ACCEPTANCE OF CLOUD COMPUTING IN BUSINESSES: A CASE STUDY IN NIGERIA

A THESIS SUBMITTED TO THE GRADUATE SCHOOL OF APPLIED SCIENCES OF NEAR EAST UNIVERSITY

By
TEMITOPE EMMANUEL MOBOLADE

In Partial Fulfillment of the Requirements for the Degree of Master of Science in Computer Information Systems

NICOSIA, 2016

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I hereby declare that all information in this document has been obtained and presented in accordance with academic rules and ethical conduct. I also declare that, as required by these rules and conduct, I have fully cited and referenced all material and results that are not original to this work.

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Special thanks to my family for supporting my education this far, continued moral support and prayers, I will forever be grateful to you.

Lastly to the creator of the world for his grace and enduring mercy. He has been wonderful to me.

To my family…

ABSTRACT

Cloud Computing is a fast rising technology everyone wants to get involved with in one way or the other. The acceptance level Cloud Computing varies with from the understanding of the user and also the business. Hence, this research is aimed at investigating the acceptance of Cloud Computing in businesses with a case study in Nigeria. Research based models and questionnaires was employed in this study where data was collected from 208 staffs of different levels in different information technology businesses all around Nigeria. Data was collected to get a basic information about the company and to get information from businesses and know their levels of acceptance of cloud computing all based on utilities, deficiency, determinants and Cloud Computing Usage, all to check their acceptance of the Cloud Computing for their businesses. SPSS was used to analyze the data. percentage, mean, standard deviation, frequency and Linear Regression Analysis methods were also used. The result shows that a higher percentage of organizations who fully adopted cloud computing into their system enabled ease business flow and saved them a whole lot of stress. This may also help the service providers of Cloud Computing to understand the factors that influence business decisions in adopting Cloud Computing, the services that should be created or edited to suite their users and the actions to put in place to attract and encourage more businesses to use Cloud Computing.

Keywords: Cloud computing; cloud computing acceptance; cloud computing acceptance model; Nigeria; small and medium sized enterprises

ÖZET

Bulut Bilisim, herkesin o ya da bu şekilde müdahil olmak istediği hızlı yükselen bir teknolojidir. Bulut Bilişim'in kabul seviyesi, kullanıcıya ve kullanıcının iş anlayışına göre değişiklik göstermektedir. Bu nedenle, bu araştırma, Bulut Bilişim'in Nijerya'da bulunan işletmelerdeki kabülünü bir durum çalışması ile araştırmayı amaçlamaktadır. Araştırmaya dayalı modeller ve anketler bu çalışmada kullanılmıştır. Anketler ve modellerdeki veriler, Nijerya'nın dört bir yanındaki farklı bilgi teknolojileri işletmelerindeki farklı kademelerde çalışan 208 personelden toplanmıştır. Şirketler hakkında genel bilgiler, Bulut Bilişimin şirket içeriisnde kullanım durumları ve Bulut Bilisimin şirket içerisindeki kabul seviyesini belirlemek için gerekli veriler çalışma kapsamında toplanmıştır. Toplanan verileri analiz etmek için SPSS kullanılmıştır. Yüzde, ortalama, standart sapma, frekans ve Doğrusal Regresyon Analiz yöntemleri uygulanmıştır. Araştırma sonunda, Bulut Bilişim sistemlerini şirketlerine tamamen adapte edenlerin iş akışları kolaylaşmış ve bunun sonucu olarak da şirket içi stresi azalttığı tesbit edilmiştir. Böylece çalışmadan elde edilen sonuçlardan, Bulut Bilişim sistemleri sağlayıcıları şirketlerin Bulut Bilişim sistemlerini kullanmalarını etkileyen faktörleri anlamış olacağından daha fazla işletmeyi Bulut Bilişim sistemlerini kullanmaları için cesaretlendirici ve teşvik edici eylemleri anlamalarına yardımcı olacağı düşünülmektedir.

Anahtar Kelimeler: Bulut bilgi işlem; Bulut bilisim kabul; Bulut bilgi işlem kabul modeli; Nijerya; Küçük ve orta ölçekli işletmeler

TABLES OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS

ARPANET	Advanced Research Projects Agency Network
ASP	Application Service Provider
AWS	Amazon Web Service
BIRN	Biomedical Informatics Research Network
CAGR	Compound Annual Growth Rate
CERN	European Organization for Nuclear Research
CRM	Customer Relationship Management
Df	Degree of Freedom
eTC	Electronic Test Company
EC2	Elastic Cloud Computing
ECM	Enterprise Content Management
ERP	Enterprise Resource Planning
FPS	Flexible Payment Services
ICT	Information and Communication Technologies
IaaS	Infrastructure as a Service
LED	Team Light Engineering Development Team
LHC	Large Hadron Collider
NIST	National Institute of Standards and Technology
NITEL	Nigerian Telecommunications Limited
OS	Operation System
P2P	Peer-to-Peer
PaaS	Platform as a Service
PAYG	Pay-As-You-Go
QoS	Quality of Service
R&D	Research & Development
S3	Simple Storage Service
SaaS	Software as a Service
SLA	Service Level Agreement

SME	Small and Medium Sized Enterprises
SOX	Sarbanes Oxley Act
SP	Service Provider
SQS	Simple Queuing Service
SERD	Sustainable Educational Research and Development
VPN	Virtual Private Network

CHAPTER 1

INTRODUCTION

Cloud Computing in this present time has earned its position of becoming one the many most talked about technologies. It has gained so much popularity because of the unique opportunities it offers. The concept of creating a unified computing service was first gotten in the 1960s, when mainframe time-sharing technology was the computing service provided. Just a brief history, In the 50s mainframe computers were so big, taking so much space. Due to the cost of purchasing and maintaining mainframes, organizations couldn't afford to purchase one for each user. Time sharing was the solution to lots of shared access to data and CPU time. The known term “time sharing” is the foundation of Cloud Computing. Cloud Computing stays considered to be one of the greatest influential developments in Information and Communication Technology in the past decade. Surveys of top ICT decision makers in developed countries such as the United States of America (USA) and Australia have positioned this technology in the top five of their major initiatives (Baty and Stone, 2011; CIO, 2013) and researchers have proposed cloud as a tool for organizations in developing countries such as Jamaica to speedily and economically revolutionize their operations (Greengard, 2010; Kshetri, 2010). Google gave out the idea of Cloud Computing in 2007, which would be part of the different business related services like infrastructure as a Service (IaaS), Platform as a Service (PaaS), and Software as a Service (SaaS). Cloud Computing has evolved through a number of phases which include grid and utility computing, application service (ASP), and Software as a Service (SaaS). The idea of an “Integrated Computer Network” was introduced in the 60’s by J.C.R. Licklider, who was accountable for aiding the development of ARPANET (Advanced Research Projects Agency Network) in 1969. His dream was for everybody in the world to be interconnected and having access to programs and data at any website and from anywhere in the world.

Zhang and Zhou (2015) concluded that the final products of the services offered by cloud offerings are services that are provided the Cloud Computing Platform (CCP) has been developed to reduce the overall expenses as it provides the on demand services at any time on pay-per-use pattern. Kaur et al. (2014) provided that Internet is the medium for deploying Cloud Computing services for users to access the required application and services, thus there is a need for available of good and

quality bandwidth for the cloud to thrive. Cloud Computing is a great chance for developing business, and third world counties to enhance their systems and capabilities, and with this the gap between the developed countries and the developing countries is reduced. Now, with the emergence of Cloud Computing it has brought about increase volume output to productivity with fewer people, maintain easy access to your information with minimal upfront spending, people worldwide and in Nigeria to be precise can have access to the cloud, provided access to the Internet is available, and also it is a solution with a budgetary effect and with the help of this technology the introduction of so many enterprises, institutions and organizations is possible.

1.1. Problem Statement

Cloud Computing, as a challenging new technology, is peculiar to the African continent and Nigeria to be specific. This is out of the fact that Nigeria falls short of the basic IT infrastructure requirements (like steady electricity, and poor internet connectivity) for the effective adoption of the technology. Complicated legal framework, fear of not wanting to be the first to go are also some of the militating factors. These reasons slow down the adoption of cloud technology in Nigeria thus denying the country of vital growth opportunities and revenue gains, skills development, job creation, competitiveness etc. (Ogunjobi, 2015).

1.2. The Aim of the Thesis

The aim of this thesis is to study the acceptance of Cloud Computing in Business with a case in Nigeria.

1. What is the business perceptions on the acceptance of Cloud Computing?
2. What is the business perceptions on the acceptance of Cloud Computing on the Size of the Company?
3. What is the business perceptions on the acceptance of Cloud Computing on the type company?
4. What is the business Perceptions on the Acceptance of Cloud Computing on budget?

1.3. Importance of the Thesis

The model will help the institutions know how willing they are to migrate to Cloud Computing services, comparing the local computing to the Cloud Computing, and then checking opportunistic services offered by Cloud Computing and the risk assessment facing the institutions or companies when agreeing to make use of Cloud Computing.

1.4. Limitations of the Study

There are a number of limitations to his research. These should be considered in the other studies to be conducted. This study is limited by the period that begins from March 2015 until March 2016, a longitudinal research in the future would be the best to collect varied data to be later analyzed. This study is limited to Nigeria, a research should could also include more companies in Nigeria. Time of the study was a major limitation in the sense that if this study will be carried out again at the future, the perceptions of the businesses might to cloud computing.

1.5. Overview of the Thesis

This section briefly explains the components of the thesis:

Chapter One displays the object and purpose of the thesis, and its importance, as well as the obstacles and difficulties that interface work in this thesis, in the first quarter as well as an explanation of the contents of the chapters of the thesis

Chapter Two presents studies related to Cloud Computing. Most of these studies and research on Cloud Computing were done in recent years. The topic of Cloud Computing itself has recently emerged and there are not large numbers of studies present. This section includes explanation for each case study.

Chapter Three consists of a brief history about distributed computing and Cloud Computing definition, as well as explaining the Cloud Computing architecture. It also mentions the most important Cloud Computing providers and gives a brief idea about their services, in addition to this it explains Cloud Computing from a business perspective.

Chapter Four explains the data collection method used through interviews with specialists and an online questionnaire. In addition to this, it explains the respondents' profile and how the questions were designed.

Chapter Five offers a model that facilitates the decision making process of moving from traditional computing to Cloud Computing. It also identifies the people who are interested in Cloud Computing. This model consists of ten questions; each question represents an aspect. There are three answers for each question and each answer is assigned a mark. These marks will be gathered to get the final total, which will show whether the decision to move to Cloud Computing is correct, or not. In this chapter, all model questions and the distribution of marks for the answers are explained.

Chapter Six studies, how to apply the model of decision analysis and the results of model are explained.

Chapter Seven includes a review of all chapters of the thesis, the recommendations and possibilities for future research.

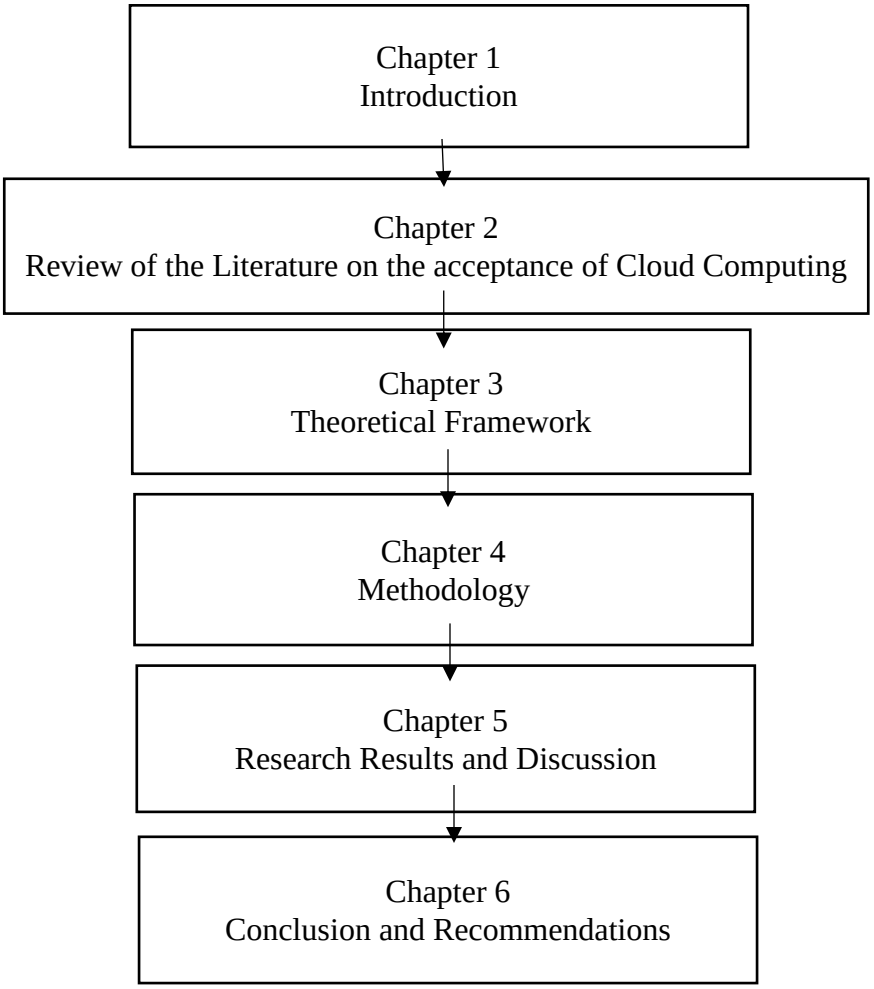


Figure 1.1: Illustrating the sequential order of the thesis

CHAPTER 2

RELATED RESEARCH

2.1. Introduction

Cloud Computing is undoubtedly a technology that has come to stay as several organizations, governments, and individuals are encouraged to key into this emerging smart technology. However, it is worthy of note that this technology is built upon already existing technologies. The figure below illustrates the evolutional technological trend of Cloud Computing.

