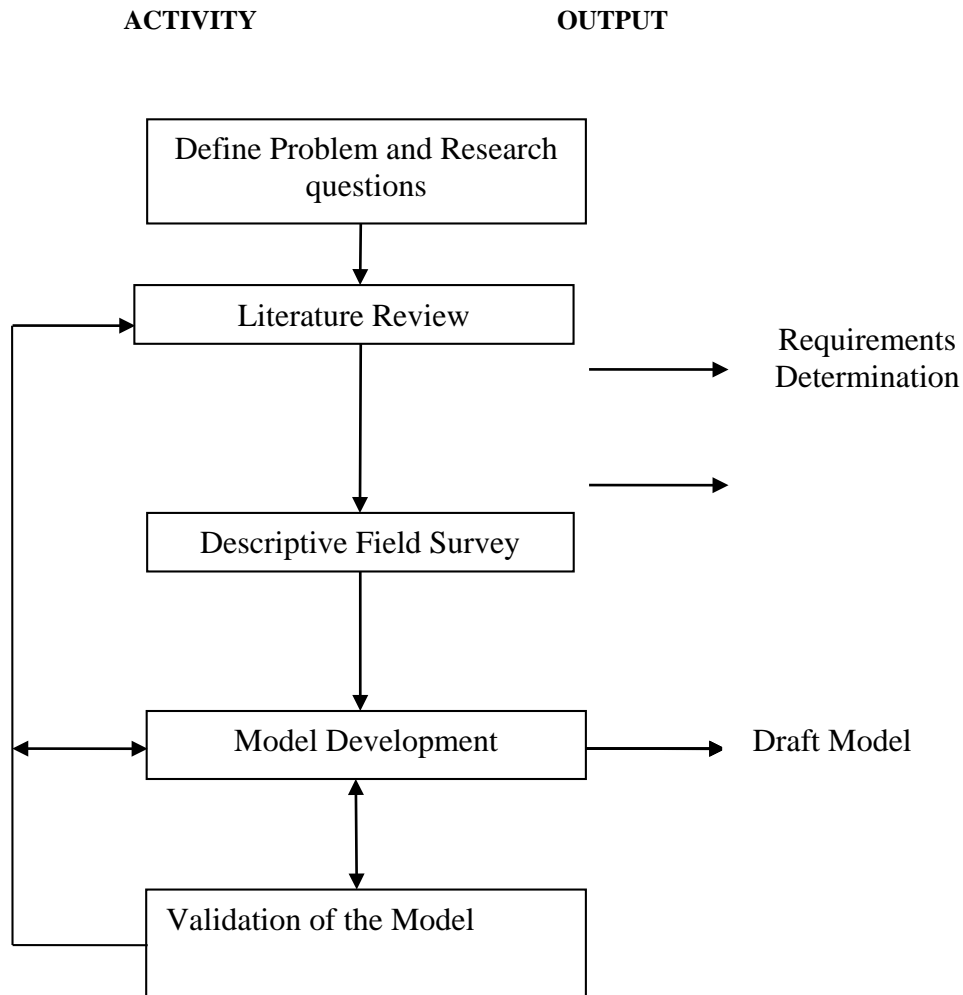
To validate whether the developed model improves adoption of cloud computing in a developing country (third objective), the theoretical model will be validated with cloud computing for e-government experts, ICT providers as well as representatives of MDAs specifically those currently involved/responsible for cloud implementation of cloud computing services and relevant members of the private sector.

This chapter describes the methodological approach that will be used and the reason for choosing it is justified. How the data will be collected and how it will be analyzed is also presented.

#### 3.2 RESEARCH METHODS AND JUSTIFICATION OF METHOD APPLIED.

The kind of research one is doing will determine the research methodology you use to support your work and methods you use in order to collect data. When measuring variables and verifying theories or hypotheses or questioning them then one will go for quantitative way of collecting data. Data is often used to generate new hypotheses based on the results of data collected about different variables. Some people are often much happier about the ability to verify quantitative data as many people feel safe only with numbers and statistics. And quantitative data, it must be remembered, are also collected in accordance with certain research vehicles and underlying research questions. Even the production of numbers is guided by the kinds of questions asked of the subjects, so is essentially subjective, although it appears less so than qualitative research data (Prince. C 2013). However, often collections of statistics and number crunching are not the answer to understanding meanings, beliefs and experience, which are better understood through qualitative data and which is more suited for this research.

The major activities of the research design are indicated in the following figure



**Figure 3. 1:**Overview of the Major Activities in the Research Design

### 3.2.1 QUALITATIVE RESEARCH SELECTED.

Qualitative research is aimed at gaining a deep understanding of a specific organization or event, rather than a surface description of a large sample of a population. It aims to provide an explicit rendering of the structure, order, and broad patterns found among a group of participants (Csulb.edu, 2013). Qualitative research allows the participants to state and explain what is been asked in respect to how they use and see it rather than the researcher limiting the participants. It was chosen because it is flexible and can adjust to settings. Changes can be made in respect to concept, data collection methods and tools as the research progresses.

The author will use qualitative research methodology to collect the data needed through conducting interviews. The author conducted a background study on the organizations that are will be interviewed in order to accomplish the research's objectives and the people directly connected to the topic will be contacted so as to collect the primary data.

## 3.3 COLLECTION TECHNIQUES, TARGET SAMPLING AND JUSTIFICATION

### 3.3.1 COLLECTION TECHNIQUES: INTERVIEW QUESTIONNAIRE

Because qualitative method of research was chosen as the primary technique to be used in this research, Questionnaire was choosing in order to have a better understanding and get the necessary data needed on the subject matter. The author prepared the questions in advanced and contacted the people connected to the topic within the government and private organizations. In this particular research the questionnaires was send by using Google form to staff of the government organizations and cloud service providers. The participants are from different government institutions, cloud service providers ranging from the national level, provincial level and local level with different profession the questions prepared in advance will be asked during the fill the questionnaire form but depending on the interviewees response new questions can be asked as well.

### **3.3.2 COLLECTION TECHNIQUES: SECONDARY DATA COLLECTION**

It is important to note that before primary data was collected, an in-depth secondary data was studied (Chapter 2) where materials were reviewed from authentic sources. Importance was given to current data, as the topic is new in the African continent; it is still in its infancy stages.

### **3.3.3 TARGET SAMPLING**

The research is aimed at finding the uptake of cloud computing in government institutions in Nigeria, so it is important to target both government organizations and private institutions (cloud service providers). The IT personnel of this various institutions are the ones been targeted as they are the ones with the responsibility of making sure the objectives of the research service been used and achieved.

### **3.4 METHOD OF ANALYSIS**

The data collected will be analyzed in order to make sense of the data collected and make the interpretation of the data simple. Names of both the organization and the interviewees will be withheld because of privacy and confidentiality. The author will use aliases in referring to the organizations.

## **IV. DATA PRESENTATION, INTERPRETATION AND ANALYSIS FINDINGS**

The purpose of the field study was to examine how the uptake of cloud computing can be increased in government institutions in Nigeria. This chapter presents the results from questionnaires that were administered to government institutions and cloud service providers in Nigeria. Thirty five (35) questionnaires were administered to cloud service providers in Nigeria. And it covered Out of the thirty-five questionnaires given out, twenty one (21) were responded to. In from 13 cloud service providers organisations that is It solutions, Cloud Host Nigeria, Go4 Hosting Nigeria, Host Ville Nigeria, Utiware.net Nigeria, Globacom Nigeria, SimbaNET (U) limited, DESCASIO CLOUD Solutions, NCC, GBB, NigComSat Lyd, Galaxy Backbone and Etisalat / 9Mobile Nigeria and on 16 positions that is Administrator, Data Officer, Software Engineer, IT Manager, Network engineer, Senior officer, Database administrator, Technical manager, IT officer, E-Government Solutions Manager, Engineering, Operation Manager, Technician, Network Admin, Programmer and System Analyst.

Also Thirty five (35) questionnaires were administered to government institutions in Nigeria. And it covered Out of the thirty-five questionnaires given out, twenty one (21) were responded to. Sections 4.1 and 4.2 below, present the findings obtained from each group. In from 13 cloud service providers organizations that is National information technology agency, Kano State Government, Nigerian Communications Commission, Ministry of education Kaduna, Abubakar Tafawa Balewa University Bauchi, Kano Geographical Information system, NMC, Energy Commission of Nigeria, Board of Internal Revenue Kano State, Nigerian Airspace Management Agency, National Pension Commission, Petroleum Technology Development Fund, Central Bank of Nigeria, Ministry Of Science And Technology Kano and Kano electricity distribution company and on 17 positions that is IT Officer, IT, Director ICT, Director scholarship department, Commissioner Inspectorate, Executive officer, Tax Administrator, Help Desk Analyst, System Admin, GIS officer, Lecturer, Deputy Manager, Senior Officer, Chief information officer, Network Engineer, Senior Special Assistant On ICT, Senior assistant

### **4.1 FINDINGS FROM CLOUD SERVICE PROVIDERS.**

In total 17 cloud service providers participated in the study namely: IT solutions, Cloud Host Nigeria, Go4 Hosting Nigeria, Host Ville Nigeria, Utiware.net Nigeria, Globacom Nigeria, SimbaNET (U) limited, DESCASIO CLOUD Solutions, GBB, NigComSat Lyd, Galaxy Backbone and Etisalat / 9Mobile Nigeria

The participating cloud service providers were mainly represented by 16 positions that is Administrator, Data Officer, Software Engineer, IT Manager, Network engineer, Senior officer, Database administrator, Technical manager, IT officer, E-Government Solutions Manager, Engineering, Operation Manager, Technician, Network Admin, Programmer and System Analyst from ICT department.

### **4.2 Organizations that Participated in the study**

In total 17-cloud service providers based in Nigeria participated in the study. All the 17 had 1 participant except for GBB that had 2 participants and Galaxy backbone that had 3 participants. The list of all cloud service providers that participated in the study is given in the appendix as appendix 1.

### **4.3 Position of the Respondents**

The respondents were distributed among different specializations of IT namely; Administrator, Data Officer, Software Engineer, IT Manager, Network engineer, Senior officer, Database administrator, Technical manager, IT officer, E-Government Solutions Manager, Engineering, Operation Manager, Technician, Network Administrator, Programmer and System Analyst.

#### **4.1 Gender**

Majority of the participants were male at 63.2% compared to the females who were 36.8%

#### **4.2 Age of the Respondents**



Majority of the respondents were between 25-34 years of age followed by the 35-44 years age bracket as summarized in table 4.3 below.

*Table 4.3 Age of the Respondent*

Age	Frequency	Percentage
Below 25 Years	0	0%
25-34 Years	8	57.9%
35-44 Years	4	20%
45-54 Years	2	10.3%
55-64Years	1	6.5%
65+ Years	0	0%

*Figure 4.3 Ages*

#### 4.3 Level of Education for the participants

Majority of the participants were holders of bachelors and Masters degrees as shown in table 4.4 below.

*Table 4.4 Level of Education for the Participants*

Qualification	Frequency	Percentage
Masters and above	9	42%
First degree	10	47.4%
Diploma	2	10.5%
Certificate	0	0%
Other	0	0%

*Figure 4.4 Educations*

#### 4.5 Types of cloud services provided

Majority of the cloud service providers provide platform as a service followed by software as a service followed by infrastructure as a service and advisory services for cloud computing as shown in table 4.5 below.

Cloud Service	Frequency	Percentage
Software as a service	5	21.1%
Infrastructure as a service	4	15.8%
Advisory services for cloud computing	4	15.8%
Platform as a service	6	26.3%
Business process as a service	0	0%
All	13	63

*Table 4.5 cloud services*

#### 4.6 Other companies that provide cloud services in the country

Other companies that provide cloud services in the country some are based in Nigeria while others are not based in Nigeria include; MTN, Globacom, Amazon Web services and Google.

#### 4.7 Whether government institutions are among the customers of cloud services provided in Nigeria

Participants were asked whether government institutions were among the customers of cloud services provided in Nigeria to which 68.8% said YES while 36.8% said NO.

#### 4.8. Government Institutions that Currently Use Cloud Services

Participants were further asked to name the Government Institutions that were currently using their cloud services and the kind of cloud services they were using. Table... below gives a summary of the Nigerian Government institutions that are currently using cloud services and the kind of cloud services currently used.

**Table 4.9 government institutions using cloud services and the kind of services used**

<b>Name of Government Institution</b>	<b>Kind of Cloud Service used from your company</b>	<b>4.9 Challenges Faced by Cloud Service Providers</b>
Federal Inland Revenue Services,	Platform as a services	Participants were asked about the challenges they currently face in their business of providing cloud services to which majority low demand for the services (68.4%) indicated recruitment of qualified staff with 15.8%, high operational cost with 0% and low demand for the services with 10.5 as summarized in table 4.9 below.
National Insurance commission,	Platform as a services	
Federal Inland revenue services,	Platform as a services	
National information Technology development agency.	Platform as services, infrastructure as services.	
Federal inland revenue services,	Platform as a services, infrastructure as a services, Software as a service	
Nigerian Social Insurance Trust, Bank of Agriculture,	All	
Oyo State Government	Platform as services. Platform as a service and business process as a services	
Plateau State University, Bokokos	Software as a service, Platform as a service, Advisory services for cloud computing	
ALL FEDERAL AGENCIES	All	
Nigeria Institute Management	Platform as a service and business process as a service	
NIGCOMSAT	Platform as a service, infrastructure as services, platform as a services, infrastructure as a services, Software as eservices	<i>Table 4.9 challenges and comments on cloud services</i>
Federal Ministry Of Science And Technology, FIRS, Platform as services, Software as services.	Platform as a service, infrastructure as services, Software as a service, Platform as a service.	
Pension Commission	Infrastructure as a services, platform as a services	
Nigerian Airspace Management Agency.	Messaging as a service, SharePoint-as-a-service, platform as a services, Infrastructure-as-a-service, Software-as-a-service	
Central Bank of Nigeria	A-service (SaaS) as well as Infrastructure-as-a-service (IaaS)	
Transcorp Hotel,	A-service (SaaS) as well as Infrastructure-as-a-service (IaaS)	
AMCOM Nigeria,	IaaS, Messaging as a service, SharePoint-as-a-service, platform as a services	
Coscharis Group and it offered	IaaS, Messaging as a service, platform-as-a-service.	
Federal Ministry of Education,		

<b>Challenges</b>	<b>Frequency</b>	<b>Percentage</b>
<b>High operational costs</b>	<b>0</b>	<b>0%</b>
<b>Recruitment of qualified employees</b>	<b>3</b>	<b>15.8%</b>
<b>Low demand for the services</b>	<b>14</b>	<b>68.4%</b>
<b>Others specify</b>	<b>0</b>	<b>0%</b>

#### 4.10 Suggestions about how the uptake of cloud services among government institutions in in Nigeria can be increased

Participants were asked to make suggestions of ways uptake of cloud computing services among government institutions can be increased in Nigeria and below is a summary of the suggestions given.

**Awareness and training about cloud computing:** Some of the individual responses for this category are:

- Awareness about cloud services to institutions
- Providing awareness of cloud services to organization
- Cloud Computing awareness on their benefit
- Organise sensitisation and awareness workshop for government institutions' decision makers
- Increased Awareness
- Awareness about cloud computing
- Increased advocacy on the use and benefits of cloud computing to organisations

**Availability of IT experts in cloud computing,** data center and power supply about cloud computing. Some of the individual responses for this category are:

- By availability of IT cloud experts, Data center etc.
- Stability of power supply
- Availability of Internet network and stability of electricity supply etc.
- Electricity supply, internet network, ICT infrastructures
- Adequate electricity supply
- The unreliability of power supply in the country needs to be taken seriously and resolved as soon as possible. This is because electricity is very essential especially in the running of data centers; there should be intensified awareness creation by cloud service providers geared at sensitizing the public on the benefits and risks of cloud adoption by organizations in Nigeria
- Power supply is needed because cloud can not run without internet and internet needs electricity, public institutions needs awareness about cloud computing so that they can use it in there organisations
- Availability of power supply, which can protect lost of date and inability to access cloud services
- It need data center, ICT Infrastructures

**Availability of ICT infrastructures** and more cloud service providers for cloud computing. Some of the individual responses for this category are:

- Provide adequate ICT infrastructures
- Availability of ICT cloud infrastructure
- Provide broadband to backbone infrastructure, data centers
- Increased advocacy on the use and benefits of cloud computing to organisations, The establishment of manufacturing plants for ICT equipment, participation of cloud service providers, the government institutions at all levels
- Need for backbone infrastructure sharing/general communication problems, it need data center, ICT Infrastructures
- More cloud service providers are needed in the country to encourage competition, which will result to the driving down of the cost of its services. This would make the technology more appealing to organizations, promotion of pervasive broadband deployment, increasing its adoption and usage, and ensuring availability of broadband services at affordable rates.

**Adequate financing for cloud computing:** Some of the individual responses for this category are:

- Adequate financing for GBB services

#### 7. 4.11 Other relevant comments made by the Participants

*Table 4.12 other relevant comments*

##### **Why should adopt**

Adopting cloud computing is the best for public and private institution in Uganda.

Uptake of cloud computing in Nigeria will make cloud computing the next big thing in Nigeria.

Government institution should be aware to know that cloud computing is one the best technology for easy access to improve services in their institutions.

Cloud computing is safe and easy to access at anytime and anywhere.

Adoption of cloud computing in government institutions is the best technology in the new generation.  
Cloud computing will also help organisation achieve reasonable saving on energy cost  
It's good for government institutions to adopt cloud computing in there organisations.  
Cloud computing services are more secured, reliable and affordable.  
Cloud computing is a new technology in our institutions.  
The future of cloud computing in Nigeria is bright if government and all stakeholders would put all hands on deck to ensure that these identified challenges/impediments to its feasibility are addressed squarely.  
Cloud technology is good for our institutions.  
Cloud computing globally has come to stay, and Nigeria cannot afford to leave behind.  
Cloud computing offerings globally are taking center stage in strategizing businesses for more profitability and cost management.  
Adoption of cloud in institutions will enable cloud computing to work viably in Nigeria.  
To make cloud computing the next big thing in Nigeria can properly be achieved through the active participation of all involved stakeholders.

#### **Why not to adopt**

Unstable power provision in the country is a big challenge for cloud service providers

## **4.2 FINDINGS FROM GOVERNMENT INSTITUTIONS**

National information technology agency, Kano State Government, Nigerian Communications Commission, Ministry of education Kaduna, Feedback was also sought from 14 government institutions above  
The in total 14 government institutions participated in the study were mainly represented by Directors and senior staff in the ICT department namely:

### **1. Name of the Institutions**

*Table 4.13 Name of the government institution.*

<b>Government Institution</b>	<b>frequency</b>	<b>Position of the staff that participated</b>
National information technology agency	3	IT officer, IT, Executive officer
Kano State Government	1	Senior special assistant on ICT
Nigerian Communications Commission	3	Deputy Manager, System admin, Network engineer
Ministry of education Kaduna	2	Director scholarship department, commissioner inspectorate Lecturer
Abubakar Tafawa Balewa University Bauchi	1	GIS officer
Kano Geographical Information system	1	System admin
National M Commission	1	Desk analyst,
Energy Commission of Nigeria	1	Tax administrator
Board of Internal Revenue Kano State	1	Network Engineer
Nigerian Airspace Management Agency	1	IT Officer
National Pension Commission	1	Network Engineer
Petroleum Technology Development Fund	1	Executive officer
Central Bank of Nigeria	1	Director ICT
Ministry Of Science And Technology Kano	1	Chief information officer
Kano electricity distribution company	1	



Table 4.13 shows the names of organization that participated in the study, number of staff that participated and positions of the staff that participated.

## 2. Gender

Majority of the participants were Male (15) while Females were (6). This could be due to the fact that globally most ICT professional are men.

## 3. Age

Majority of the participants were between 25-34 years at 52.4%

**Table 4.14 Age**

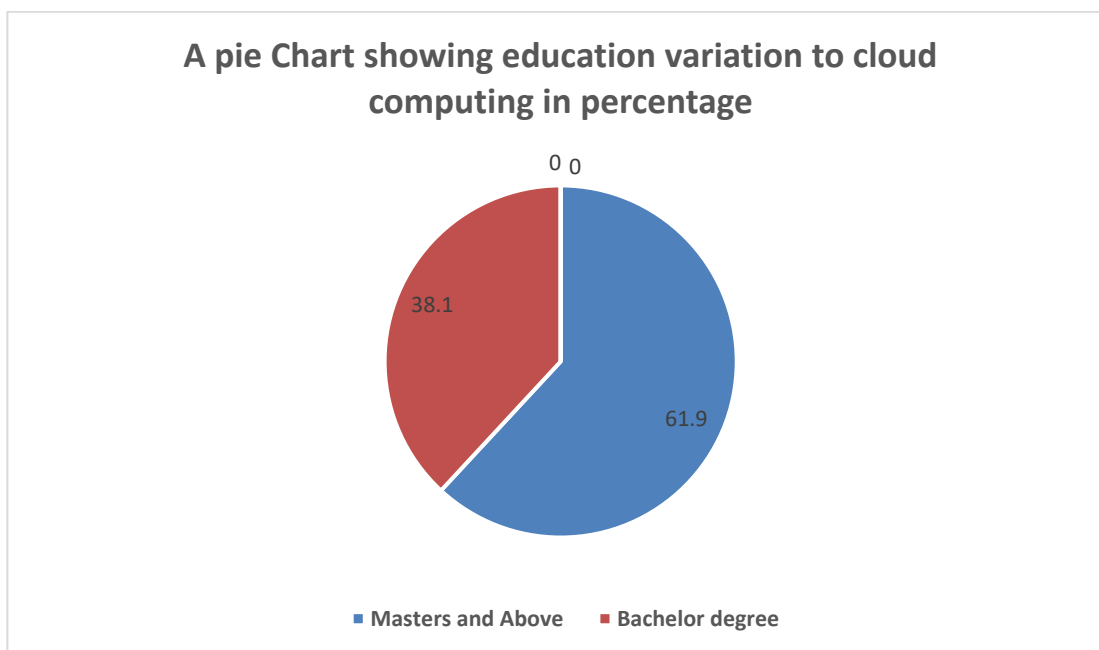
Age	Frequency	Percentage
Below 25 Years	1	4.8%
25-34 Years	11	52.4%
45-54 Years	8	38.1%
55-64 Years	1	4.8%
65+ Years	0	0%
	0	0%

## 4. Education

**Table 4.15 level of Education for participants**

Majority of the participants had Masters degrees and above at 62%. All others had Bachelors degrees.