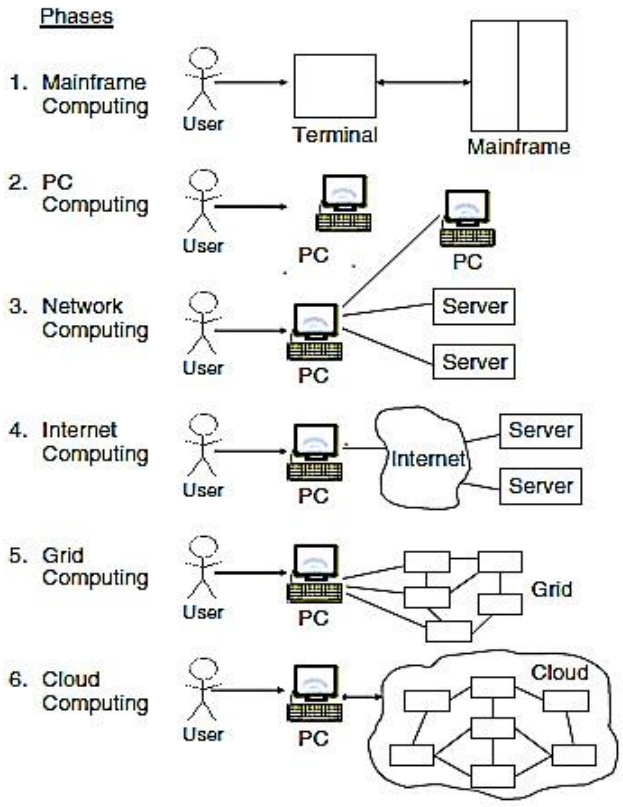


Figure 2.1: Six computing paradigm (Voas and Zhang, 2009)

In this chapter, different definitions on the subject 'Cloud Computing' will be appraised as well as brief discussions on the characteristics, technologies, service and deployment models of Cloud Computing, impediments to its adoption, its feasibility, and the google app engine.

2.2. Description of Cloud Computing

Several definitions have been given on Cloud Computing by different authors. However, the word 'Cloud Computing' has become a popular marketing term that needs clarification through suitable definitions. The vaguest definition of Cloud Computing is the one given by Landis et al. (2011) that defines it as computing on the Internet, as opposed to computing on a desktop. This definition succeeds only on recognizing the dependency of Cloud Computing on the Internet. Cisco (2009) in its own attempt defines Cloud Computing as IT resources and services that are abstracted from the underlying infrastructure and provided on-demand and at scale in a multitenant environment. This next definition is a fairly good attempt as it points out three (3) key attributes of Cloud Computing namely – on demand, at scale, and multitenant environment. Similarly, Accenture (2011) defines Cloud Computing as the dynamic provisioning of IT capabilities (hardware, software, or services) from third parties over a network. This definition acknowledges the on demand, at scale and multitenant nature of Cloud Computing. Another definition is that given by T-System (2008) which states as follows – Cloud Computing is the renting of infrastructure and software, as well as bandwidth, under defined service conditions. These components should be adjusted daily to the needs of the customer and offered with the utmost availability and security. Included in Cloud Computing are end-2-end service level agreements (SLAs) and use-dependent service invoices. This definition is very elaborate but rather too long. Furthermore, Gartner (2009) defines Cloud Computing as the style of computing in which scalable and elastic IT-enabled capabilities are delivered as a service to external customers using internet technologies. This is a good attempt. However, the most generally accepted definition comes from United States National Institute for Standard and Technology (NIST) which defines Cloud Computing as a model for enabling convenient, on-demand network access to a shared pool of configurable computing resources (e.g. networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction.

Of all these definitions, one affirmed fact by most of the authors is that Cloud Computing is an internet-based on-demand service built on the concept of resource sharing. The diagram below depicts a general view of a cloud environment which illustrates provider's response to clients' fluctuating changes in demand.

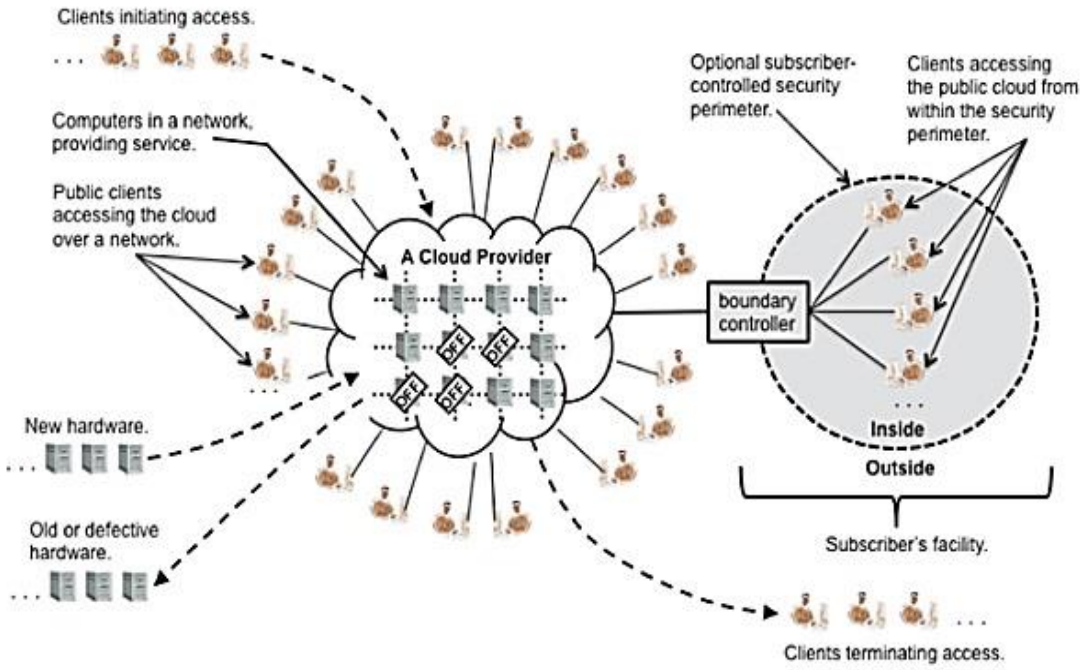


Figure 2.2: General cloud and subscriber view (Badger et al., 2011)

The above figure simply illustrates what happens in the cloud. At every time span, some clients initiate access requiring the cloud provider's service while some others terminate access releasing the resources that they once held. At the same time, some other clients may still be well engaged with the services they require from the service provider. The service provider has several hardware to enable it effectively manage peak service requirement by clients. The hardware not in use is turned off to save energy and cost thereby boosting resource efficiency. Moreover, in case of hardware failure, the cloud is able to relinquish the use of failed hardware and utilize working ones while the provider replaces the old failing hardware with new ones in due course in order to maintain steady service delivery in spite of service failures and service life expirations.

2.3. Features of Cloud Computing

The generally accepted basic characteristics of Cloud Computing is the one given by the National Institute for Standard and Technology (NIST) which proffers five essential characteristics as follows:

1. ***On-demand self-service:*** That is the ability of a client to sign up and receive services at will from any cloud provider.
2. ***Broad network access:*** This refers to the ability of a client to access the cloud provider's services using any standard computing device with internet connectivity like desktop, laptop, mobile phone, etc. The figure below shows Cloud Computing capability of being accessed across several classes of users.

Figure 2.3: Service users using diverse computing tools (Sakr, 2010)

3. ***Resource pooling:*** Regardless of the client's location, the cloud provider's computing resources are readily available and can be accessed as desired by each client to meet up its needs.
4. ***Rapid elasticity:*** Due to varying demands in workloads by different clients, Cloud Computing has the ability to scale up and down to meet up each client's demand.
5. ***Measured service:*** Computing resource usages by clients are transparently recorded to reflect the actual rate of usage by each client.

2.4. The Technology of Cloud Computing

Cloud Computing technology is built based on some already existing technologies like grid computing, utility computing, virtualization, data center computing, the Internet, and the web. The two emerging trends that converge to bring about Cloud Computing is virtualization and application provisioning (T-systems, 2011). Virtualization is a technology that combines or divides computing resources to present one or many operating environments using methodologies like

hardware and software partitioning or aggregation, partial or complete machine simulation, emulation, time-sharing and others. (Nanda & Chiueh, 2009). Virtualization allows you to do more with your existing resources by decoupling the software (like servers) from their underlying hardware. Without virtualization hardware is committed to a single purpose whether it's actively used or not; and when hardware fails the entire configuration has to be rebuilt. (Space, 2012). Virtualization is the key support mechanism to enable infrastructure-as-a service, and are of seven (7) types namely – hardware, memory, data, network, storage, software and desktop virtualization. The figure below shows the different types of virtualization. Hardware, network, storage,

Virtualization					
Hardware	•Full	•Bare-Metal	• Hosted	•Partial	•Para
Network	•Internal Network Virtualization		• External Network Virtualization		
Storage	•Block Virtualization		•File Virtualization		
Memory	•Application Level Integration		•OS Level Integration		
Software	•Os Level	•Application	•ServiceData	•Database	
Desktop	•Virtual Desktop infrastructure		• Hosted Virtual Desktop		

Table 2.1: Types of virtualization (Kelser, 2015)

Network virtualization replaces the traditional Wide Area Network (WAN) which is normally owned and managed by each organization at a very high cost. Storage virtualization offering like Amazon S3 (Simple Storage Service) is utilized by social networking sites like Twitter, Flickr, etc for storage of data. Other examples of storage virtualization include Microsoft SkyDrive, and Apple's MobileMe Service. Server virtualization enables users to subscribe for virtual servers over the Internet. The popular offerings are coming from VMware, Microsoft and Citrix. Application virtualization presents applications over the cloud with each application packaged in a separate virtual box to avoid conflict between different applications and guarantee faster installation. Desktop virtualization enables the user to use his desktop as a virtual one. Citrix and Sun are popular in this cloud offering. (Petri, 2010). Virtualization serves a very essential role in enabling the pooling and sharing of IT resources for outright allocation to clients in today's data

centers. Data center, sometimes called a server farm, is a facility used to house computer systems and associated components, such as telecommunications and storage systems. (Stryer, 2010). They are usually built in less populated areas with cheaper energy rates and lower probability of natural disasters. Modern data centers usually consist of thousands of inter-connected servers. The figure below shows a typical data center facility.

Figure 2.4: A typical data center (Stryer, 2010)

2.5. Cloud Computing Service and Deployment Models

There are essentially three service models as agreed by several authors. They are namely – Software as a service (SaaS), Platform as a service (PaaS), and Infrastructure as a service (IaaS) (Badger et al., 2011; Kepes, 2011; Sun, 2009; Landis & Blacharski, 2010). SaaS stands for the applications that are designed for the end user, and delivered over the web. In otherwise, software is presented in a browser to the end users as services that can be shared by numerous clients on demand. Examples include Google Maps, Google Apps for Business, and Salesforce.com. PaaS provides you with the toolkits you need to facilitate for easy developing, deploying, and management of applications. Examples include Google App Engine, Microsoft Azure platform, Amazon Map Reduce, Amazon Simple Storage Service. IaaS is the delivery of compute

infrastructure (network connectivity, servers, data center space, operating system, virtualization technology, etc.) as a service. Examples include Amazon EC2, Rackspace cloud, Google Infrastructure cloud, and Microsoft Azure. The figure below shows the three (3) main categories of Cloud Computing services.