Current Position	Frequency	Percentage
Less than 1 year	1	4.8%
Between 1 to 4 years	7	33.3%
Between 4 to 7 years	5	23.8%
Between 7 to 10 years	3	14.3%
More than 10 years	5	23.8%
Qualification	Frequency	Percentage
Masters and above	13	61.9%
Bachelor degree	8	38.1%
Diploma	0	0%
Certificate	0	0%
Other	0	0%



**Figure 4.1 Education**

**5. Duration in current position**

Majority of the position duration are between 1 to 4 years with 33.3% then between 4 to 7 years and more than 10 years with 23.3% then followed between 7 to 10 years with 14.3% and the lowest position duration are less than 1 year with 4.8%

**6. Level of operation for the government institutions that participated in the study?**

Most institutions that participated in the study were operating at the national level (76.2%) while the rest were operating at the provincial level, none operated at the local level.

**7. Level of Understanding of Cloud Services?**

Majority of the participants had a moderate (43%) and low (33%) understanding of cloud services

**Table 4.20 cloud service level**

Level of understanding	Frequency	Percentage
High	5	23.8%
Low	7	33.3%
Moderate	9	42.9%
Others	0	0%

**5. Reasons for the level of understanding of cloud services**

High level of understanding: Some of the individual responses for this category are:

Because its modern technology that boost the tomorrow's technology to high intensity.

Cloud it usually been used in institutions at national level

Cloud has different Services that gives options to cloud users e.g. platform, software and infrastructure as a services.

Is a model in which application software is delivered via the internet.it is a model where, the service providers supply service to the users, such as development environment, and server platforms through which the users can develop custom applications.

Cloud services are platform as service, infrastructure as services.

Cloud computing is a process whereby data's and storage in a cloud and it can easily be access at anytime and anywhere at far as there's Internet Connection.

Cloud computing is the delivery of computing services—servers, storage, databases, networking, software, analytics and more—over the Internet (“the cloud”). Companies offering these computing services are called cloud providers and typically charge for cloud computing services based on usage; similar to how you are billed for water or electricity at home.

The practice of using a network of remote servers hosted on the Internet to store, manage, and process data, rather than a local server or a personal computer.

With the adoption of Cloud Computing, Data will be more secured and easier to access everywhere and where necessary.

As specialist in the field of Computing and Currently undergoing some research on Virtual Machine Placement in Cloud Computing.

It is a kind service provided to users on demand through the use of Internet from cloud computing provider's server instead of providing by on-premise server own by the company.

Moderate: Some of the individual responses for this category are:

Not much knowledge about it because is a new to our organization.

Not much Knowledge about the cloud computing.

Basic knowledge.

I know how cloud system operates seamlessly across various devices

Low: Some of the individual responses for this category are:

Low.

We use Cloud services and I lecture Cloud computing.

I have not used it much.

#### 6. Institution using clouds services

Majority (76.2%) the institutions were using clouds services.

#### 7. Cloud services used

Majority of the participants were using software as a services, infrastructure as services and platform as a services.

*Table 4.22 cloud services used*

Services used	Frequency	Percentage
Software as a service between	11	52.4%
Infrastructure as a service	11	52.4%
Advisory services for cloud computing	1	4.8%
Platform as a service	8	38.1%
Business process as a service	2	9.5%
Others specify	1	4.8%
None of the above	2	9.5%
Not using	1	4.8%

#### 8. Other government institutions using cloud services in the country

A total of 15 other government institutions were given by participants as also using cloud

Corporate affairs commission Nigeria

Nigerian communication commission

Petroleum Trust Development Funds

Central Bank of Nigeria,

Security & Exchange Commission,

National Information Technology Development Agency,

Pension Commission

Federal University of Nsukka

Federal Inland Revenue Service,

Nigeria ComSat,

Nigeria Communication Commission

National Identification Management Commission

Nigeria Insurance Commission

Federal Airport Authority of Nigeria

Ahmadu Bello University ZARIA

#### 9. Whether all government institutions should adopt use of cloud services

Participant were asked whether they think it is a good idea for all government institutions to adopt use of cloud services to which 75% said Yes and 25% No

#### 10. Reason why government institutions should use of cloud computing.

**Why should adopt:** Some of the individual responses for this category are.

Because it saves cost

There are many benefits of cloud computing most important is cost reduction and instant access.

It will help government institutions in storing data and easy accessibility

With the adoption of Cloud Computing, Data will be more secured and easier to access everywhere and where necessary. The issues of losing Data will be minimized.

It makes data storage easier and more secured in terms of data loss.

It help reduce Cost of running the Organisations, reduce IT Resource wastage, and enhance speed in executing complicated tasks

Scalability: Cloud infrastructure scales on demand to support fluctuating workloads. Storage options: Users can choose public, private, or hybrid storage offerings depending on security needs and other considerations. Control choices: Organizations can determine their level of control with as-a-service options. These include software as a service (SaaS), platform as a service (PaaS), and infrastructure as a service (IaaS). Tool selection: Users can select from a menu of prebuilt tools and features to build a solution that fits their specific needs. Security features: Virtual private cloud, encryption, and API keys help keep data secure.

The Cloud computing makes your business dependent on the reliability of your Internet connection. When it's offline, you're offline. If your Internet service suffers from frequent outages or slow speeds, cloud computing may not be suitable for your business.

It can store are huge data's, it will reduce cost to the government, it can keep records for a long time

It kept huge data, it protect data from missing

It can helps for recording data easily

This will save cost

Cloud computing Will assist in conducting all government business in simple way.

Because all the data's store can easily be accesses and you can keep huge information on a cloud.

Use cloud-based servers.

**Why should not adopt:** Some of the individual responses for this category are.

Because of sensitive of information, security agencies and other departments should not use it now.

Its not 100% secured

The data's are not so secured

Because it is not secured to keep some confidential information on cloud

Because its the needs of modern technology

The reasons for and against cloud service adoption given by participant's shows that they understand fairly well the pros and cons of cloud services in general and for government institutions in particular.

11. Suggestions on ways the adoption of cloud computing services among government institutions in the country can be increased?

**Awareness and Training:** Some of the individual responses for this category are.

Advertising benefits, promoting cloud computing in schools.

Adequate awareness about cloud services, providing adequate infrastructures in which clouds will be run e.g. electricity, internet connectivity etc.

Enlighten the stakeholders and convincing them about the importance of it.

Sensitization and training of IT Staff

Traditional programmers should be trained on the new cloud technologies; government should allocate relevant training funds to his IT organization, Available power supply and Data Center

Enlightenment about the benefit of cloud to government institutions, Cloud Computing Experts with are knowledge on how to managed all clouds service in an educational institution and aviation sectors

Awareness or Enlightenment about cloud computing benefit, Availability of fund to carry out the project, Experts that can manage and show how cloud services can be used

It needs Enlightenment for the institutions before adopt it, it need Available electricity for connecting with Internet so that you can access data stored etc.

**Improve the quality of Internet and infrastructure:** Some of the individual responses for this category are.

Government should provide accessible, available and affordable Internet access service

By providing reliable Internet services and uninterrupted power grids

Data Center, Power supply, Internet Connection, IT infrastructures

ICT infrastructures, Power supply, Experts that can manage and control cloud services

**Develop a government policy on cloud service adoption:** Some of the individual responses for this category are.



Government should use Nigerian Information Technology Development Agency (NITDA) as tool to sensitize other agencies on the importance cloud computing.

- By employing skilled IT staffs.

- Introducing New Policy that makes organisations to operate in real time.

- Ensure the use IT Technology in all government institution.

- Experts that know well about the clouds

Cloud services knowledge about it benefit which can convince institutions at state level to adopt Software as a service

#### **Security and privacy**

Security is the biggest concern when it comes to cloud computing.

Ensure all data and information on cloud are secured.

- Provide reliable security on the data stored.

- The cloud users should have privacy on their data

- Protect their data from unauthorized users

#### **12. Other relevant comments provided by participants**

**To adopt cloud services:** Some of the individual responses for this category are.

Cloud is important.

Cloud computing is the next big technology.

Adopting cloud computing in Nigerian institutions is the best idea.

Cloud computing is new and should be adopted with absolute care in its adopt action.

Nigerian government Institution should adapt the use of Cloud Service as it reduces Cost of running the organisation. And for Researchers, there is a need for further research on Cloud Computing & Fog Computing in order to help save Energy.

I personal think more private institutions should adopt the use of cloud computing services in Nigeria.

Nigerian ICT institutions

Cloud will be the best technology in the near future for storing information by government institutions.

Adopting cloud computing will bring fast gaining when implemented.

Is good for government to adopt cloud services in their ministries and other agency.

To adopt cloud in government institutions it has side effect and benefits to the organisations.

It will be much more better for government institutions to uptake this new technology

Uptake of cloud at state ministries can benefits government alots.

Government should adopt the use cloud computing in their e-governance activities.

We will be high glad to have this fantabulous project within our institutions because they needed to be on a new world.

- Adopting cloud computing in government institutions will be are good ideas for.

I see little evidence of anyone losing their job as a result of cloud computing. I do, however, see job responsibilities shifting in IT department.

- Enlightenment is Very important as many people at stakes doesn't know about the Cloud computing

Cloud computing has many impacts from the social, organizational, and environmental point of views so is good government to adopt in it some Institutions.

**Not to adopt cloud services:** Some of the individual responses for this category are.

A major disadvantage of cloud computing is Downtime. No cloud provider, even the very best, would claim immunity to service outages.

Cloud computing systems are Internet based, which means your access is fully dependent on your Internet connection.

The adoption of cloud computing in the enterprises particularly organizations and government agencies in developing countries is a major challenge. Cloud computing is a recent innovation in computing technology and still under development. Though it received considerable attention of research in industrialized countries, and envisioned to be the next generation architecture of IT enterprise, its understanding and recognition is quite low even among IT practitioners in developing countries, this eventually leads to organizations and government agencies not exploring its full benefits.

Quantitative and qualitative approaches were employed in the research process to explore the factors responsible for slow adoption of cloud computing, data were collected and analysed and the findings led to the conclusion that though cloud adoption is foreseeable in near future, efforts are required from both government and IT service providers to overcome the obstacles to its adoption

### **4.3 Requirements for increasing adoption of cloud services among Government Institutions in Nigeria**

**4.3.1 Awareness and Training:** Sixty eight percent (68%) of the cloud service providers that participated in the study indicated that one of the key challenges faced by the sector is low awareness about cloud computing services and their importance. The representatives of government institutions that participated in the study agreed with cloud service providers and suggested that Government through the Nigerian Information Technology Development Agency (NITDA) should sensitize other agencies on the importance of cloud computing. Representatives of government institutions that participated in the study advised that to increase adoption of cloud computing in government institutions, traditional programmers should be trained about the relatively new cloud

computing technologies and government should allocate funds for such training. They also advised that all public servants should be enlightened about the benefits cloud computing such as cost saving, more reliable services, etc. The research carried out by Awosan (2014) revealed that 89.1 percent of the research respondents were of the view that lack of proper awareness of the workings and benefits of cloud computing was responsible for its poor adoption. The people interviewed also corroborated this view. The research also revealed that many small businesses in Nigeria have employees that lack the requisite skills to operate basic ICT tools including cloud applications. And many business owners do not want to invest in upgrading the skills of these personnel for several reasons including cost of training and fear that the employees may end up leaving the organization abruptly (Awosan, 2014). So lack of skills to manage these applications and business owners not seeing real value in automating their processes are huge challenges working against the adoption of cloud based solutions among many Nigerians.

#### **4.3.2 Improve the quality of the Internet Infrastructure:**

Cloud service providers that participated in the study noted that there is a need to provide broadband connection to the backbone infrastructure and data centres to make it easier for individuals and institutions to access cloud services. The representatives of the government institutions noted that to increase adoption of cloud services in the country, government should provide more reliable and affordable Internet services. Ogunraku (2014) reported that the very few data centers located in Nigeria are mainly situated in Lagos which has better network backbone connectivity due to its close proximity to the various under sea Internet cables including Main One and GLO 1 cables. The in-country network backbone connectivity in Nigeria is still very poor because most other states in Nigeria lack direct connection to the undersea Internet network (Purefoy & Kermeliotis, 2012). Backbone networks play major role in the delivery of ICT services including cloud services in all countries. And it contributes a huge portion of the total cost incurred by network providers to their overall cost. And in a country with very vast geographical spread like Nigeria the cost of providing broadband connectivity per subscriber is very high. This cost is much lower per subscriber in cities like Lagos and other densely populated cities compared to rural areas and cities with sparse population (Williams, 2010). Internet penetration is still very low with broadband penetration even lower (Chidiebere, 2013). There isn't long distance national backbone to carry and distribute the capacities provided by the submarine cables mentioned above to the users in offices, schools, and homes in the hinterland across Nigeria (Olusola & Olaojoyetan, 2013). Some of the problems identified as hampering the growth of broadband and by extension cloud computing services in Nigeria is the very high cost of obtaining right of way (inclusive of cost involved in settling government officials, the cost of settling various indigenous owners of the land where the infrastructure will pass through and long delays in procuring the right of way permits). This cost invariably causes the cost of leasing transmission infrastructure to be high. The high cost of investment in last mile broadband infrastructure leads service and infrastructure providers such as the telcos to concentrate only in major cities. Frequent vandalization of broadband infrastructure by hoodlums leaves undesirable financial burden on owners of telecommunication infrastructures. Other challenges include multiple taxation on the part of the federal, state and local governments; weak regulation in some case, incessant disruption due to road works and huge cost of providing alternative electricity to power telecommunication equipment (Olusola & Olaojoyetan 2013). Consequently Internet penetration in Nigeria is very poor due to inadequacy of this infrastructure. And where available the cost is quite high. According to the Nigeria Communications Commission there over 85 million Nigerians with access to the Internet as at March 2015. This figure is calculated by adding up all the Internet subscribers per telecommunication operator. This figure may not be very accurate as many Nigerians own more than one phone line, so there may be issues of double counting. The US Census Bureau (2014) suggests that Internet penetration in Nigeria is 33 percent. If this figure by the US Census bureau is correct it means that Internet penetration in Nigeria is low when compared to other African countries especially Morocco, Egypt, Tunisia and South Africa.

**4.3.3 Develop a government policy on cloud service adoption:** The Government of Nigeria should introduce a new policy that mandates and guides all government institutions in the country to use cloud services for some aspects of their work in order to exploit some of its advantages

**4.3.4 Provide more reliable power supply:** Lack of or unstable power supply especially outside the big towns was given as another big challenge to the adoption of cloud computing in Nigeria. Greengard (2010) identified lack of stable power supply as one of the factors that can cause both loss of data and inability to access cloud services. He noted that, in essence consumers may not be able to access cloud services always and even when they do sudden loss of power supply can cause loss of data (Greengard, 2010).

**4.3.5 High Cost of Internet:** Another major problem limiting the ready adoption of cloud services is the high cost of bandwidth required to transfer data through the Internet especially when working with data intensive applications (Otuka, Preston, & Pimenidis, 2014). Furthermore, unreliability of Internet services due to high cost of Internet and several factors including low bandwidth capacity is also a limiting factor (Leavitt, 2009).

Mobile operators are nevertheless now the primary means of Internet access as they are for voice services. The Research ICT Africa household and individual ICT survey (2012) found that in 11 of the 12 participating sub-Saharan African countries (the exception being South Africa), less than 16 per cent of the population has ever used the Internet. Moreover, internet users are concentrated in urban areas, while rural and marginalised areas are almost untouched by the Internet; and of those using the Internet, the majority gains access to it through mobile devices but with high cost of bandwidth (Research ICT Africa, 2012).

**4.3.6 Provide reliable and consistent the cloud services:** There is also the lack of confidence on the part of organisation on the overall reliability and consistency in the quality of service provided by cloud service providers over a long term (Otuka, Preston, & Pimenidis, 2014). Some organizations especially large organizations may not be too comfortable entrusting their IT services to cloud service providers for fear of down time. They may not be sure if the cloud services provider will guarantee optimal performance for their missions critical business. This view is supported by Carr (2005), who rightly opined that one of the major impediments to the

adoption of cloud computing will not be technology but attitude of end-users towards cloud computing. Marston et al., (2011) observed that some applications may not be currently sustainable to be implemented as cloud service but may therefore need to interact with other cloud based applications a process that may pose challenge both in terms of contractual and support issues. Due to the nature of cloud computing services some organizations may be skeptical in adopting the service, as they do not have “control” as such over the information and supporting infrastructure. And some may also be worried about vendor location due to lack of standards or the vendor even completely going out of service.

**4.3.7 Data Security, privacy and lack of standards:** Security and privacy are the major challenges facing cloud computing not only in Nigeria but also across the world. These concerns are some of the issues hindering people and organizations to adopt cloud computing. T. Ilias (2013) noted that by adopting cloud computing, an organization is handing over its data and information to a third party to manage and protect them hence reliability is very important. If the data is to be compromised, it will be a disaster to big organizations financially and it will taint their reputation. The news people hear on cyber wars among countries and security breach been faced by the top IT companies in the world doesn't help assure people that cloud computing is secure.

T. Ilias (2013) pointed out that privacy are some of the concerns in cloud computing. From the research carry out, various stories of data loss and password leakage in the media does not help to reassure some of the most concerned users.

Security is the biggest concern when it comes to cloud computing. By leveraging a remote cloud based infrastructure, a company essentially gives away private data and information, things that might be sensitive and confidential. It is then up to the cloud service provider to manage, protect and retain them, thus the provider's reliability is very critical. Similarly, privacy in the cloud is another huge issue. Companies and users have to trust their cloud service vendors that they will protect their data from unauthorized users.

Awosan (2014), Qamar et al (2010) and Otuka, Preston, & Pimenidis, (2014) pointed out that issues of security, privacy and lack of standards are some of the major concern in cloud computing. From the research carried out by Awosan (2014) Chief Information Officers in selected organizations in Nigeria are of the view that cloud service adoption is considered risky due to insecurity and lack of privacy. Likewise the research by Otuka, Preston, & Pimenidis (2014) especially from the focus group part discovered that security and privacy issues were seen as major impediments to cloud computing adoption in Nigeria. Furthermore they found out that lack of standards governing ICT use in general in Nigeria is a key problem to the adoption of cloud services by organisations

**National Insecurity:** Insecurity faced in some parts of the country is a challenge because it disrupts the connectivity to the cloud infrastructure. Telecommunication Company's base stations are sometimes destroyed across the country, According to International Bank for Reconstruction and Development / The World Bank (2016). 150 base stations were lost due to bombing and flooding in 2012 alone and twice as many dependent base stations were also affected. Fibre links laid across the country have many times been vandalized leading to disruption of service and it hinders the ability of service providers to have their service available 24/7 and more importantly, such occurrence discourage potential customers from taking up use of cloud services

#### **4.4 ADDITIONAL REQUIREMENT FOR THE UPTAKE OF CLOUD COMPUTING IN DEVELOPING COUNTRIES.**

The requirement to make cloud computing the next big thing in Nigeria can properly be achieved through the active participation of all involved stakeholders. These include the cloud service providers, the government institutions at all levels, telecommunication infrastructure providers, financial institutions among others. Government on its part should put more effort in developing and propagating the adoption of ICT in Nigeria. It should ensure the development of basic infrastructure such as stable electricity supply. This can be achieved in collaboration with private sector investors in the area of electricity generation, transmission and distribution. With such infrastructure in place other investors in the ICT sector will be encouraged to make more tangible investment in cloud computing facilities and indeed other ICT infrastructures that will one way or the other support cloud computing. With stable and efficient power supply, organizations that are into the provision of cloud computing services will invest in the establishment of data centers in Nigeria. This will decrease the cost of accessing cloud services and also improve the speed of access, as the consumers will be able to access the services in country instead of accessing it from a distance country. Furthermore, promoting the establishment of more inclusive and robust network infrastructure will bring about increase in the use of broadband services. The current state of network backbone infrastructure in Nigeria is still very limited not covering most sections of the country thereby making the reach of broadband very poor and where available not adequate. Government either working alone or in partnership with private sector investors by providing the necessary enabling environment should aggressively pursue the extension of current ICT network backbone across the country (Dahunsi & Owoseni, 2015).

The establishment of manufacturing plants for ICT equipment especially the equipment that are used in cloud computing will help reduce the price of these items and invariably the adoption of cloud computing (Dahunsi & Owoseni, 2015). Investment in such manufacturing plants should be embarked upon by private sectors. On government's part it can provide the enabling environment including tax relieves to private sector investors to encourage them to setup such manufacturing plants. The private sector investors should be bold enough to make necessary investments in setting up manufacturing plants. They should take special consideration to the over 100 million prospective consumers and the over 17 million micro businesses that can potentially become small and even medium size enterprises.

There should be increased advocacy on the use and benefits of cloud computing to organisations. Many organisations are not entirely aware of the real effect automation can bring to their bottom line. Letting them know how automation can help improve sales, manage customers; track inventory and so on will surely help encourage the adoption of cloud computing services. Government and cloud computing service providers can also go further to give incentives to organisations that adopt the use of basic cloud computing services in their activities. For instance organisations can be given free tutorial on how to migrate to cloud services and service providers

should also consider giving free trial for a given period of time to try out cloud services. Increased availability of more cloud computing service providers will also aid adoption. This will help address the issue of inaccessibility and in the long-term reduce cost and bring about improvement in cloud services due to competition among cloud service providers. Development of innovative cloud solutions that are suitable for government institutions in Nigeria, such as CliniPak (West, 2015) a mobile healthcare solution currently in use in Nigeria will ultimately help improve cloud services adoption. Similar solutions should be developed for the various sectors in Nigeria in simple to use and affordable manner.

More focused research should be geared towards improving cloud computing infrastructure and services. Private sector organizations can sponsor research institutions either through grants, scholarships etcetera to carryout research work that will help improve cloud-computing services in Nigeria. Such research can include looking at ways of improving present services, manufacturing new hardware equipment and software applications. Dahunsi & Owoseni (2015) suggest that public universities can be encouraged to establish cloud network laboratory in their institutions to teach regular students and organizations that may wish to send their employees to learn specific skills on the provision, management, support and deployment of cloud computing services.

Regulation including enforcement of data protection laws and all other intellectual property rights protection regime should be adequately enforced. Nigeria is a member of WIPO and is signatory to all the major IPRs treaties but the problem has always been the enforcement of the relevant laws. Fully enforcing such laws will give users the confidence to adopt cloud computing services including allowing their vital data to be warehoused in a data center knowing that their data will be adequately protected. And where there is a breach they can easily get the relevant government authorities to take necessary action including getting redress from the legal system. Having a sound regulatory system that ensures that service providers keep to their side of the bargain and deliver proper services with minimal downtime will be a huge source of encouragement to organisations to adopt cloud-computing services.

## V. DEVELOPMENT OF A MODEL FOR ADOPTION OF CLOUD COMPUTING IN GOVERNMENT INSTITUTIONS IN NIGERIA.

### 5.1 Introduction

This chapter presents the model for the adoption of cloud computing in government institutions in Nigeria. It covers discussion of the requirements for the model, development of the model and finally validation of the developed model.