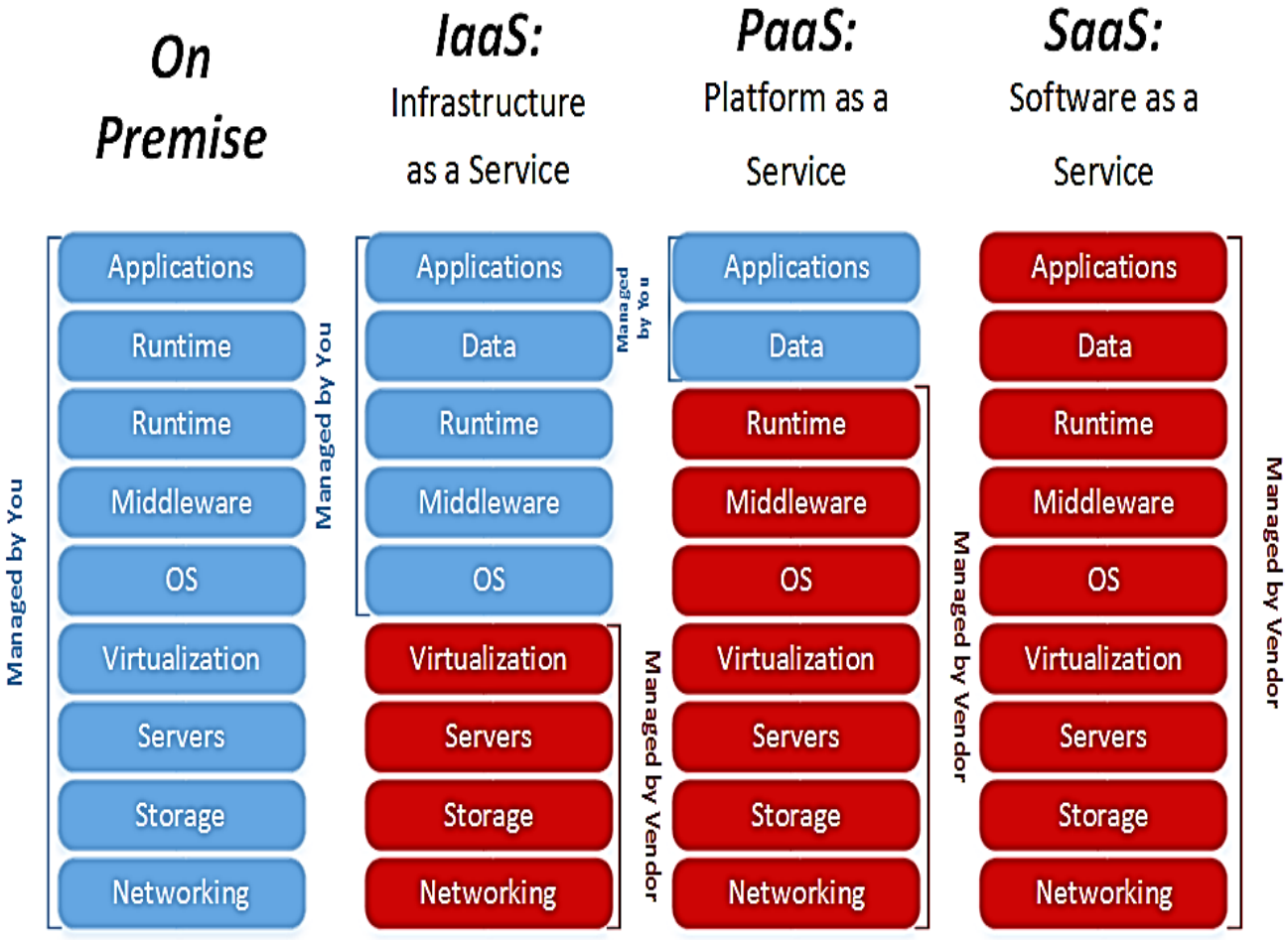


Figure 2.5: Categories of cloud computing services
(https://www.crucial.com.au/blog/2013/05/27/types-of-cloud-computing/
Retrieved February 23, 2016)

Sun Microsystems (2010) categorizes Cloud Computing into three deployment models namely – public clouds, private clouds and hybrid clouds. However, several others are of the view that there are four basic deployment models namely - public, private, hybrid, and community clouds (Badger, 2011; Petri, 2010).

Public cloud is run by third parties that sell cloud services, and jobs from different customers may be mixed together on the servers, storage systems, and other infrastructure within the cloud. The figure below illustrates a public cloud.

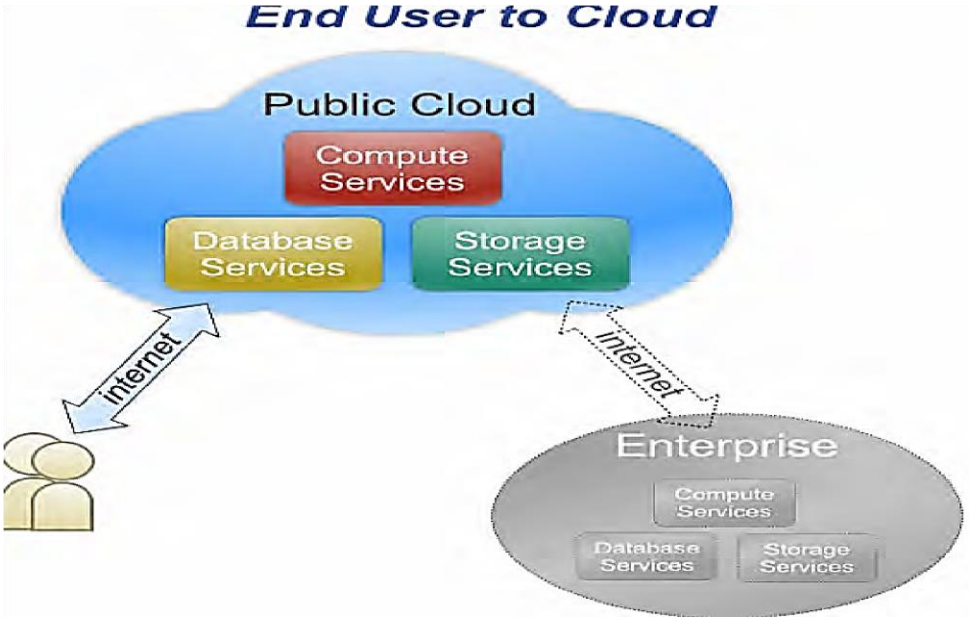


Figure 2.6: Public cloud (Dustin et al., 2010)

Private cloud is on-demand infrastructure owned by a single customer/organization. This infrastructure may be managed by the organization or leveraged to a third party. The figure below illustrates a private cloud.

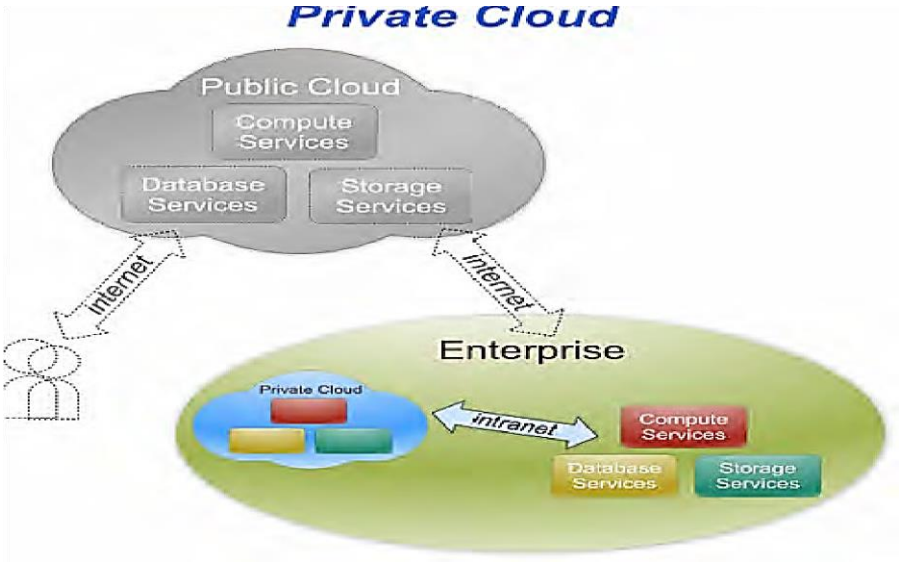


Figure 2.7: Private cloud (Dustin et al., 2010)

Hybrid cloud is a combination of two or more clouds that remain unique entities but are bound together by a uniform technology that enables data and application portability. The figure below illustrates a hybrid cloud.

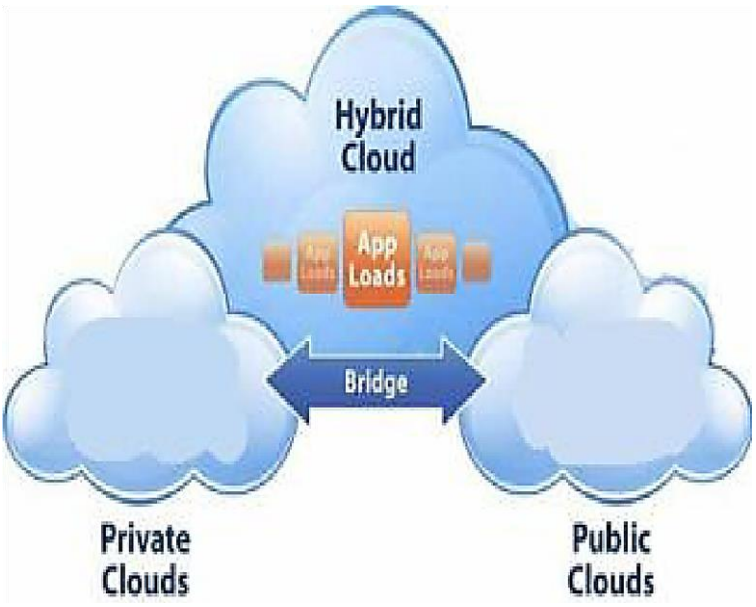


Figure 2.8: Hybrid cloud (Prasad et al., 2013)

Community cloud refers to cloud infrastructure that is shared by several organizations and supports a specific community that has shared concerns (e.g. educational institutions, banking sector, etc). It may be managed by the organizations. The figure below illustrates a community cloud.

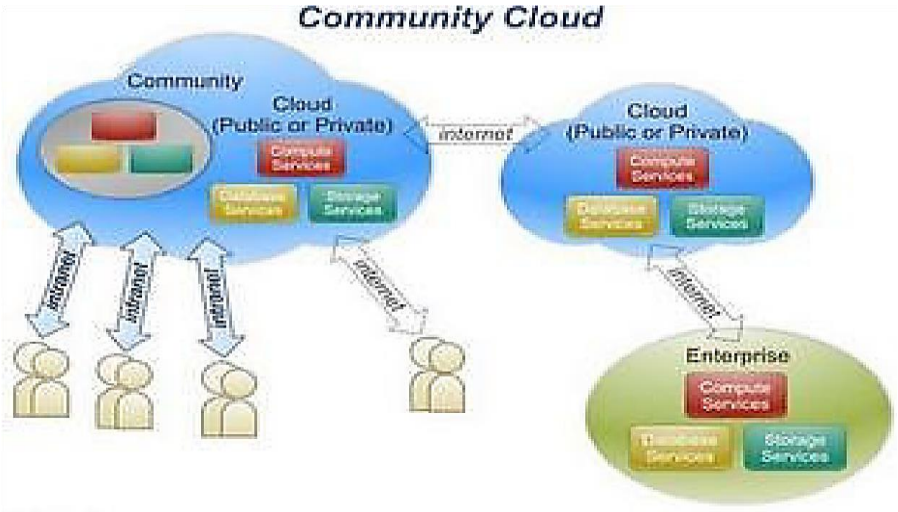


Figure 2.9: A community cloud (Prasad et al., 2013)

2.6. Impediments to Cloud Computing Adoption in NIGERIA

The following are some of the addressable impediments to the feasibility of Cloud Computing in Nigeria:

a) ***Unreliable Power Supply***. Unreliable power supply in this country had been a major setback to the introduction of Cloud Computing in Nigeria. The president of the Association of Telecommunications Companies of Nigeria (ATCON) identified inadequate power supply as the major impediment to the growth of ICT in Nigeria. According to him, a pursuit of the liberalization agenda of the power sector as obtained in the telecommunication sector is needed to solve the protracted issue of inadequate power supply (Omo-Ettu, 2011).

b) ***Lack of political will to the genuine growth of ICT***. The Director-General of National Information Technology Development Agency (NITDA) stated that a major challenge militating against ICT development in Nigeria is lack of political will from the decision makers as he cited that the IT industries are under-funded, and reiterated the need for government to invest substantially in science and technology (Anyaye, 2010). In another development, the president of the Institute of Software Practitioners of Nigeria (ISPON) asserted that in 2012 ICT recorded growth but there was no adequate development. He stressed that we need to promote the indigenous software and infrastructure companies to ensure growth and development of ICT in the country (Uwaje, 2013).

c) ***Corruption***. Experts have reasoned that Nigeria is one of the most corrupt nations in the world today. Oruame (2008) stated that the facts are emerging on how ICT projects have merely ended up as conduit pipes with which billions of U.S. dollars have been siphoned from the public treasury into private bank accounts. Therefore, if these trends remain unchecked, it would hamper the advancement of Cloud Computing in Nigeria.

d) ***Persistency of poor internet services***. The CEO of Main One Cable Company which has laid a 7,000km fiber optic cable linking West Africa to Europe, said that the absence of robust national backbone has led to increased cost of moving capacity around the country. Investigation reveals that to get connected from Lagos to London costs $600 per megabyte as against $1,100 between

Lagos and Abuja due to governments' inability to encourage investment geared towards strengthening backbone transmission networks. According to her, $250 million had been invested so far by the company in building the underwater cables and constructing distribution networks. She opined that the federal government should conduct a review of the national backbone infrastructure, manage the country's national frequency spectrum resource as well as encourage infrastructure sharing amongst telecoms operators in order to improve internet penetration in the country (Opeke, 2011). According to Global System for Mobile Communications Association (GSMCA), MTN, Globacom, and Airtel have only deployed 8,000km, 10,000km, and 4,600km of fibre backbone respectively making a total of 22,600km. This results to only 28.6% internet penetration across the country. Also, some of these providers offer skeletal services to the populace. This must change to enable Cloud Computing to work viably in Nigeria.

e) ***Need for backbone infrastructure sharing/general communication problems***. Infrastructure sharing by mobile operators in Nigeria will no doubt reduce both capital expenditure (CAPEX) and operating expenditure (OPEX). Ohakwe (2011) in his blog stated that operators need to share costs and invest in network technologies that support transmission of large quantities of data such as optical fibre and associated technologies. Furthermore, the landing of undersea cables like Main 1 and Glo 1 and the deployment of enhanced 3G (3G+) and 4G technologies will amplify the increasing demand for data services which is too expensive for individual operators to duplicate, thus requiring the need for infrastructure sharing.

Furthermore, Ikekeonwu (2011) in a paper presentation on Cloud Computing in Nigeria identified several communication problems which could hamper the smooth take off of Cloud Computing in Nigeria. Some of these problems range from broadband to backbone infrastructure. He pointed out the lack of focus on the part of ISPs as all the ISPs (MTN, Globacom, Airtel, etc) target national coverage with none thinking of being a regional operator or provider. For instance, Visafone concentrating on eastern region, and making sure that coverage is highly optimized, steady and efficient. Being a regional operator would result to cost effectiveness and improved delivery since the cost would be less. As a result of these developments, the broadband offerings of all the service

providers in Nigeria are very frustrating/unreliable due to inadequacy of infrastructure and funding. The next section discusses the feasibility of Cloud Computing in Nigeria.

2.7. Probable Facts of Cloud Computing in Nigeria

Cloud Computing offerings globally are taking center stage in strategizing businesses for more profitability and cost management. Nigeria is not an exception as major players in the service provision sector are making some giant strives and intensifying their efforts to create more awareness and contribute substantially in helping companies migrant to the cloud. The then Director for Telecommunication Standardization Bureau at the International Telecommunication Union (ITU) said that Cloud Computing saves costs for servers and storage, offers speed and streamlines application deployment without upfront capital. He stressed that for this reason alone many organizations are now considering adoption of Cloud Computing to provide more efficient and cost effective network services (Johnson, 2010). Similarly, the Chief executive of Sunnet Systems says that Nigerians should take advantage of the Cloud Computing technology to improve and drive their businesses to greater heights. The companies - Sunnet and IBM collaborate to provide dynamic infrastructure technology that would ensure that ISPs and businesses remain on track maximizing their profits and reducing infrastructural risks (Olagunju, 2011).

Cloud Computing globally has come to stay, and Nigeria cannot afford to lack behind. In Nigeria, the major cloud solution providers (like Microsoft, IBM, and Goggle) are working around the clock to make the technology work out. This is done by them in two ways – either providing services directly to organizations or via partnership with other IT/service provider firms.

Microsoft runs large scale cloud services using their data centers around the world. Their cloud services include Microsoft Azure, Microsoft Bing and Windows Live. Microsoft in 2012 established a private cloud environment for Wema Bank Nigeria Plc. The bank now uses MS Exchange 2010 for email messaging, MS SharePoint Server 2010 for collaboration and MS Lync Server 2010 for instant messaging and videoconferencing. Similarly, Nigerian Airspace Management Agency (NAMA) has improved its services by deploying Windows Server 2012 which contains lots of features to meet up with their needs thereby cutting down IT costs amidst other advantages. Furthermore, Cisco and NetApp are examples of service providers that partner with Microsoft to offer more robust cloud services to its clients. Today, NetApp technology is being used by the Central Bank of Nigeria (C.B.N.) as well as the top eight (8) banks in Nigeria.

Moreover, the CBN is championing the course of creating a common Software-as-a-service (SaaS) as well as Infrastructure-as-a-service (IaaS) for all banks in Nigeria. The development of having a common banking application and infrastructure provided and run by a third party (NetApp technology) gave rise to the recent change of bank account numbers to a uniform 10-digit number, popularly referred to as Nigerian Uniform Bank Account Number (NUBAN). It is a laudable project as cost of infrastructure and software provisions are no longer going to be borne by the individual banks alone, but are shared among banks to reduce the cost of doing business and boost the profitability of these banks.

IBM is currently managing the data center of Airtel (Nigeria) as the later had outsourced its infrastructure in Lagos to IBM. This in turn has driven down the cost of using the services of Airtel, and would really lead to the company's sustainability. This implies that if the telecommunication industries outsource their infrastructure to a major cloud solution provider as Airtel had done, cost of rendering services would be drawn down drastically which invariably would lead to less pay in making use of their services. To further enhance Nigerian businesses, IBM is partnering with Sunnet technology solution provider to offer organizations a dynamic infrastructure and Cloud Computing solution that would enable organizations ensure that their infrastructural risks are well managed to promote their efficiency and reduce cost of running their businesses thereby making them more profitable than ever. Google (Nigeria) offers lots of Cloud Computing services rendering enormous support to its clients and partners. Google Apps messaging tools which include email, calendar, and instant messaging solutions helps people to communicate and stay connected anytime anywhere as they wish. One of its key partners in Nigeria is Descasio Ltd which has numerous clients like Coscharis Group, Transcorp, AMCON, etc. With Google Apps Engine cloud platform, data is never lost and searches can easily be performed with much data storage space available to each user anywhere anytime for hosting documents of different formats, and for easy downloads, enabling secure realtime collaboration among workgroups, etc. For example, Gmail provides each user with up to 10GB inbox storage space in the cloud, which is quite enormous. Wyse technology, a cloud provider, offers its services to Electronic Test Company (eTC) in the conduct of examinations in Nigeria. The services of eTC are transforming the way examinations are conducted in Nigeria. eTC has built several centers across the nation's universities with plans to extend it to other examinations like WEAC, etc. With this development, testing will be fast and reliable devoid of inherent fraud that characterized the

traditional paper-based examinations which is time consuming when it comes to marking, scoring and computation of the results. (Wyse, 2011). Business Connexion offerings in Nigeria include IaaS, messaging as a service, Sharepoint-as-a-service, and also builds private clouds for clients – government and private establishments. (Onwuegbuchi, 2013). Main One, a leading provider of internet connectivity in West Africa, is really widening its scope geared towards providing reliable and affordable broadband internet services across the nation. Phase 3 Telecom is partnering with Main One towards the realization of this ambition of extending Main One's services from Lagos to various parts of the country (Opeke, 2013). Industry analysts opined that Nigeria has a Cloud Computing market potential of over $1 billion if broadband infrastructure bottlenecks are quickly addressed to deepen internet penetration (Uzor, 2013).

CHAPTER 3

CLOUD COMPUTING

3.1. Cloud Computing

Cloud Computing is a computing paradigm shift where computing is moved away from personal computers or an individual application server to a cloud of computers (Bharanta, 2014). Users of the cloud only need to be concerned with the computing service being asked for, as the underlying details of how it is achieved are hidden. This method of distributed computing is done through pooling all computer resources together and being managed by software rather than a human (Ramamurthy, 2016).

The services being requested of a cloud are not limited to using web applications, but can also be IT management tasks such as requesting of systems, a software stack or a specific web appliance (Vasudevk, 2010).

From the business point of view, Cloud Computing is a dynamism that aids flip this percentage and offers IT units the capacity to spend 80% of their time on main business developments, like business application design. It's for this aim, the ability to go from 20% of time and money devoted to main business developments to 80%, that the economics of Cloud Computing is so captivating. Nowhere is the present-day model's inefficiency more evident than in the opportunity costs that organizations pay to manage their own computing needs (Soni, 2014).

From another point of view, Cloud Computing can be defined as applications and services that operate on a scattered network by means of virtualized resources and accessed by common Internet protocols and networking standards. It is notable by the notion that resources are virtual and infinite and that details of the physical systems on which software operates are abstracted from the user. Cloud Computing signifies a real prototype modification in the way in which systems are deployed. The enormous measure of Cloud Computing systems was enabled by the commercialization of the Internet and the growth of some large service companies (Yonjan, 2016). Cloud Computing brands the long-held dream of utility computing conceivable with a pay-as-you-go, infinitely scalable, universally available system. With Cloud Computing, you can begin very small and become big very fast. That's the reason Cloud Computing is revolutionary, even if the technology it is built on is evolutionary. Not all applications benefit from deployment in the cloud.

Issues with latency, transaction control, and in particular security and regulatory compliance are of particular concern. Cloud Computing is a model for enabling ubiquitous network access to a shared pool of configurable computing resources (Mell & Grance, 2011).

Cloud Computing and storage solutions provide users and enterprises with various capabilities to store and process their data in third-party data centers (Haghighat et al., 2015). It relies on sharing of resources to achieve coherence and economies of scale, similar to a utility (like the electricity grid) over a network (Grance, 2011). At the foundation of Cloud Computing is the broader concept of converged infrastructure and shared services.

3.1.1. Types of Computing

Computing is classified into different categories. Some of which are:

1. Grid Computing
2. Utility Computing
3. Distributed Computing
4. Virtualization
5. Cluster Computing

3.1.1.1. Grid Computing

Grid computing is a processor architecture that combines computer resources from various domains to reach a main objective. In grid computing, the computers on the network can work on a task together, thus functioning as a supercomputer. Typically, a grid works on various tasks within a network, but it is also capable of working on specialized applications. It is designed to solve problems that are too big for a supercomputer while maintaining the flexibility to process numerous smaller problems. Computing grids deliver a multiuser infrastructure that accommodates the discontinuous demands of large information processing.

Multiple independent computing clusters which act like a grid because they are composed of resource nodes not located within a single administrative domain. Offering online computation or storage as a metered commercial service, known as utility computing, computing on demand, or Cloud Computing. The creation of a virtual supercomputer by using spare computing resources within an organization.

A grid is connected by parallel nodes that form a computer cluster, which runs on an operating system, Linux or free software. The cluster can vary in size from a small work station to several networks. The technology is applied to a wide range of applications, such as mathematical, scientific or educational tasks through several computing resources. It is often used in structural analysis, Web services such as ATM banking, back-office infrastructures, and scientific or marketing research. The idea of grid computing was first established in the early 1990s by Carl Kesselman, Ian Foster and Steve Tuecke. They developed the Globus Toolkit standard, which included grids for data storage management, data processing and intensive computation management. Grid computing is made up of applications used for computational computer problems that are connected in a parallel networking environment. It connects each PC and combines information to form one application that is computation-intensive. Grids have a variety of resources based on diverse software and hardware structures, computer languages, and frameworks, either in a network or by using open standards with specific guidelines to achieve a common goal.

Grid operations are generally classified into two categories:

- ***Data Grid***: A system that handles large distributed data sets used for data management and controlled user sharing. It creates virtual environments that support dispersed and organized research. The Southern California Earthquake Center is an example of a data grid; it uses a middle software system that creates a digital library, a dispersed file system and continuing archive.
- ***CPU Scavenging Grids***: A cycle-scavenging system that moves projects from one PC to another as needed. A familiar CPU scavenging grid is the search for extraterrestrial intelligence computation, which includes more than three million computers. Grid computing is standardized by the Global Grid Forum and applied by the Globus Alliance using the Globus Toolkit, the de facto standard for grid middleware that includes various application components.