### 5.2 Requirements for adoption of cloud services among Government Institutions in Nigeria

The requirements for adoption of cloud computing services among government institutions in Nigeria were obtained from a survey on cloud service providers and Government institutions in Nigeria as well as a review of related literature. The requirements obtained include: awareness and training, improving the quality of the internet infrastructure, developing a government policy on cloud service adoption, providing more reliable power supply, reduction of Internet costs, providing reliable and consistent cloud services, data security, privacy and development of standards and a national security policy.

**5.2.1 Awareness and Training:** Sixty eight percent (68%) of the cloud service providers that participated in the study indicated that one of the key challenges faced by the sector is low awareness about cloud computing services and their importance. The representatives of government institutions that participated in the study agreed with cloud service providers and suggested that Government through the Nigerian Information Technology Development Agency (NITDA) should sensitize other agencies on the importance of cloud computing. Representatives of government institutions further advised that to increase adoption of cloud computing in government institutions, traditional programmers should be trained about the relatively new cloud computing technologies and government should allocate funds for such training. They also advised that all public servants should be enlightened about the benefits of cloud computing such as cost saving, more reliable services, etc. The research carried out by Awosan (2014) revealed that 89.1 percent of the research respondents were of the view that lack of adequate awareness of the workings and benefits of cloud computing was responsible for its poor adoption. The people interviewed in this research also corroborated this view. Furthermore Awosan (2014) established that many small businesses in Nigeria have employees that lack the requisite skills to operate basic ICT tools including cloud applications yet many business owners are reluctant to invest in upgrading the skills of these personnel for several reasons including cost of training and fear that the employees may end up leaving the organization abruptly. So, lack of skills to manage these applications and business owners not seeing the real value of taking some/all their computing services to the cloud are huge challenges working against the adoption of cloud based solutions among many Nigerian institutions including government agencies.

### 5.2.2 provide more reliable Internet Service:

Cloud service providers that participated in the study noted that there is a need to provide broadband connection to the backbone infrastructure and data centres to make it easier for individuals and institutions to access cloud services. The representatives of the government institutions noted that to increase adoption of cloud services in the country, government should provide more reliable and affordable Internet services. Ogunraku (2014) reported that the very few data centers available in Nigeria are mainly situated in Lagos which has better network backbone connectivity due to its close proximity to the various under sea Internet cables including Main One and GLO 1 cables. The in-country network backbone connectivity in Nigeria is still very poor because most of the out of town states in Nigeria lack direct connection to the undersea Internet network (Purefoy & Kermeliotis, 2012). Backbone networks play major role in the delivery of ICT services including cloud services in all countries and contributes a huge portion of the total cost incurred by network providers to their overall cost. In a country with a very vast geographical spread like Nigeria, the cost of providing broadband connectivity per subscriber is very high. This cost is much lower per subscriber in cities like Lagos and other densely populated cities compared to rural areas and cities with sparse population (Williams, 2010). Internet penetration is still very low with broadband



penetration even lower (Chidiebere, 2013). Additionally, there is not long distance national backbone to carry and distribute the capacities provided by the submarine cables to the users in offices, schools, and homes in the hinterland across Nigeria (Olusola & Olaojoyetan, 2013). Some of the problems identified as hampering the growth of broadband and by extension cloud computing services in Nigeria is due to the very high cost of obtaining right of way (inclusive of cost involved in settling government officials, indigenous owners of the land where the infrastructure will pass and long delays in procuring the right of way permits). This cost invariably causes the cost of leasing transmission infrastructure to be high. The high cost of investment in last mile broadband infrastructure leads service and infrastructure providers such as the telecos to concentrate only in major cities. Frequent vandalization of broadband infrastructure by hoodlums leaves undesirable financial burden on owners of telecommunication infrastructure. Other challenges on the reliability and cost of the Internet service include: multiple taxation on the part of the federal, state and local governments; weak regulation in some cases, incessant disruption due to road works and huge cost of providing alternative electricity to power telecommunication equipment (Olusola & Olaojoyetan 2013). Consequently Internet penetration in Nigeria is very poor due to the inadequacy of the infrastructure and where available, the cost is quite high. According to the Nigeria Communications Commission, there were over 85 million Nigerians with access to the Internet as of March 2015. This figure is calculated by adding up all the Internet subscribers per telecommunication operator. However, this figure may not be very accurate as many Nigerians own more than one phone line, so there may be issues of double counting. The US Census Bureau (2014) reported an Internet penetration in Nigeria of 33 percent in 2014. This shows that Internet penetration in Nigeria is still very low compared to other African countries especially Morocco, Egypt, Tunisia and South Africa.

**5.2.3 Develop a government policy on cloud service adoption:** Given the low awareness about the potential of cloud computing and skills to acquire and manage such services among government institutions in Nigeria, the Government of Nigeria should introduce a new policy that mandates and guides all government institutions in the country to use cloud services for some aspects of their work in order to exploit some of its advantages

**5.2.4 Provide more reliable power supply:** Lack of or unstable power supply especially outside the big towns was given by the survey participants as another big challenge to the adoption of cloud computing in Nigeria. Additionally, Greengard (2010) identified lack of stable power supply as one of the factors that can cause both loss of data and inability to access cloud services. He noted that, in essence, consumers may not be able to access cloud services always and even when they do sudden loss of power supply can cause loss of data (Greengard, 2010). Therefore, for more institutions in Nigeria to adopt cloud services, the reliability of power in areas that already have it should be improved and for those that have not yet got it, it should be extended there.

**5.2.5 Reduction of internet Costs:** Another major problem identified by both cloud service providers and government institutions as limiting the ready adoption of cloud services is the high cost of bandwidth required to transfer data through the Internet especially when working with data intensive applications (Otuka, Preston, & Pimenidis, 2014). This challenge is a continental challenge. The Research ICT Africa household and individual ICT survey (2012) found that in 11 of the 12 participating sub-Saharan African countries (the exception being South Africa), less than 16 per cent of the population has ever used the Internet. Moreover, most of those that have ever used the Internet are concentrated in urban areas, while rural and marginalised areas have poor or no Internet at all ; and of those using the Internet, the majority gain access to it through mobile devices but at a very high cost of bandwidth (Research ICT Africa, 2012).

**5.2.6 Availability of reliable and consistent cloud services:** The study participants also expressed limited confidence in the overall reliability and consistency in the quality of service provided by cloud service providers over a long term. This was also pointed out by Otuka, Preston & Pimenidis (2014). In the survey, representatives of some government agencies expressed their discomfort about entrusting their IT services to cloud service providers for fear of down time. They noted that they may not be sure if the cloud services provider will guarantee optimal performance for their mission critical business. This view is supported by Carr (2005), who rightly opined that one of the major impediments to the adoption of cloud computing will not be technology but attitude of end-users towards cloud computing. Marston et al., (2011) observed that some applications may not be currently sustainable to be implemented as cloud service but may therefore need to interact with other cloud based applications, a process that may pose challenges both in terms of contractual and support issues. Due to the nature of cloud computing services some organizations may be skeptical in adopting the service, as they do not have “control” as such over the information and supporting infrastructure. Furthermore some may also be worried about vendor location due to lack of standards or the vendor even completely going out of service.

**5.2.7 Data Security, privacy and standards:** just like elsewhere in the world, government institutions in Nigeria raised the issue of Security and privacy as one of the major issues hindering them from adopting cloud computing services. Ilias (2013) noted that by adopting cloud computing, an organization is handing over its data and information to a third party to manage and protect hence reliability is very important. Data compromise will cause a disaster to big organizations financially and taint their reputation. Furthermore the survey participants noted that the stories they hear on cyber wars among countries and security breaches faced by the top IT companies in the world confirms their fears about the security challenges of cloud computing services. As noted by Ilias (2013), leveraging a remote cloud based infrastructure means that a company essentially gives away private data and information, including what might be sensitive and confidential. It is then up to the cloud service provider to manage, protect and retain them, thus the provider’s reliability is very critical. Similarly, privacy in the cloud is another huge issue. Companies and users have to trust their cloud service vendors that they will protect their data from unauthorized users. In a research carried out by Awosan (2014) Chief Information Officers in selected organizations in Nigeria concurred that cloud service adoption is risky due to insecurity and lack of privacy. Likewise the research by Otuka, Preston, & Pimenidis (2014) reported that the IT community in Nigeria considered security and privacy issues as well as lack of standards governing ICT use in general in Nigeria, major impediments to cloud computing adoption in Nigeria.



**5.2.8 National security:** Insecurity faced in some parts of the country is a challenge because it can disrupt the connectivity to the cloud infrastructure. Telecommunication Companies base stations are sometimes destroyed across the country, According to International Bank for Reconstruction and Development / The World Bank (2016), 150 base stations were lost due to bombing and flooding in 2012 alone and twice as many dependent base stations were also affected. Fiber links laid across the country have many times been vandalized leading to disruption of service hence hindering the ability of service providers to have their service available 24/7 and more importantly, such occurrences discourage potential customers from taking up use of cloud services. Therefore, improvement of national security will increase the reliability of the internet infrastructure and cloud services which will in turn attract more people to take up use of cloud services.

### **5.3 The development of a model for adoption of Cloud Computing in developing nations.**

This section discusses a model for adoption of cloud computing in Nigeria, based on the requirements discussed in section 5.2. The model builds on the integrated model that has been widely utilized in efforts to increase adoption of cloud computing in developing nations. Other models for cloud computing adoption were evaluated as presented in chapter two section 2.9, but the integrated model was the closest to the requirements established for increasing adoption of cloud computing in Nigeria.

#### **5.3.1 Deriving the Model**

There are various models for adoption of cloud computing as presented in section ....but the integrated model was the closest to the requirements for adoption of cloud computing in Nigeria.

The integrated model was developed to examine the most important factors for adoption of cloud services in an organization. It covers technological, organizational and environmental factors (Tornatzky and Fleischer, 1990).

The components of technological factor meets the requirement for available and reliable power supply, the components of security privacy meets the requirement for level of security procedure in place to protect information or the system from unauthorized access or any other security events. The components of organizational factors meets the requirements for top management support and technology readiness, According to requirement collected the management will helps with developing of a government policy on cloud services adoption, management should introduce a new policy that mandates and guides all government institutions in the country to use cloud services for some aspects of their work in order to exploit some of its advantages while for technology readiness IT infrastructure and human resources in terms of cloud computing is by improving the quality of internet infrastructure. Cloud service providers that participated in the study noted that there is a need to provide broadband connection to the backbone infrastructure and data centres to make it easier for individuals and institutions to access cloud services, the components of environmental factors meet the requirement for The environmental factor that determines the environmental elements that might affect an organisation's intent to use cloud technology like compliance with regulation, trading partner pressure and competitive pressure.

#### **5.3.2.1 A Model for Increasing Adoption of Cloud Computing Services In Nigeria**

An integrated model has been developed to examine what are the most important factors for adopt the cloud in an organisation. This model incorporates aspects of the Technology Organization Environment Framework TOE (Tornatzky and Fleischer, 1990), The research model consists of three fundamental factors: technological, organisational, and environmental factors.

##### **5.3.3.1 Components of The Model Developed**

##### **5.2.3.2 Technological Factor**

The technological factor describes the characteristics of the cloud technology and identifies the factors that affect an organisation's decision to adopt this technology.

- 5.2.3.2.1 Availability:** Availability is an influential factor in relation to an organisation's decision to adopt cloud computing. Cloud computing offers resources online, meaning that the consumer can access the cloud from anywhere and at any time. This means the system needs to function properly and must be available to use whenever it is requested.
- 5.2.3.2.2 Reliability:** The reliability of the cloud is another major factor in the decision. It refers to the ability of a system to fulfill its intended function in a proper manner as expected. Reliability involves ensuring a high quality of service to end users, with a high transmission rate, minimum rate of errors, and fast recovery.
- 5.2.3.2.3 Security:** Refers to the level of security procedures in place to protect information or the system from Unauthorised access or any other security events. Lack of security is one of the biggest doubts for many organisations that intend to adopt the cloud (Benlian and Hess, 2011)
- 5.2.3.2.4 Privacy:** Defined as confidentiality of data, where only authorised users can access it. It is the main concern for organisations thinking about cloud computing because when using a cloud service an organisation cannot fully control the information stored on cloud-based servers.
- 5.2.3.2.5 Trust:** Trust refers to the reliance on another entity and the belief that this entity will function as expected. Trust in the cloud environment heavily depends on trusting the service itself and the provider to provide a trusted level of authenticity, integrity and confidentiality in regard to the service and the stored data.
- 5.2.3.2.6 Relative advantage:** Relative advantage is an element of the DOI model (Rogers, 1995). This factor refers to the level of benefit to an organisation if they decide to move into cloud computing.
- 5.2.3.2.7 Compatibility:** Refers to the ability of the existing application to be compatible with the cloud. The compatibility of a firm's applications with the cloud environment is a real problem that an organisation needs to consider carefully when considering use of the cloud. This factor was identified in the Rogers model (Rogers, 1995).
- 5.2.3.2.8 Complexity:** An organisation normally considers the degree of difficulty involved in using new technology as an important element in their decision before adopting this technology. This factor is also an element of the DOI model (Rogers, 1995).

### 5.2.3.3 Organisational Factor

The organisational factor describes the characteristics of an organisation that might have a significant impact on their decision.

**5.2.3.3.1 Top management support:** Top management plays an important role and has a significant impact on the adoption rate of IT innovations at the organisational level. Support from top management is essential because they have the ability to make the change and execute acceptance of the cloud. This change in the organisation needs a supportive decision from top management.

□ **5.2.3.3.2 Organisation size:** The size of the organisation is another influential factor. The number of employees, the amount of investments, the target market and annual revenue defines the organisation size.

**5.2.3.3.3 Technology readiness:** The technological readiness of organisations, meaning the degree of readiness of the IT infrastructure and the human resources in terms of cloud computing.

### 5.2.3.4 Environmental Factor

The environmental factor determines the environmental elements that might affect an organisation's intent to use cloud technology.

**5.2.3.3 Compliance with regulations:** This is an influential factor that can make an organisations reluctant to move into cloud computing. This concern comes from the fact that there are no governmental regulations or rules that can support the firm in the event of a data breach. The lack of IT standards is a real problem that might obstruct adoption decisions (Marston et al, 2011).

**5.2.3.4 Competitive pressure:** Defined as the degree of pressure that an organisation faces from competitors. In a highly competitive industry, an organisation encounters pressure from competitors to adopt new technologies. This pressure forces some organisations to adopt cloud computing technology and gain a great benefit, more business facilities and better operational efficiency.

**5.2.3.5 Trading partner pressure:** This is another pressure affecting the organisations adoption decision. This pressure comes from vendors or other partners who might adopt cloud computing. Consequently, this might encourage an organisation to adopt this technology.

**5.2.3.6 Physical location:** The physical location is a critical factor that affects an organisation's decision to adopt cloud computing for several reasons. First there are no international policies or regulations for data protection in cloud. Second the fact that some of the cloud providers store the data in another country without disclosing this to the end users (Jaeger et al, 2009).

## 5.4 Cloud computing adoption Model

### TRADITIONAL FACTORS

Availability  
Reliability  
Security  
Privacy  
Trust

### DIFFUSION OF INNOVATION THEORY

Relative Advantage  
Compatibility  
Complexity



Intention To Adopt Cloud



### ORGANISATIONAL FACTORS

Top Management Supports

Organisational Size

Technology Readiness

Figure 1 an integrated model for cloud computing adoption



## VII. CONCLUSION AND RECOMMENDATION

The objective of the research is to examining how the uptake of cloud computing can be increased in government institutions in developing countries, the specific objectives of the study are: To collect requirements for increasing the uptake of cloud computing in developing countries like Nigeria, To design a model that provides guidance on how to increase uptake of cloud computing in developing countries and To test and validate how use of cloud computing in developing countries like Nigeria can be increased?

The learning from the literature review and the Questionnaire results has provided the uptake of cloud computing in government institutions in Nigeria that have been summarized into the following three research questions.

### 5.1 CONCLUSION

If the present challenges militating against the adoption of cloud computing in Nigeria are resolved it has the potential to deliver immense benefits to government institutions businesses. Organizations can take advantage of cloud computing to quickly enter into a market a move that would have previously been more difficult due to cost of acquiring ICT infrastructure. This is particularly of advantage in emerging markets like Nigeria where there is gross inadequate infrastructure, which poses a strong disadvantage to organizations that are trying to compete with others in the countries. But with the advent of cloud computing these businesses can leverage readily available, efficient and affordable cloud services. So cloud computing will allow organizations in Nigeria to have access to information technology services on demand without having to incur the full cost of setting up full blown technology infrastructure of their own. This will allow the organization to utilize the money it should have invested in acquiring technology infrastructure into other areas. And the fact that the organization under cloud computing environment will have to pay only for what it needs and uses, it further saves the organization from making investment in infrastructure that it could cease to use in future. So in essence the problem of underutilization of technology infrastructure will be taken care of.

Organizations in Nigeria will have faster time to market their products/services as not only the cost of setting the necessary ICT infrastructure is reduced but also the time it would take to setup such facilities is also avoided. Marston, et al., (2011) further notes that cloud

Computing significantly lowers the barrier to innovation, making it more feasible for businesses to scale their services (either upwards or downwards depending on demand and other considerations). And furthermore, cloud computing makes it possible for businesses to access new classes of applications and services that were hitherto impossible to access. Cloud computing will also help organizations achieve reasonable savings on energy cost. This is particularly true since the organization will have limited IT infrastructure that require energy in its premises.

### 5.2 RECOMMENDATIONS

The future of cloud computing in Nigeria is bright if government and all stakeholders would put all hands on deck to ensure that these identified challenges/impediments to its feasibility are addressed squarely. On this note, the researcher proffers the following recommendations which if implemented would enhance the effective adoption of cloud computing in Nigeria.

The unreliability of power supply in the country needs to be taken seriously and resolved as soon as possible. This is because electricity is very essential especially in the running of data centers.

There should be intensified awareness creation by cloud service providers geared at sensitizing the public on the benefits and risks of cloud adoption by organizations in Nigeria.

More cloud service providers are needed in the country to encourage competition, which will result to the driving down of the cost of its services. This would make the technology more appealing to organizations.

Cloud providers in Nigeria should be able to provide free trials of their services to their targeted organizations at a stipulated period of time to encourage them to adopt the technology.

More data centers should be established in the country to improve the access to cloud computing resources, reduce costs of access, increase monitoring for security purposes, and protect local content.

There should be a strong legal framework on data protection, which should be in line with international best practices. When this is properly put in place, clarification of

Relations between data center managers and clients, as well as service level agreements would be enhanced.

The implementation of the submission of a committee set up by the federal government to develop a national broadband strategy and roadmap for Nigeria would go a long way in helping the growth of cloud computing in Nigeria. The implementation period is between 2013 and 2018 (a five-year period) geared towards increasing Internet and broadband penetration across the country tremendously. The intention is to ensure that all state capitals and urban cities will have metro-fibre infrastructure installed within the period. The key objectives of the plan as highlighted include the promotion of pervasive broadband deployment, increasing its adoption and usage, and ensuring availability of broadband services at affordable rates.

**Question 1. What are the requirements for increasing the uptake of cloud computing in government institutions in developing countries?**

**Question 2. How can the requirements for increasing the uptake of cloud computing in government institutions in developing countries be realized?**

**Question 3. How can improvement in the uptake of cloud computing in government institutions in developing countries be tested and validated?**

### 5.3 FUTURE RESEARCH

There are areas in which further research can be done to provide more insight into uptake of cloud computing within government institutions in developing nations particularly Nigeria.

The governance of cloud computing in government institutions in Nigeria for a new paradigm of computing. So the possible research question is: "What is the new cloud computing governance in government institutions in Nigeria?"

The number of cloud computing projects will start to increase in future therefore research into uptake of cloud computing will be important. A possible research question is: "What are the critical considerations for successful uptake of cloud computing in the government institutions in Nigeria?"

One of the main concerns about cloud computing is poor security. This needs to be researched and a possible research question is: "How to secure cloud computing by developing an enterprise security architecture for the government institutions?"

With the huge upfront investment of cloud computing, a possible research question is: "How to make cloud computing an enabler to government objectives?"

### REFERENCES

- [1] Venkatesh, V, Morris, M. G, Davis, G. B. And Davis, D (2003) "User acceptance of information technology: toward a unified view". MIS Quarterly, vol. 27, no. 3, pp. 425-478, 2003
- [2] [https://www.utwente.nl/cw/theorieenoverzicht/Theory%20Clusters/Communication%20and%20Information%20Technology/Diffusion\\_of\\_Innovations\\_Theory](https://www.utwente.nl/cw/theorieenoverzicht/Theory%20Clusters/Communication%20and%20Information%20Technology/Diffusion_of_Innovations_Theory)
- [3] Amrhein, D., & Quint, S., 2009. "Cloud computing for the enterprise: part 1: capturing the cloud." Developer Works, IBM, 8
- [4] Andrew King, 2013. 3 Interesting Cloud Computing Statistics | ERP Software Blog. [Online] Available at: <http://www.erpsoftwareblog.com/2013/06/3-interesting-cloud-computing-statistics/> [Accessed on 7th September 2013]
- [5] Anna, 2011. The Fear of Cloud Computing. <http://www.axon-it.com/2011/12/06/the-fear-of-Cloud-computing/> [Accesses on: 8th September, 2013]
- [6] BizWatchNigeria.com. 2013. Telecoms Operators Target \$35.6bn Revenue in Cloud-Service Market. [Online] Available at: <http://bizwatchnigeria.com/telecoms-operators-target-35-6bn-revenue-in-cloud-service-market-2/> [Accessed on: 20th August 2013]
- [7] Blogs.idc.com. 2013. IDC eXchange >> Blog Archive >> New IDC IT Cloud Services Survey: Top Benefits and Challenges. [Online] Available at: <http://blogs.idc.com/ie/?p=730> [Accessed on 20th August 2013]
- [8] Businessdayonline.com. 2012. Why FG is embracing cloud computing – CommTech Minister. [Online] Available at: <http://www.businessdayonline.com/NG/index.php/tech/telecoms/47059-why-fg-is-embracing-cloud-computing-commtech-minister#!> [Accessed on: 24th August 2013]
- [9] Carroll, L. 2013. Time to embrace cloud computing in Nigeria, says EMC. [Online] Available at: <http://www.communicationsafrica.com/internet/time-to-embrace-cloud-computing-in-nigeria-says-emc> [Accessed on: 15th August 2013]
- [10] CBS News. 2012. Sweden moving towards cashless economy. [Online] Available at: [http://www.cbsnews.com/8301-202\\_162-57399610/sweden-moving-towards-cashless-economy](http://www.cbsnews.com/8301-202_162-57399610/sweden-moving-towards-cashless-economy). [Accessed on: 5th September 2013]
- [11] Central Bank of Nigeria CBN, 2011. "Nigeria: Cashless Economy Policy Will Save the Country N192 Billion". Vanguard, All Africa Global Media (allAfrica.com). <http://allafrica.com/stories/201110060223.html> [Accessed on: 6th September 2013]
- [12] Chabrow, E. 2010. Cloud Computing: Lack of Awareness as an Obstacle. [Online] Available at: <http://www.govinfosecurity.com/cloud-computing-lack-awareness-as-obstacle-a-2664/op-1> [Accessed on: 8th September 2013]
- [13] Cloud Computing - The Complete Cornerstone Guide to Cloud Computing Best Practices. n.d. [e-book] The Art of Service. pp. 17-21. [Accessed: 1 Sep 2013].
- [14] Cloud Computing in Africa Situation and Perspectives. 2012. [e-book] Available through: ITU [http://www.itu.int/ITU-D/treg/publications/Cloud\\_Computing\\_Afrique-e.pdf](http://www.itu.int/ITU-D/treg/publications/Cloud_Computing_Afrique-e.pdf) [Accessed: 1 Sep 2013].
- [15] Forrester Research. 2009. James Staten's Blog. [online] Available at: [http://blogs.forrester.com/james\\_staten/09-10-14-cloud\\_defined\\_now\\_stop\\_cloudwashing](http://blogs.forrester.com/james_staten/09-10-14-cloud_defined_now_stop_cloudwashing) [Accessed on: 10th August 2013].