Grid architecture applies Global Grid Forum-defined protocol that includes the following:

- Grid security infrastructure

- Monitoring and discovery service
- Grid resource allocation and management protocol
- Global access to secondary storage and Grid FTP

3.1.1.2. Utility Computing

The word utility is used to make an analogy to other services, such as electrical power, that seek to meet fluctuating customer needs, and charge for the resources based on usage rather than on a flat-rate basis. This approach, sometimes known as pay-per-use or metered services is becoming increasingly common in enterprise computing and is sometimes used for the consumer market as well, for Internet service, Web site access, file sharing, and other applications. Another version of utility computing is carried out within an enterprise. In a shared pool utility model, an enterprise centralizes its computing resources to serve a larger number of users without unnecessary redundancy. Conventional Internet hosting services have the capability to quickly arrange for the rental of individual servers, for example to provision a bank of web servers to accommodate a sudden surge in traffic to a web site. Utility computing usually envisions some form of virtualization so that the amount of storage or computing power available is considerably larger than that of a single time-sharing computer. Multiple servers are used on the back end to make this possible. These might be a dedicated computer cluster specifically built for the purpose of being rented out, or even an under-utilized supercomputer. The technique of running a single calculation on multiple computers is known as distributed computing.

Utility computing is the process of providing computing service through an on-demand, pay-per-use billing method. Utility computing is a computing business model in which the provider owns, operates and manages the computing infrastructure and resources, and the subscribers accesses it as and when required on a rental or metered basis.

Utility computing is one of the most popular IT service models, primarily because of the flexibility and economy it provides. This model is based on that used by conventional utilities such as telephone services, electricity and gas. The principle behind utility computing is simple. The consumer has access to a virtually unlimited supply of computing solutions over the Internet or a virtual private network, which can be sourced and used whenever it's required. The back-end infrastructure and computing resources management and delivery is governed by the provider. Utility computing solutions can include virtual servers, virtual storage, virtual software,

backup and most IT solutions. Cloud Computing, grid computing and managed IT services are based on the concept of utility computing.

3.1.1.3. Distributed Computing

Distributed computing is a field of computer science that studies distributed systems. A distributed system is a software system in which components located on networked computers communicate and coordinate their actions by passing messages. The components interact with each other in order to achieve a common goal. Three significant characteristics of distributed systems are: concurrency of components, lack of a global clock, and independent failure of components. Examples of distributed systems vary from SOA-based systems to massively multiplayer online games to peer-to-peer applications. A computer program that runs in a distributed system is called a distributed program, and distributed programming is the process of writing such programs. There are many alternatives for the message passing mechanism, including pure HTTP, RPC-like connectors and message queues. A goal and challenge pursued by some computer scientists and practitioners in distributed systems is location transparency; however, this goal has fallen out of favor in industry, as distributed systems are different from conventional non-distributed systems, and the differences, such as network partitions, partial system failures, and partial upgrades, cannot simply be 'papered over' by attempts at transparency.

A method of computer processing in which different parts of a program are run simultaneously on two or more computers that are communicating with each other over a network. Distributed computing is a type of segmented or parallel computing, but the latter term is most commonly used to refer to processing in which different parts of a program run simultaneously on two or more processors that are part of the same computer. While both types of processing require that a program be segmented divided into sections that can run simultaneously, distributed computing also requires that the division of the program take into account the different environments on which the different sections of the program will be running. For example, two computers are likely to have different file systems and different hardware components. Distributed computing is a model in which components of a software system are shared among multiple computers to improve efficiency and performance.

According to the narrowest of definitions, distributed computing is limited to programs with components shared among computers within a limited geographic area. Broader definitions

include shared tasks as well as program components. In the broadest sense of the term, distributed computing just means that something is shared among multiple systems which may also be in different locations.

In the enterprise, distributed computing has often meant putting various steps in business processes at the most efficient places in a network of computers. For example, in the typical distribution using the 3-tier model, user interface processing is performed in the PC at the user's location, business processing is done in a remote computer, and database access and processing is conducted in another computer that provides centralized access for many business processes. Typically, this kind of distributed computing uses the server communications model.

The Distributed Computing Environment (DCE) is a widely-used industry standard that supports this kind of distributed computing. On the Internet, third-party service providers now offer some generalized services that fit into this model.

3.1.1.4. Virtualization

McEvoy and Schulze (2008) presented Virtualization as well-known concept firstly in network technology. It meant putting an additional layer between real systems and applications which translates concurrent access to real systems into seemingly exclusive access to the virtual system. Nowadays, it is a technology not only associated with the software layer but the hardware too. The virtualization can be applied on servers, networks, storage devices, and even a whole data center. Typical examples for hardware virtualization on the widely used x86 architecture are the Intel VT-x technology and the AMD-V from these two leading chip manufacturers (Fisher-Ogden, 2006). Generally speaking, the resource virtualization is the abstraction of server, storage, network, and operation system by creating a virtual version of them. Virtualization is certainly one of the most underlying technologies enabling Cloud Computing (as well as Grid Computing). As mentioned by Staten (2008), nearly every Cloud Computing vendor abstracts the hardware with some sort of server virtualization. System virtualization is not a new technology; it has existed for decades aboard mainframe systems from IBM and other companies. The primary use of virtualization technologies was to support multiple operating systems. Essentially, it uses a virtual machine monitor or host called a hypervisor to enable multiple operating system instances to run on a single physical server, and based on that, it can enable hardware consolidation in an enterprise or large organization, Gillen et al. (2006). At the software platform level, the heterogeneity exists too:

Windows NT, Unix, or Java 2 Enterprise Edition are just the most important among them, which usually offer different implementations, semantic behaviors and APIs. For these heterogeneous systems, virtualization is the pivotal technology to realize interoperability, Foster et al. (2002). A good example of how virtualization and Cloud Computing are tightly connected is the Citrix XenDesktop, a desktop virtualization system that centralizes and delivers desktop as a service to enterprise users anywhere.4 This virtualization technology avoids installation of all the different office software on the user's local machine and provides ubiquitous access to the software they need, and in the meantime, the system update, backup and other maintenance become much easier and more time-efficient. What the XenDesktop delivers, is a typical Cloud Computing service, although the services are not necessarily provided via Internet.

3.1.1.5. Cluster Computing

A computer cluster is a group of linked computers, working together closely so that in many respects they form a single computer. The components of a cluster are commonly, but not always, connected to each other through fast local area networks. Clusters are usually deployed to improve performance and/or availability over that provided by a single computer, while typically being much more cost-effective than single computers of comparable speed or availability. A computer cluster consists of a set of loosely or tightly connected computers that work together so that, in many respects, they can be viewed as a single system. Unlike grid computers, computer clusters have each node set to perform the same task, controlled and scheduled by software. The components of a cluster are usually connected to each other through fast local area networks (LAN), with each node (computer used as a server) running its own instance of an operating system. In most circumstances, all of the nodes use the same hardware and the same operating system, although in some setups (i.e. using Open Source Cluster Application Resources (OSCAR)), different operating systems can be used on each computer, and/or different hardware. They are usually deployed to improve performance and availability over that of a single computer, while typically being much more cost-effective than single computers of comparable speed or availability.

Computer clusters emerged as a result of convergence of a number of computing trends including the availability of low-cost microprocessors, high speed networks, and software for high-performance distributed computing. They have a wide range of applicability and deployment,

ranging from small business clusters with a handful of nodes to some of the fastest supercomputers in the world such as IBM's Sequoia. The applications that can be done however, are nonetheless limited, since the software needs to be purpose-built per task. It is hence not possible to use computer clusters for casual computing tasks.

3.1.2. The Business of Cloud Computing Today

Cloud Computing is a flourishing technology, but not widely understand stood and used by many because it is a new age technology. Compared to other widely used technologies like Grid Computing, Cloud Computing is particularly market-oriented, and the market situation for Cloud Computing services is thus far very complex: in general, the Cloud services for personal use, like the webmail services from Microsoft, Google and Yahoo etc. are already a necessary part of people's online life. But a market of Cloud Computing services pointing at enterprise customers is not yet well developed. These kinds of services include raw computer materials, like central processing unit power, storage space and memories; software like office software toolkit and Enterprise Resource Planning software etc.; as well as IT services like backup service and software modification management service. For a long time, companies prefer to keep all the related resources in certain places, either in their own data center or a dedicated data center, and buy or let special IT SPs design software for them, and then own the software as their properties. These consuming patterns of IT services are changing because of the emerging Cloud Computing services for enterprises. As companies seek to consume their IT services in a more cost-effective way, interest is growing in gaining a broad range of services, e.g. computational power, storage and business applications, from Cloud Computing SPs rather than from on-premises equipment.

Facing the ever larger demand of Cloud Computing services, various analysis institutions have mostly made strong predictions in the market growth of Cloud Computing in the near future.
Cloud-based applications are becoming more engrained in core business processes across enterprises. The study found that enterprises are migrating significant processing, systems of engagement and systems of insight to the cloud beyond adoption levels of the past. 81.3% of sales and marketing, 79.9% of business analytics, 79.1% of customer service and 73.5% of HR & Payroll activities have transitioned to the cloud. The impact on HR is particularly noteworthy as in 2011; it was the third least likely sector to be disrupted by Cloud Computing.

78% of enterprises expect their SaaS investments to deliver a positive Return on Investment (ROI) in less than three months. 58% of those enterprises who have invested in Platform-as-a-Service (PaaS) expect a positive ROI in less than three months.

Top inhibitors to cloud adoption are security 45.2%, regulatory/compliance 36%, privacy 28.7%, lock-in 25.8% and complexity 23.1%. Concerns regarding interoperability and reliability have fallen off significantly since 2011, 15.7% and 9.9% respectively in 2015.

A more conservative prediction from Gartner Inc. is that Cloud Computing services need at least 7 years to mature, so by 2015, Cloud Computing will have been commoditized and will be the preferred solution for many application development projects (Gartner, 2009). As a leading provider of Cloud Computing service, Amazon AWS has enjoyed a quarterly growth rate of 12% during the period from 2005 to 2008 (Stanley, 2008); another example of how quick the Cloud Computing services from Amazon are expanding is that in mid-2007, the total bandwidth consumption of AWS is already more than the bandwidth consumption of Amazon's Global Websites, the websites providing the traditional ecommerce services.

Hurd, the CEO of Oracle, made some bold predictions for where the enterprise market is going. The first prediction he made is that 80% of all applications will run in the Cloud by 2025. Today, he said, 24 percent of enterprise applications are in the cloud. Secondly, by 2025, Two Suite providers will have 80% of the SaaS Applications market. Further, Oracle will be one of the two. Thirdly, 100% of New Development Testing will be in the Cloud by 2025. The fourth prediction is that Virtually all Enterprise data will be in the Cloud by 2025. The last is that Enterprise Clouds will be the most secure IT environments.

3.1.2.1. Pyramid Model of Cloud Computing Market

Cloud Computing services as a whole are certainly not homogeneous, and the market for Cloud Computing services is not consist of all similar providers, either. In fact, services provided in this market are quite different regarding their inherent characteristics as well as their business models. Figure 1 below demonstrates a layered structure of current Cloud Computing market, based on (Blau et al., 2008; Youseff et al., 2008).

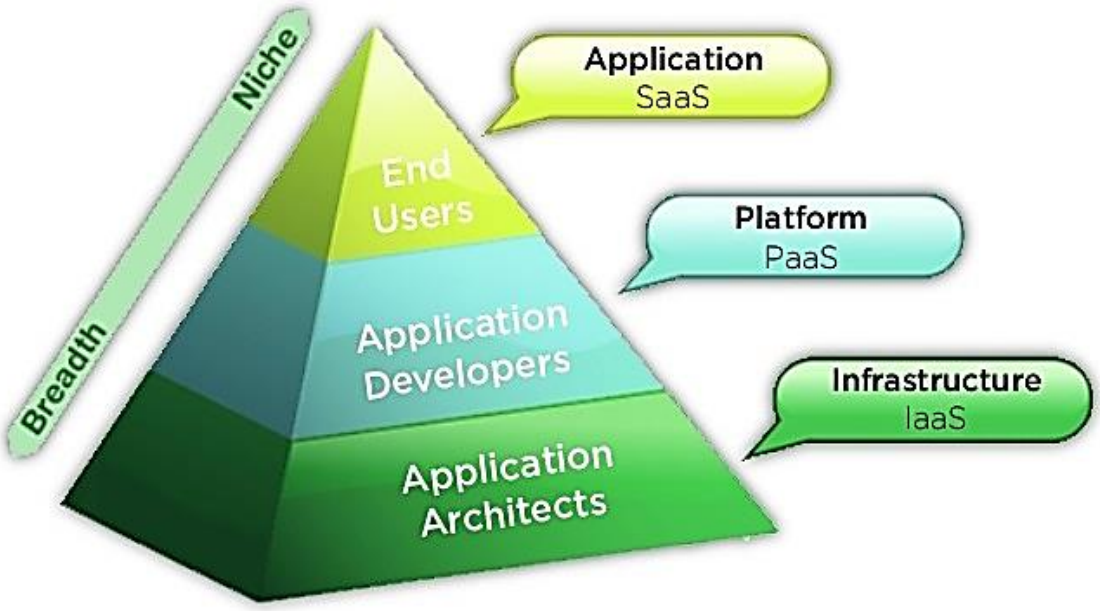


Figure 3.1: Cloud pyramid: layered structure of cloud computing services (Teunissen et al., 2011)

3.1.2.2. Cloud Technology Providers: are basically the Cloud enablers. This technology is the first step of enabling a Cloud structure. The Technology Providers on the current market can be divided into two types:

a) Companies develops and implement Cloud Computing technology by themselves; and

b) Companies focus purely on technology and delivering the technology to other Cloud Service Providers.

Amazon is a typical example of the first one, which has designed and implemented a complete new, idiosyncratic structure for its ecosystem of Cloud Computing services.

3Tera is an example of the second. It provides the AppLogic operating system, which can be used to transform a normal data center into a Grid system, and therefore enables other companies to provide Cloud Computing services based on that system architecture. The companies providing hosting services based on 3Tera's technology include Gridlayer, Agathongroup, Areti and many other important players in the Cloud market.

3.1.2.3. Cloud Infrastructure/Physical Resources Providers: the physical infrastructure provides fundamental resources to higher-level services such as application services. As suggested by Youseff et al. (2014), the physical resources in Cloud Computing market can be categorized into three categories:

a) Computational resources, which are commonly calculated in CPU hours. Typical examples are the Amazon EC2 and Google App Engine;

b) Data storage; and

c) Communication. Among all Cloud Computing services, providing data storage service is relatively easier compared to others, because the physical storage devices are already commodities and the virtualization technology for storage system is already mature. Therefore, the number of mid-sized providers of Cloud storage services is growing fast. Typical examples include Areti, Enki, Terremark etc, as well as some traditional data storage/ data center providers like EMC, AT&T etc.

3.1.2.4. Cloud Platform Providers: a platform is a place to exchange certain resources. There are basically two types of Cloud platforms:

a) platform for raw computer resources exchange; and

b) platform as a software environment for developing, testing, deploying and running Cloud Computing applications.

The first type, which can be described as the Ebay for computer resources, can only be built in an environment where exchange of raw computer resources is already a common business, and the widely expected standards for the exchange already exist. As these conditions are not yet reached in the market, the only currently available platform for computer resource exchange is the Zimory Marketplace from Zimory GmbH, a spin-off of Deutsche Telekom Laboratories.

The second type of Cloud platform is more common. Typical examples for that include the Force.com from Salesforce, the leading On-Demand CRM software provider, and Google App Engine, which provides raw computer resources in the meantime.

3.1.2.5. Cloud Application Providers: this is the most complex, but also indispensable part of a whole Cloud Computing structure. Cloud applications can be categorized into:

a) Elementary applications and

b) Complex applications.

Unlike Blau et al. (2012), the difference between elementary and complex applications is mainly characterized by the homogeneity of applications rather than the complexity of their functions. The reason is: homogeneous applications are more like commodities; hence their economic characters share more similarity with the basic services in the Cloud Computing structure, i.e. providing the raw computer resources.

3.1.3. SMEs IN NIGERIA

There is no precise definition of Small and Medium-Sized Enterprises (SMEs) as this can differ from region to region and even from one company to another. Different standards can be used to define an SME including using revenue, number of employees, profits, capital employed, available finance, market share and relative size within the given industry (Etuk, Etuk, & Michael, 2014). According to (Etuk, Etuk, & Michael, 2014) the National Council of Industry in 2003 defined a small business as one that has between 11-35 employees with total cost including working capital but excluding Land of between 1 - 40 million Naira. It defined a medium enterprise as one that has between 36-100 employees and with total cost including working capital but excluding Land of between 40 – 200 million Naira. A more current definition by the Central bank of Nigeria describes SMEs as entities with asset base of N5 million and not more than N500 million (excluding land and buildings) with employees of between 11 and 200 (Central Bank of Nigeria, 2014). According to a joint report by Small and Medium Enterprises Development Agency of Nigeria (SMEDAN) and Nigeria Bureau of Statistics (NBS) Nigeria has over 17 million Micro, Small and Medium Enterprises (Survey Report on MSME in Nigeria, 2010). Often both private and public authorities at various occasions suggest that Nigeria has about 17 million SMEs that currently employ over 32 million people (Oniyitan, 2014). This is not true at all as the data from SMEDAN and NBS suggest otherwise. The 2010 collaborative survey report from SMEDAN and NBS clearly states that Nigeria has 17,284,671 MSMEs out of which 17,261,753 constituting about 99.87% are micro businesses. The survey observed that small businesses constitute 21,264 or 0.12% while medium businesses constitute only 0.015 or 1,654. So in a nutshell SMEs are merely 22,918 or 0.13% of

the total number of MSMEs in Nigeria. And furthermore, out of the 32,414,884 jobs created by MSMEs the actual number created by SMEs at the time was only 39,918. In as much as there are many SMEs in Nigeria with potentials to positively contribute to the country's GDP, Oyelaran-Oyeyinka (2007) believes that Nigeria is not very serious in growing its SMEs sector as compared to other emerging markets. According to International Finance Corporation (IFC) most established businesses in Nigeria are SMEs (about 96 percent) compared to only about 53% in US and 65% in Europe. And even despite the fact that most of the businesses in Nigeria are SMEs, they only contribute about 1% of GDP. This is very low compared to 40% in Asian countries and 50% in the US or Europe (Oyelaran-Oyeyinka, 2007). While it may be true that most SMEs in Nigeria use ICT in their businesses not many of them have access to the Internet (Otuka, Preston, & Pimenidis, 2014). However, a large number of them see ICT as important to their business (Otuka, Preston, & Pimenidis, 2014). While a fair number of SME owners/managers seem to have knowledge of Cloud Computing service an overwhelming majority have never used any Cloud Computing service. In fact, according to the survey by Otuka, Preston, & Pimenidis, (2014) only about 23 percent currently use cloud services in their organizations. Although this figure may seem low it is still significant considering the fact that Cloud Computing is still relatively a new technology. The survey also discovered that most of the respondents use Infrastructure-as-a-service (IaaS) followed by software-as-a-service (SaaS), while platform-as-a-service (PaaS) is the least patronized. An improved cloud ecosystem in Nigeria will foster not just adoption of cloud services among SMEs but will improve collaboration among them as well, as there will be improvement in information gathering and sharing. It can effectively bridge the digital divide between SMEs spread across Nigeria as learning is made easier and access to vital information is made simpler.

3.1.3.1. Challenges Facing Cloud-Computing Services in Nigeria

Status of key infrastructure in Nigeria 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. Ogunruku (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 undersea 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 & Olaojoyetan, 2013). Other challenges facing cloud-computing services in Nigeria 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. 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 researcher 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 SMEs. 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 losses 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 & Pimenidis, 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 SMEs 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 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 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 SMEs.

3.1.3.2. Suggested solutions to improving the state of Cloud Computing in Nigeria: making Cloud Computing the next big thing in Nigeria

The quest 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 SMEs, government 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 SMEs. Many SMEs are not entirely aware of the real effect automation can bring to their bottom line. Letting them know how automation can help improve sales, mange 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 enterprises that adopt the use of basic Cloud Computing services in their businesses. For instance, SMEs 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 SMEs 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 SMEs 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 SMEs to adopt cloud-computing services.

CHAPTER 4

METHODOLOGY

This chapter discusses the procedure undertaken to conduct this research. By meticulously examining the proposed research model, information on the participants of the research, the data collection tools, the data analysis, the procedure and the duration of the thesis and the resources utilized.

4.1. Research Model

This study is aimed at investigating the acceptance of cloud computing by small and medium sized enterprises in Nigeria, with a focus on fifteen businesses in major cities of the country. The independent variable of the research and casual comparative study includes business size, business type, staff position and budget for IT. The dependent variables were determinants, deficiencies and utilities. All of these factors fall under the small and medium sized businesses where they all get to use all or some of Cloud Computing services. Figure 13 shows the research model used in this study.

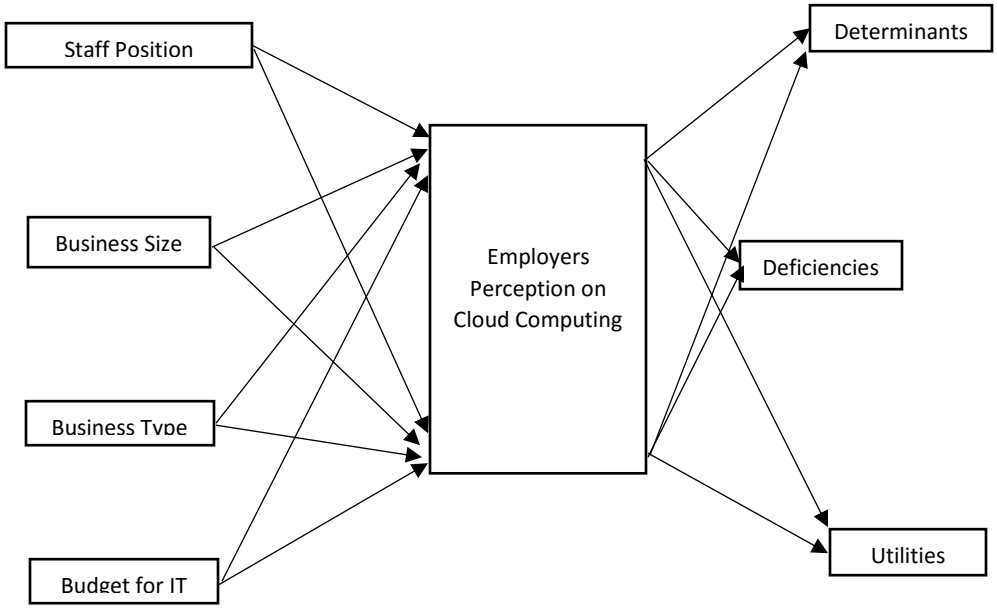


Figure 4.1: Research model

The Determinants refers to the factors which the business use in selecting which service provider to use for the deployment of Cloud Computing for the business. Deficiency talks about the major reasons why businesses are reluctant in moving their traditional computing into the Cloud. Utilities give light to the factors why Cloud Computing is adopted by businesses in Nigeria. The research is meant to find out how staff position, size of business, business type, budget for IT affected the utilities, deficiency and determinants to why they are grouped as small and medium sized enterprises.

4.2. Research Participants

The research targeted businesses in Nigeria already using cloud services or intending to venture into the technology. It involved IT businesses, non-IT businesses and other but must have an active IT department. The participants in this study were chosen using stratified random sampling consisting 208 respondents from different businesses. 36 respondents which are 17.3% of the respondents were from the owner and executive management, 27 respondents which are 13.0% of the respondents were IT Managers, 24 respondents which are 11.5% of the respondents were Programmer, 20 respondents which are 9.6% of the respondents were Network administrator, 29 respondents which are 13.9% of the respondents were from the Business Unit Management, 33 respondents which are 15.9% of the respondents were from the User support/ help desk, 17 respondents which are 8.2% of the respondents were Telecommunications Engineers, 22 respondents which are 10.6% of the respondents were either Staff, Normal User or Others.

Table 4.1: Demographic data of participants (N = 208)

	Frequency	Percent
Owner & executive Management	36	17.3
IT Manager	27	13.0
Programmer	24	11.5
Network Administrator	20	9.6
Business Unit Management	29	13.9
User Support / Help Desk	33	15.9
Telecommunications Engineer	17	8.2
Staff / Normal User / Other	22	10.6
Total	208	100.0

4.2.1. Information About Businesses

The businesses were selected using stratified random sampling were the population is divided into groups, based on some characteristic. Then, within each group, a probability sample is selected. Data was collected from 15 businesses which were either an IT based business, Non-IT business and others. All these organizations were either one-man business, partnership, co-operative, family business, private limited company or public limited company. 58 participants where from the IT companies which made 27.9% of the total, 73 participants where from the Non-IT companies which made 35.1% of the total and 77 participants where from the other companies which made 37.0% of the total. They all have an active IT department in which they were part of in one way or the other.

Table 4.2: Type of company

	Frequency	Percent
IT Company	58	27.9
Non-IT Company	73	35.1
Other	77	37.0
Total	208	100.0

4.2.2. Information About Company Size

Small and medium enterprises have been considered as the engine of economic growth and for promoting equitable development. The major advantage of the sector is its employment potential at low capital cost. The labor intensity of the SME sector is much higher than that of the large enterprises. The role of small and medium enterprises in the economic and social development of the country is well established. The sector is a nursery of entrepreneurship, often driven by individual creativity and innovation (Aremu & Adeyemi, 2011).