- [16] Gartner.com. 2009. Gartner Highlights Five Attributes of Cloud Computing. [Online] Available at: <http://www.gartner.com/newsroom/id/1035013> [Accessed: 1 Sep 2013].
- [17] Goodenough, M. 2013. Forbes. Does Cloud Computing Mean the End of Traditional Storage Networks? [Online] Available at: <http://www.forbes.com/sites/centurylink/2013/04/09/does-cloud-computing-mean-the-end-of-traditional-storage-networks/> [Accessed on: 5th August 2013]
- [18] Google. 2010. Official Blog: Three million businesses have gone Google: celebrating growth, innovation and security. [Online] Available at: <http://googleblog.blogspot.ae/2010/09/three-million-businesses-have-gone.html> [Accessed: 1 Sep 2013].
- [19] Gens, F. 2013 IDC eXchange >> Blog Archive >> Defining “Cloud Services” and “Cloud Computing”. [Online] Available at: <http://blogs.idc.com/ie/?p=190> [Accessed on: 10th August, 2013].
- [20] Huth, A. and Cebula, J. 2011. The Basics of Cloud Computing. [e-book] Carnegie Mellon University. Available through: US-CERT <http://www.us-cert.gov/sites/default/files/publications/CloudComputingHuthCebula.pdf> [Accessed: 1 Sep 2013].
- [21] Itnewsafrika.com. 2013. Getting a better deal on cloud computing | IT News Africa- Africa's Technology News Leader. [Online] Available at: <http://www.itnewsafrika.com/2013/07/getting-a-better-deal-on-cloud-computing/> [Accessed: 1 Sep 2013].
- [22] Java Code Geeks. 2013. Advantages and Disadvantages of Cloud Computing – Cloud computing pros and cons. [Online] Available at: <http://www.javacodegeeks.com/2013/04/advantages-and-disadvantages-of-cloud-computing-cloud-computing-pros-and-cons.html> [Accessed: 1 Sep 2013].
- [23] Kuyoro, S. O., Ibikunle, F., & Awodele, O. 2011. Cloud Computing Security Issues and Challenges. International Journal of Computer Networks. Cited on Ume, A., Bassey, A. and Ibrahim, H. 2012. Impediments Facing the Introduction of Cloud Computing Among Organizations in Developing Countries: Finding the Answer. [e-book] Asian Transactions on Computers. Pp. 14-18. <http://www.asian-transactions.org/Journals/Vol02Issue04/ATC/ATC-70209042.pdf> [Accessed on: 8th September 2013]
- [24] Linthicum, D. 2013. The cloud is killing traditional hardware and software. [Online] Available at: <http://www.infoworld.com/d/cloud-computing/the-cloud-killing-traditional-hardware-and-software-216963> [Accessed on: 10th August 2013].
- [25] Mell, P. and Grance, T. 2011. The NIST Definition of Cloud Computing. [e-book] pp. 2-3. <http://csrc.nist.gov/publications/nistpubs/800-145/SP800-145.pdf> [Accessed: 1 Sep 2013].
- [26] Microsoft Research. 2013. [Online] Available at: <http://www.google.ae/url?sa=t&rct=j&q=&esrc=s&source=web&cd=1&cad=rja&ved=0CDEQFjAA&url=http%3A%2F%2Fresearch.microsoft.com%2Fpubs%2F102318%2FLocation-based%2520service%2520on%2520the%2520Cloud.pptx&ei=atFRUoCiFoiy0QX114GgBw&usq=AFQjCNHfHw8TwgAIMf1gMWzFebz9yeRpA&bvm=bv.53537100,d.bGE> [Accessed on: 20 August 2013]
- [27]
- [28] Ministry of Communication and Technology. 2013. Slideshare.net. [Online]. Available at: <http://www.slideshare.net/TransformNG/ministry-of-communication-and-technology> [Accessed on 25th August 2013].
- [29]
- [30] Oluwanishola Abiodun, O., Igwe Sunday, A., Anthony Chukwudi, O., Phalecs, J., Blessing, O. and Clement Omozuanbo, A. 2013. Achieving Cashless Economy in Nigeria: The Cloud Computing Approach and Imperative of Nigeria's CBN for Effective Coordination. International Journal of Multidisciplinary Sciences and Engineering, 4(6), pp.22-24. Available at: <http://www.ijmse.org/Volume4/Issue6/paper5.pdf> [Accessed on: 6th September 2013]
- [31]
- [32] Pardeep, K., Sehgal, K. V., & Singh, D. C. 2011. Effective Ways of Secure, Private and Trusted Cloud Computing. International Journal of Computer Science Issues. Cited on Ume, A., Bassey, A. and Ibrahim, H. 2012. Impediments Facing the Introduction of Cloud Computing Among Organizations in Developing Countries: Finding the Answer. [e-book] Asian Transactions on Computers. Pp. 14-18. <http://www.asian-transactions.org/Journals/Vol02Issue04/ATC/ATC-70209042.pdf> [Accessed on: 15th September 2013]
- [33] Shamelle. 2011. A brief History of Cloud Computing | Azure cloud Pro. [Online] Available at: <http://www.azurecloudpro.com/a-brief-history-of-cloud-computing/> [Accessed on: 26th August 2013]
- [34] Sub-Saharan Africa Mobile Observatory. 2012. [e-book] Deloitte and GSMA. Available at: [http://www.gsma.com/publicpolicy/wp-content/uploads/2012/03/SSA\\_FullReport\\_v6.1\\_clean.pdf](http://www.gsma.com/publicpolicy/wp-content/uploads/2012/03/SSA_FullReport_v6.1_clean.pdf) [Accessed on: 5th August 2013].
- [35] The Economist. 2013. Silver linings. [Online] Available at: <http://www.economist.com/news/finance-and-economics/21582013-banks-big-and-small-are-embracing-cloud-computing-silver-linings> [Accessed on 15th September 2013]
- [36] The Punch. 2013. Taking advantage of cloud computing. [Online] Available at: <http://www.punchng.com/i-punch/taking-advantage-of-cloud-computing/> [Accessed on: 10th September, 2013]
- [37] Ume, A., Bassey, A. and Ibrahim, H. 2012. Impediments Facing the Introduction of Cloud Computing Among Organizations in Developing Countries: Finding the Answer. [e-book] Asian Transactions on Computers. Pp. 14-18. <http://www.asian-transactions.org/Journals/Vol02Issue04/ATC/ATC-70209042.pdf> [Accessed on: 11th September 2013]
- [38] Adobe (2011) Adobe Dreamweaver CS6 tutorial. <http://www.bgsu.edu/downloads/cio/file85411.pdf>.
- [39] Accenture (2010) Cloud computing – opportunities for Accenture Lagos. Accenture (2011) Application deployment Guide version 1.0.
- [40] [http://www.WebServiceDeploymentEnvironmentSetupGuide\\_V1](http://www.WebServiceDeploymentEnvironmentSetupGuide_V1) [1]. v.pdf
- [41] Agande, B. (2013) Jonathan promises full implementation of a national broadband roadmap, May 31. <http://www.vanguardngr.com/2013/05/jonathan-promises-full-implementation-of-national-broadband-roadmap/>.
- [42] Agbonile, U. (2010). Why Infoware. <http://www.infowarelimited.com/why-infoware>. Agbaje, J. & Munro, T. (2013) Dimension Data launches cloud services in Nigeria.
- [43] <http://www.vanguardngr.com/2013/03/dimension-data-launches-cloud-services-in-nigeria>.
- [44] Nigeria. Anyaye, C. O. (2010) Lack of political will militates against ICT development.
- [45] <http://www.dailytrust.com.ng/index.php/it-world/36513-lack-of-political-will-militates-against-ict-development>.
- [46] Militates-against-ict-development. Badger, L., Grance, T., et al. (2011) Cloud computing synopsis and recommendations.
- [47] <http://csrc.nist.gov/publications/nistpubs/800-146/sp800-146.pdf>. Chappel, D. (2008) A short introduction to cloud platforms: An enterprise-oriented view.
- [48] <http://davidchappel.com/CloudPlatform>. Cisco (2009) Cisco cloud computing – Data center strategy, architecture, and solutions. Point
- [49] Of view white paper for U.S. public sector, 1st edition. Dustin, A. et al. (2010) Cloud computing use cases white paper version 3.0 ed., cloud
- [50] Computing use case discussion group. Gartner (2009) Gartner IT glossary – cloud computing.
- [51] <http://www.gartner.com/it-glossary/cloud-computing/>