The European definition of SME follows. The category of micro, small and medium-sized enterprises (SMEs) is made up of enterprises which employ fewer than 250 persons and which have an annual turnover not exceeding 50 million euro, and/or an annual balance sheet total not exceeding 43 million euro.

In this research, we will be classifying the companies into two groups which are the small scale businesses and the large scale businesses. Data was also collected from companies which had more

than 250 employees which means we will fix them under the group of large scale businesses which is this thesis we can call the medium sized enterprises. The rest if the business with less than 250 employees with be rated as the small scale enterprises. 58 participants were from a business with 1 to 9 employees, 53 participants were from a business with 10 to 50 employees, 44 participants were from a business with 50 to 250 employees and 53 participants were from a business with over 250 employees. With what we have now, we can say: 155 of our participants were in a Small scale enterprise while 53 of our participants were in a large scale enterprise.

Table 4.3: Company size

	Frequency	Percent
1-9 Employees	58	27.9
10-50 Employees	53	25.5
50-250 Employees	44	21.2
Over 250 Employees	53	25.5
Total	208	100.0

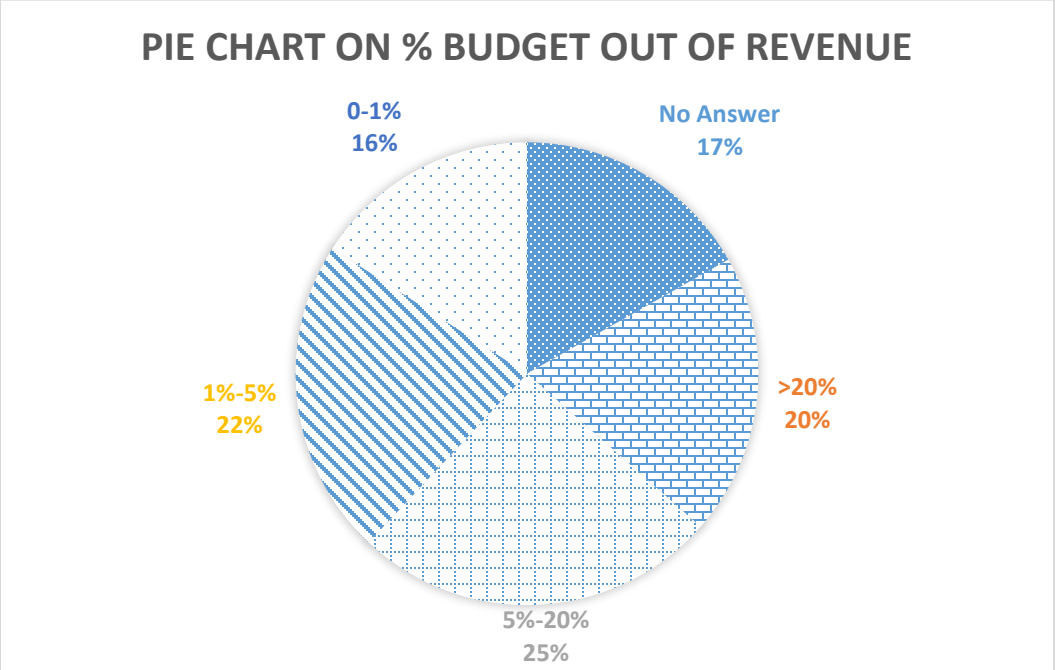
4.2.3. Previous Company Budget On IT-Related Projects

How a company gets to manage its revenue matters a lot. A very good factor a business should try to manage is that it gets all its basic and major services without these services eating deep into its total revenue. A major characteristics of cloud computing is to save businesses of spending large amounts of its revenue into IT. From this research 33 participants stated their companies spent within 0 to 1% of its last year's revenue, 46 participants stated their companies spent within 1% to 5% of its last year's revenue, 53 participants stated their companies spent within 5 to 20% of its last year's revenue, 41 participants stated their companies spent more than 20% of its last year's revenue all on information technology while 35 participants did not count it right to share information about their revenue and expenditure on a questionnaire or had no idea about it.

Table 4.4: % Budget out of revenue

	Frequency	Percent	Valid Percent	Cumulative Percent
0-1%	33	15.9	15.9	15.9
1%-5%	46	22.1	22.1	38.0
5%-20%	53	25.5	25.5	63.5
>20%	41	19.7	19.7	83.2
No Answer	35	16.8	16.8	100.0
Total	208	100.0	100.0	

Figure 4.2: Pie chart on % budget out of revenue



4.2.4. Deployment and Usage of Cloud Computing

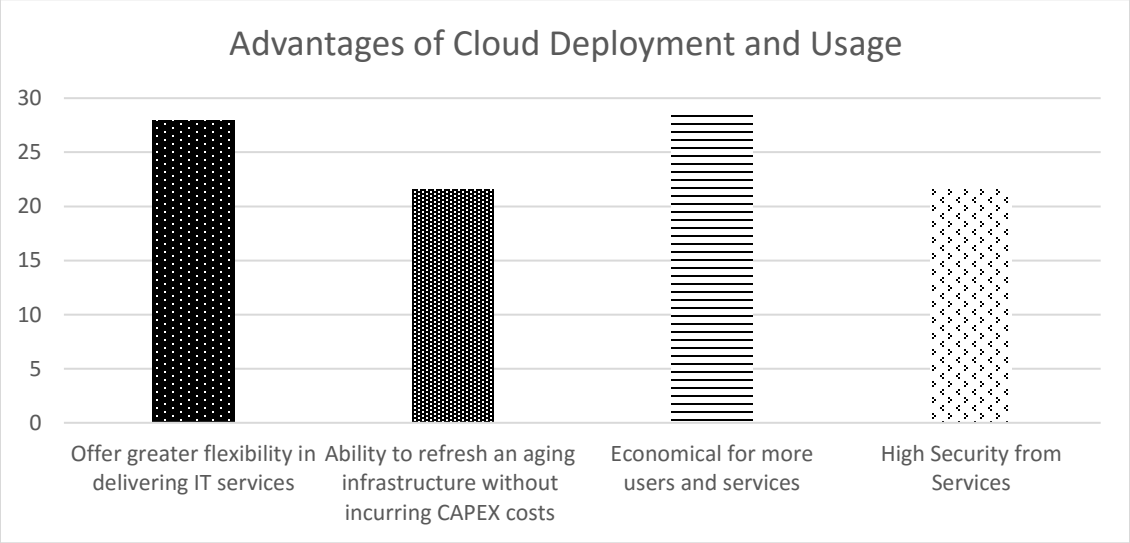
For the fact that different businesses happen to have different operations, they also have their different reasons to why they will prefer to deploy and use a cloud Service. 58 participants stated they use or would use cloud computing because of its greater flexibility in delivering IT services.

45 participants like it for its ability to Ability to refresh an aging infrastructure without incurring CAPEX costs. 60 participants go for Cloud computing because it is economical for more users and services and 45 of all the participants thought it offers a high level of security.

Table 4.5: Advantages of cloud deployment and usage

	Frequency	Percent	Valid Percent	Cumulative Percent
Offer greater flexibility in delivering IT services	58	27.9	27.9	27.9
Ability to refresh an aging infrastructure without incurring CAPEX costs	45	21.6	21.6	49.5
Economical for more users and services	60	28.8	28.8	78.4
High security from Services	45	21.6	21.6	100.0
Total	208	100.0	100.0	

Figure 4.3: Advantages of cloud deployment and usage



From figure 14 above we have the different distributions of the several participants to how advantageous cloud computing is to them. We will notice that More of the participants preferred the technology because it is economical to use.

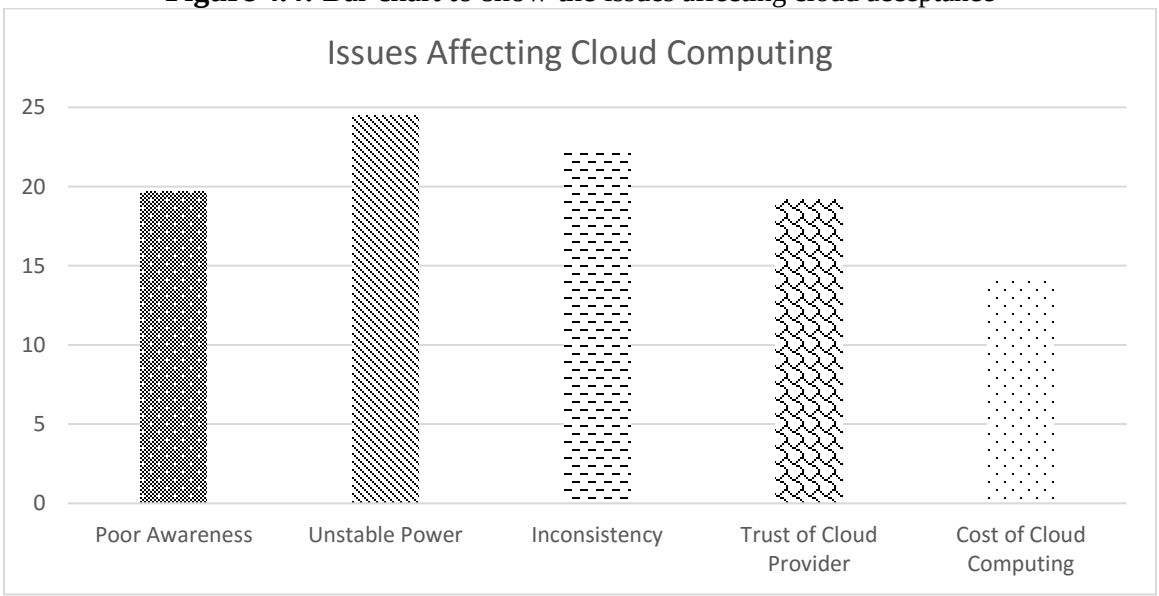
4.2.5. Issues Affecting the Adoption of Cloud Computing in Businesses

Nigeria has some issues which have affected the businesses in fully adopting Cloud Computing into their business. These issues range from poor awareness of the technology where 19.7% agreed with this, 24.5 went with unstable power as a major issue, 22.1% went for inconsistency as well as high cost of internet services, 19.2% believed the major problem is lack of trust of Cloud Provider while 14.4% feel Cost of Cloud Computing is the major issue. From the Bar chart in figure 15, 24% who happen to be 51 of participants agree that Unstable power supply is the major issue of companies to adopting Cloud Computing into their business.

Table 4.6: Issus affecting cloud acceptance

	Frequency	Percent	Valid Percent	Cumulative Percent
Poor Awareness	41	19.7	19.7	19.7
Unstable Power	51	24.5	24.5	44.2
Inconsistency	46	22.1	22.1	66.3
Trust of a Cloud Provider	40	19.2	19.2	85.6
Cost of Cloud Computing	30	14.4	14.4	100.0
Total	208	100.0	100.0	

Figure 4.4: Bar chart to show the issues affecting cloud acceptance



4.2.6. Advantage of Using Cloud Computing Services for Your Business

Participants were allowed to pick more than a choice here so we can analyze which of these services best suites their demand for Cloud Computing Services. A total of 1078 selections were made. 10.4% of the participants stated Storage, archiving and disaster recovery is advantageous to them, 10.8% of the participants stated Raw Computing power (CPU, Memory etc.) is advantageous to them, 10.5% of the participants stated Dedicated data center space or servers (e.g. Dell HPC etc.) is advantageous to them, 9.9% of the participants stated Basic office applications (e.g. MS Office) is advantageous to them, 10.8% of the participants stated Business applications (e.g. ondemand CRM, ERP etc.) is advantageous to them, 10.1% of the participants stated Specialized applications or solutions (e.g. simulation software's etc.) is advantageous to them, 9.3% of the participants stated Specialized IT services such as security management and compliance is advantageous to them, 10.4% of the participants stated Cloud Operating System (e.g. Google Gears + Google Chrome etc.) is advantageous to them, 8.6% of the participants stated Online Application Exchange Platform (e.g. Salesforce, Coghead etc.), and 9.3% of the general participants felt none of the above statements is advantageous to their business.