- [52] Gartner (2009) Gartner Highlights for attributes of cloud computing. <http://www.gartner.com/newsroom/id/1035013>.
- [53] Global Technology Industry Discussion Series (2012) Cloud Computing: Issues and Impact.
- [54] [http://www.ey.com/Publication/vwLUAssets/Cloud\\_computing\\_issues,\\_impacts\\_and\\_insights/\\$File/Cloud%20computing%20issues%20and%20impacts\\_14Apr11.pdf](http://www.ey.com/Publication/vwLUAssets/Cloud_computing_issues,_impacts_and_insights/$File/Cloud%20computing%20issues%20and%20impacts_14Apr11.pdf).
- [55] Hofer, C. & Karagiannis, G. (2011) Cloud computing services: taxonomy and comparison.
- [56] <http://doc.utwente.nl/78444/1/Hofer11cloud.pdf>.
- [57] [http://articles.economictimes.indiatimes.com/2011-07-13/news/29768954\\_1\\_key-operational-functions-african-operations-high-volume-business-model](http://articles.economictimes.indiatimes.com/2011-07-13/news/29768954_1_key-operational-functions-african-operations-high-volume-business-model).
- [58] Ikekeonwu, G.A.M. (2010) Cloud computing in Nigeria [draft]. Department of Computer Science, University of Nigeria, Nsukka.
- [59] Infoware (2011) our solutions. <http://www.infowarelimited.com/our-solutions/>.
- [60] Johnson, M. (2010) Nigeria: Cloud computing saves money – ITU.
- [61] <http://allafrica.com/stories/201005270582.html>.
- [62] Katkade, G. B., Ambekar, P. V. (2011) Cloud computing. [http://www.kkwpoly.org/.../CIT\\_REVIEW\\_2011.pdf](http://www.kkwpoly.org/.../CIT_REVIEW_2011.pdf).
- [63] Kepes, B. (2011) Understanding the cloud computing stack SaaS, PaaS, IaaS.
- [64] [http://broadcast.rackspace.com/hosting\\_knowledge/whitepapers/Understanding-the-Cloud-Computing-Stack.pdf](http://broadcast.rackspace.com/hosting_knowledge/whitepapers/Understanding-the-Cloud-Computing-Stack.pdf).
- [65] Landis, C. & Blacharski, D. (2010) Cloud computing made easy.
- [66] <http://www.slideshare.net/avil205/cloud-computing-made-easy.pdf>.
- [67] Mell, P. & Grance, T. (2011) The NIST definition of cloud computing.
- [68] <http://csrc.nist.gov/publications/nistpubs/800-145/SP800-145.pdf>.
- [69] Microsoft (2012) Nigerian bank grows business and reduces IT cost by 20 percent with focused support. <http://www.microsoft.com/africa/Press/Pages/CaseStudy.aspx?id=15>.
- [70] Microsoft (2012) Nigerian Airspace Management Agency (NAMA) government agency improves services and costs through cloud computing. <http://www.microsoft.com/africa/Press/Pages/CaseStudy.aspx?id=16>.
- [71] Nanda, S. & Chiueh, T. (2009) A Survey on Virtualization Technologies. [www.ecsl.cs.sunysb.edu/tr/TR179.pdf](http://www.ecsl.cs.sunysb.edu/tr/TR179.pdf).
- [72] Opeke, F. (2011) Poor Internet service persists.
- [73] <http://businessdayonline.com/NG/index.php/analysis/features/30448-poor-internet-service-persists>.
- [74] Opeke, F. (2013) Main One, Phase 3 take broadband awareness to P-Harcourt.
- [75] [www.vanguard.com/2013/03/main-one-phase-3-tele-broadband-awareness-to-pharcourt/](http://www.vanguard.com/2013/03/main-one-phase-3-tele-broadband-awareness-to-pharcourt/).
- [76] Ohakwe, H. O. (2011) The future of Nigerian backbone infrastructure sharing.
- [77] <http://henroblog.blogspot.com/2011/3/future-of-nigerian-backbone.html?m=1>.
- [78] Olagunji, P. (2011) Nigeria: Sunnet, IBM promise business efficiency with dynamic infrastructure. Daily Independence Newspaper, Issue no. 568, 19th August 2011.
- [79] Omo-Ettu, T. (2011) ATCON wants telecommunications success replicated in power sector.
- [80] <http://www.dailytrust.com.ng/~trust/index.php/it-world/36531-atcon-wants-telecom-success-replicated-in-power-sector>.
- [81] Onwuegbuchi, C. (2013). Business Connexion boosts cloud computing in Nigeria, targets SMEs. <http://www.nigeriacommunicationsweek.com.ng/printpdf/news/business-connexion-boosts-cloud-computing-in-nigeria-targets-smes>.
- [82] Oruame, S. (2008) Corruption is killing ICT in Nigeria.
- [83] Path (2008) Application architecture for
- [84] <http://www.techrepublic.com/.../945923>
- [85] <http://computerworldparaguay.com/articles/2008/11/20/corruption-killing-ict-nigeria>
- [86] Cloud Cloud M. F. (2010). Introduction to <http://www.qatar.cmu.edu/~msakr/15319-s10/lectures/lecture02.pdf> Computing.
- [87] Petri, G. (2010) Shedding light on [http://www.ca.com/files/whitepapers/mpe\\_cl](http://www.ca.com/files/whitepapers/mpe_cl). Sakr, Cloud
- [88] Shimba, F. (2010) Cloud computing: Strategies for cloud computing adoption. Masters Dissertation, Dublin, School of computing, Dublin institute of technology.
- [89] Stryer, P. (2010) Understanding data centers and cloud computing.
- [90] [http://viewer.media.bitpipe.com/1078177630\\_947/1267474882\\_422/WP\\_DC\\_DataCeNterCloudComputing1.pdf](http://viewer.media.bitpipe.com/1078177630_947/1267474882_422/WP_DC_DataCeNterCloudComputing1.pdf).
- [91] Sun (2009) Take your business to a higher level. <http://www.slideshare.net/danielfc/cloud-c...> Tsai, W. et al. (2010) Service-Oriented cloud computing architecture. <http://ieeexplore.ieee.org/.../05501650.pdf>.
- [92] T-Systems (2011) White paper cloud computing. Alternative sourcing strategy for business ICT. [http://www.t-systemsus.com/um/n/uti/508260\\_1/blobBinary/White+Paper+Cloud+Computing+%257B%257BPDF%252C+351+KB%257D%257D.pdf](http://www.t-systemsus.com/um/n/uti/508260_1/blobBinary/White+Paper+Cloud+Computing+%257B%257BPDF%252C+351+KB%257D%257D.pdf).
- [93] Uwaje, C. (2013) Nigeria's ICT industry is still underdeveloped.
- [94] <http://www.thisdaylive.com/articles/nigeria-s-ict-industry-is-still-underdeveloped/135910/>
- [95] Uzor, B. (2013) New Revenue Window for Nigerian IT firms seen in Cloud Technology.
- [96] <http://www.businessdayonline.com/NG/index.php/news/76-hot-topic/50402-new-revenue-window-for-nigerian-it-firms-seen-in-cloud-technology?format=pdf>
- [97] Uzor, B. (2012) Dataflex gives customers cloud computing, 22nd February 2012.
- [98] <http://www.businessdayonline.com/NG/index.php/markets/companies-and-market/33585-dataflex-gives-customers-cloud-computing>.
- [99] Voas, J., & Zhang, J. (2009) Cloud Computing: New Wine or Just a New Bottle? IEEE
- [100] ITPro, pp.15–17.
- [101] Wikipedia (2013) Web search engine. [http://en.wikipedia.org/wiki/Web\\_search\\_engine](http://en.wikipedia.org/wiki/Web_search_engine).
- [102] Wyse (2011) Nigeria chooses Wyse cloud client computing to transform education system for Millions of students.
- [103] Awosan, R. K. (2014). Factor Analysis of the Adoption of Cloud Computing In Nigeria. African Journal of Computing & ICT, 7(1).
- [104] Carr, N. G. (2005). The End of Corporate Computing. MIT Sloan Management Review 46(3)(2005) 67-73

- [103]Central bank of Nigeria (2014). Micro, Small and Medium Enterprises Development Fund (MSMEDF) Guidelines. Retrieved from <http://www.cenbank.org/out/2014/dfd/msmedf%20guidelines%20%20.pdf>
- [104]Chidiebere, N. (2013, December). Enhancing Broadband Penetration in Nigeria. Sunnewsonline.com. Retrieved from <http://sunnewsonline.com/new/enhancing-broadband-penetration-nigeria/> Etuk, R. U., Etuk, G. R & Michael, B. (2014). Small And Medium Scale Enterprises (SMEs) And Nigeria's Economic Development. Mediterranean Journal of Social Sciences, 5(7). Doi:10.5901/mjss.2014.v5n7p656 Greengard, S. (2010) 'Cloud computing and developing nations', Commun. ACM, 53(5), pp.18- 20.
- [105]Leavitt, N. (2009) 'Is Cloud Computing Really Ready for Prime Time?', Computer, 42(1), pp.15-20<sup>[1]</sup>Marston, et al., (2011). Cloud computing – The business perspective. Decision support systems, 51 (2011), 176-189
- [106]Odufunwa, F. (2012). What is happening in ICT in Nigeria: supply- and demand- side analysis of the ICT sector. Retrieved from [http://www.researchictafrica.net/publications/Evidence\\_for\\_ICT\\_Policy\\_Action/Policy\\_Paper\\_6\\_-\\_Understanding\\_what\\_is\\_happening\\_in\\_ICT\\_in\\_Nigeria.pdf](http://www.researchictafrica.net/publications/Evidence_for_ICT_Policy_Action/Policy_Paper_6_-_Understanding_what_is_happening_in_ICT_in_Nigeria.pdf)
- [107]Ogunraku, K., "Infrastructural Challenges of Cloud Computing in Developing Economies". Unpublished dissertation, Federal University of Technology, Akure. 2014
- [108]Olusola, A. A. & Olajoyetan, M. C. (2013). The Poor State of Broadband in Nigeria: An Impediment to National Development and Globalisation. Academic Journal of Interdisciplinary Studies, 2(12). Doi:10.5901/ajis.2013.v2n12p51
- [109]Oniyitan, O. (2014). SMEs: The Solution To Unemployment In Nigeria. Retrieved from <http://w-hbs.com/smes-the-solution-to-unemployment-in-nigeria/> Oyelaran-Oyeyinka, B (2007). SME: Issues, Challenges and Prospects. Being a paper presented at the International Conference on Financial System Strategy 2020 by CBN [http://www.cenbank.org/fss/wed/sme\\_issues,%20challenges%20and%20prospects\\_oyeyinka%20banji.pdf](http://www.cenbank.org/fss/wed/sme_issues,%20challenges%20and%20prospects_oyeyinka%20banji.pdf)
- [110]Otuka, R., Preston, D., & Pimenidis, E. (2014). The Use and Challenges of Cloud Computing Services in SMEs in Nigeria. Proceedings of the European Conference on Information Management; 2014, p325<sup>[1]</sup>Purefoy, C. & Kermeliotis, T. (2012). Underwater cables bring faster internet to West Africa. Retrieved from <http://edition.cnn.com/2012/01/10/business/funk-o-peeke-cable-internet/> Qamar, S., Lal, N., Singh, M., (2010). Internet Ware Cloud Computing: Challenges. (IJCSIS) International Journal of Computer Science and Information Security, Vol. 7, No. 3, March 2010.
- [111]Staten, J. (2009). Hollow out the MOOSE: Reducing Cost with strategic Rightsourcing. Forrester Research, Inc., 2009<sup>[1]</sup>Survey Report on MSME in Nigeria (2010). 2010 National MSME collaborative survey. Retrieved from <http://www.smedan.gov.ng/images/collaborative%20survey%20report.smedan-nbs.pdf>
- [112]U.S. Census Bureau. (2014, March) International Data Base Country Rankings. [Online]. <http://www.census.gov/population/international/data/idb/rank.php><sup>[1]</sup>West, D. M. (2015). Using mobile technology to improve maternal health and fight Ebola: A case study of mobile innovation in Nigeria. Center for Technology Innovations at Brookings.
- [113]Williams, M.D. (2010). Broadband for Africa: Developing Backbone Communications Networks. The World Bank. Retrieved from <https://openknowledge.worldbank.org/bitstream/handle/10986/2422/536430PUB0Broa101%20Official0Use0Only1.pdf?sequence=1>
- [114]Zissis D. and Lekkas D., "Is cloud computing finally beginning to mature?" International Journal of Cloud Computing and Services Science (IJ- CLOSER),vol. 1, no. 4, pp. 172-175, October 2012. [Online]. <http://iaesjournal.com/online/index.php/IJCLOSER/article/view/1248/pdf>
- [115]Ojobo (2016). Nigeria: Licensing More Infracos Will Reduce Internet Cost - NCC
- [116]Enlightenment is Very important as many people at stakes doesn't know about the Cloud computing
- [117]NORTH-EAST NIGERIA Recovery and Volume II Peace Building Assessment 2016 International Bank for Reconstruction and Development / The World Bank for north east

#### AUTHORS

**First Author** – YUSUF JIBRIN OYOYO, MAY16/COMP/025X, School Of Computing And Engineering, Uganda Technology And Management University, Supervisor

**Second Author** – PROF. REHEMA BAGUMA, A RESEARCH DISSERTATION SUBMITTED TO THE SCHOOL OF COMPUTING AND ENGINEERING