Table 4.7: Advantage of using cloud computing services for your business

	Responses		
	N	**Percent**	**Percent of Cases**
Storage, archiving and disaster recovery	112	10.4%	54.1%
Raw Computing power (CPU, Memory etc.)	116	10.8%	56.0%
Dedicated data center space or servers (e.g. Dell HPC etc.)	113	10.5%	54.6%
Basic office applications (e.g. MS Office)	107	9.9%	51.7%
Business applications (e.g. on-demand CRM, ERP etc.)	116	10.8%	56.0%
Specialized applications or solutions (e.g. simulation software's etc.)	109	10.1%	52.7%
Specialized IT services such as security management and compliance	100	9.3%	48.3%

Cloud Operating System (e.g. Google Gears + Google Chrome etc.)	112	10.4%	54.1%
Online Application Exchange Platform (e.g. Salesforce, Coghead etc.)	93	8.6%	44.9%
None of the above	100	9.3%	48.3%
Total	1078	100.0%	520.8%

4.3. Data Collection Tools

Factors That Affect Acceptance of Cloud Computing in The Small and Medium Scale-Sized Enterprises in Nigeria was prepared by the researcher in form of a questionnaire in connection to Cloud Computing acceptance, which is aimed to find out the factors that affect businesses behavioral intention to adopt the use of Cloud Computing for various aspects of their services. This section used a three (5) point Likert scale ranging from (1) "Strongly Agree" to (5) "Strongly Disagree". These were used to select the most appropriate constructs included in the research model. The questionnaire statements were adopted from prior studies conducted with necessary validation and changing of the statements to suit the research.

Below is a list which was used to create the proposed research model with the statements that were asked, the reference of the statements from previous researchers in the questionnaire and the combined Cronbach's Alpha for each of the 4 constructs. To trust the trustworthiness and legality of the questionnaire Cronbach's alpha was used to test each construct and the corresponding items. According to the Cronbach's Alpha, the research statement was considered to be fair. The statements asked in the questionnaire section b and c are listed below.

Table 8 shows the proposed research model statements that were used in section B and C of the questionnaire, the references of where statements where attained, the combined Cronbach's Alpha for the individual constructs and the bottom of the table the total Cronbach's Alpha.

Table 4.8: Statements, reference and total Cronbach's Alpha of each construct the proposed model

	Cronbach's Alpha
Utilities	
An increased focus on core business is a major factor for adopting the cloud.	
Easy accessibility of data using any device and at any time is a motivating factor for adopting cloud computing.	0.932
Collaboration is a motivating factor for cloud adoption.	
The reduction in IT staff motivate the adoption of the cloud computing.	
Deficiencies	
Poor Awareness	
Unstable Power	
Inconsistency	0.841
Trust of a Cloud Provider	
Cost of Cloud Computing	
Determinants	
Reputation of service Provider	
Company size	0.983
Established business relationship	
Total	**0.919**

4.4. Data Analysis

A questionnaire was drawn and used to collect data from the company employees. SPSS 24.0 was used to analyze and interpret the collected data. Cronbach's Alpha was used to test the reliability of the statements asked in the questionnaire. Output a total of 0.941 which is shown in Table 8. Frequency, percentages, mean, standard deviation and independent samples.

4.5. Procedures

This study began in March 2015 after conducting an extensive research on the topic of the acceptance of Cloud Computing by small and medium scale enterprises in Nigeria and the preparing of research proposal, this research was completed in June 2016. Table 9 and Figure 17 show all the work that was conducted and the duration taken for each item during this timeframe. Table 2 shows the duration taken whereas the Gantt shown in Figure 17 shows the start and complete dates. The thesis presentation, preparation of the data collection tools, and getting more acquainted with the analytical tools were done during this period. The expenses incurred during the research were financed by the researcher.

4.6. Research Schedule

The literatures were sorted for and carefully studied for a full understanding that in Nigeria there were not enough research conducted based on the acceptance of Cloud Computing by small and medium scale enterprises in Nigeria and the decision was made to further study this subject. A continuation to search the literature was conducted to find the suitable models that would be used for the study. A questionnaire was prepared. A decision was made as to which companies in Nigeria would be used and the total number of employee's in the companies to participate in the study. Within 7 weeks, the questionnaires were handed to the employees in the company to fill their desired answers to the questions. Once the questionnaires were collected, the data was analyzed to check for anomalies. If any of the questionnaires had missing data, they were removed. Data from the correctly filled in questionnaires was correlated and the suitable analysis methods were used to analyze the data. After the analysis, a report was written in the thesis outlining the results.

Table 9 shows the work and the duration of the work conducted on the thesis and the subsequent figure shows the Gantt chart showing the duration of the thesis.

TASKS	DURATION
• **Literature Research**	March, 2015-June 2016
• **Preparation of the Research Proposal**	10 weeks
• **Creation of Questionnaire**	5 weeks
• **Hypothesis Drawn**	5 weeks
• **Questionnaires tendered to companies**	7 weeks
• **Check Data for Anomalies**	2 weeks
• **Correlation of Data**	2 weeks
• **Interpretation of Discussion and Results**	2 weeks
• **Writing of Thesis**	40 weeks
• **Reading Discussion and Correction of the Thesis According to the feedback from Supervisor**	4 weeks

Table 4.9: Time schedule

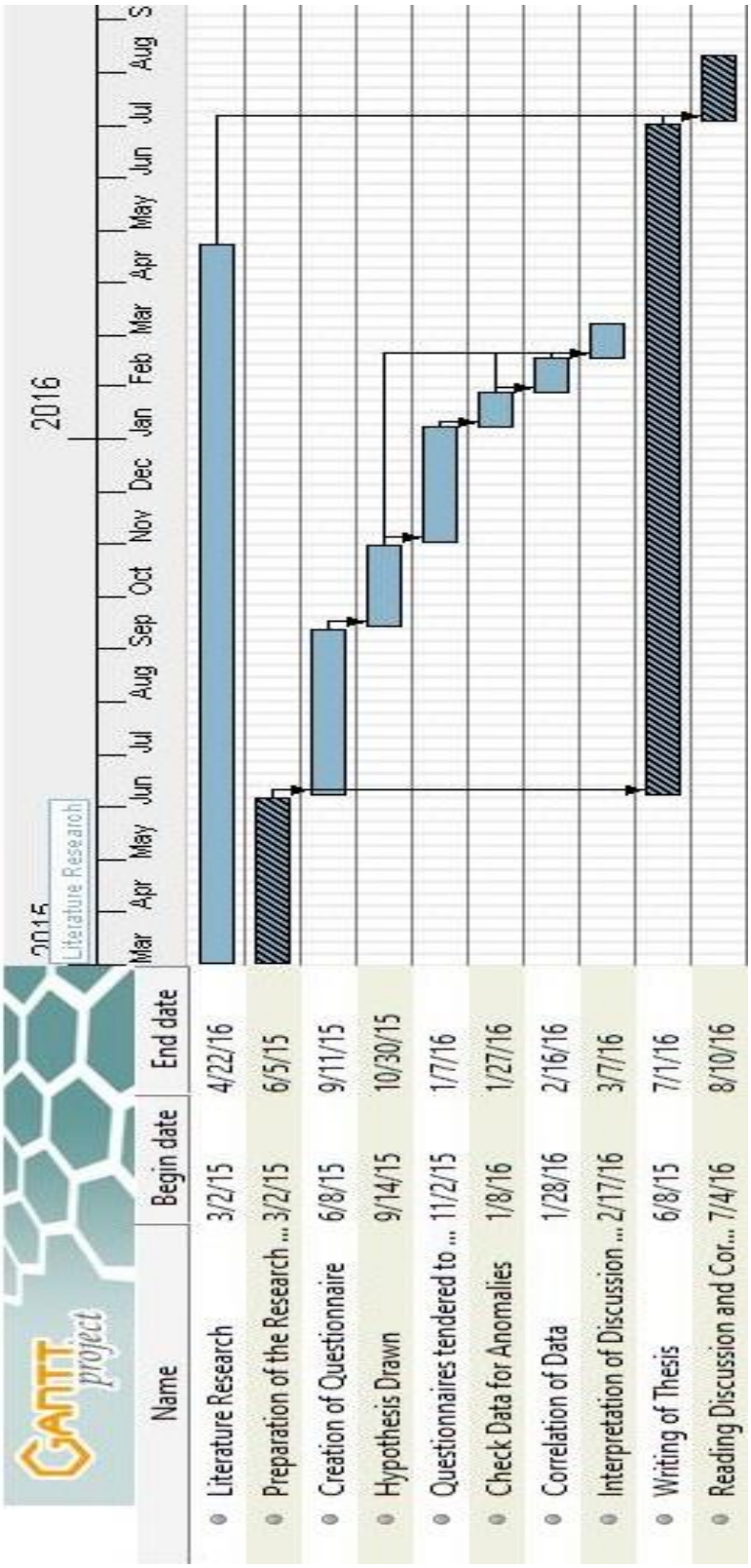


Figure 4.5: Gantt chat of research

CHAPTER 5

SURVEY RESULTS AND INTERPRETATIONS

This section presents an account of the research findings gathered from both questionnaires and interviews tailored at determining the extent of Cloud Computing adoption in Nigeria by small and medium scales enterprises.

5.1. The Employees and Business Owners Perceptions on the Acceptance of Cloud Computing

In other to understand the employees and business owner's perceptions on the acceptance of Cloud Computing, a descriptive analysis was used. Table 10 below shows the statements, mean and standard deviations for each construct. Most of the constructs were of average response as the means were above 3.0. The means and standard deviations listed below show the employees and business owners perceptions on the acceptance of Cloud Computing.

Table 5.1: The mean and standard of each item

Statements	$\bar{X}$	**SD**
Utilities		
1. An increased focus on core business is a major factor for adopting the cloud.	4.32	0.53
2. Easy accessibility of data using any device and at any time is a motivating factor for adopting cloud computing.	4.69	0.52
3. Collaboration is a motivating factor for cloud adoption.	4.34	0.48
4. The reduction in IT staff motivate the adoption of the cloud computing.	4.44	0.50
Total	4.45	0.51
Deficiency		
1. Poor Awareness	2.96	1.06
2. Unstable Power	2.94	1.04
3. Inconsistency	2.91	1.02
4. Trust of a Cloud Provider	2.94	1.04
5. Cost of Cloud Computing	2.90	1.01

Total	2.93	1.03
Determinants		
1. Reputation of service Provider	4.66	0.50
2. Company size	4.52	0.69
3. Established business relationship	4.49	0.54
Total	4.56	0.58

From the statements mentioned with their corresponding mean and standard deviation, the most important result of the constructs of proposed model was "*Easy accessibility of data using any device and at any time is a motivating factor for adopting cloud computing*." with the highest mean score ($\bar{X}$=4.69; SD=0.52) for utilities in the acceptance of Cloud Computing. Followed by *"Reputation of service Provider"* all with a score of ($\bar{X}$=4.66; SD=0.50), followed by *"Company size"* with a score of ($\bar{X}$=4.52; SD=0.69). The lowest mean from all the statements is "*Cost of cloud computing*" with a score of ($\bar{X}$=2.90; SD=1.01), followed by "*Inconsistency*" ($\bar{X}$=2.91; SD=1.01), followed by *"Unstable Power"* with a score of ($\bar{X}$=2.94; SD=2.94).

The constructs of the proposed research model in a chronological order according to the mean totals are as follows: Determinants ($\bar{X}$=4.56; SD=0.58), Utilities (4.45) and Deficiency (2.93).

5.2. The Employees and Business Owners Perceptions on the Acceptance of Cloud Computing on the Size of the Company

In other to understand the employers and the employee's perceptions on the acceptance of Cloud Computing on the size of the company differences independent samples *t*-test was employed. According to the Table 11, concerning the businesses perceptions of the acceptance of cloud computing, in all dimensions, the company with over 250 employees had the highest value ($\bar{X}$=4.96; SD=0.34). The business of 10 to 15 employees flowed suite with ($\bar{X}$=4.83; SD=0.83). There is no statistical significance difference between the company sizes in this study ($p>0.05$) among all dimensions. The research results showed that all company sizes have no different status on perceptions on the acceptance of Cloud Computing.

Table 5.2: Differences between company size (N=208)

Dimensions	Company Size	$\bar{X}$	SD	$\bar{X}$ Difference	*t*	p
Utilities	1-9 staffs	4.54	0.54			
	10-50 staffs	4.53	0.52			
	50-250 stuffs	4.51	0.57	0.00050	0.021	0.981
	Over 250	4.54	0.54			
Deficiencies	1-9 staffs	2.68	1.04			
	10-50 staffs	2.92	1.03	0.30000	1.040	1.020
	50-250 stuffs	2.54	1.06			
	Over 250	2.75	1.05			
Determinants	1-9 staffs	4.85	0.53			
	10-50 staffs	4.65	0.51			
	50-250 stuffs	4.75	0.43	-0.02440	-.847	0.432
	Over 250	4.96	0.34			

5.3. Businesses Perceptions on the Acceptance of Cloud Computing on the type Company

In order to understand to understand the businesses perceptions on the acceptance of Cloud Computing between the company types. One-way ANOVA was employed. As indicated in Table 12, in this study there are statistically significant differences between several company type mentioned towards perceptions on the acceptance of Cloud Computing ($p<0.05$). Similar results were also found in a study conducted by Awosan et al. (2014). In the literature, there were no studies focusing on company type and the business perceptions on the acceptance of Cloud Computing.

Table 5.3: Differences between company type (N=208)

Dimensions	Company Type	$\bar{X}$	SD	$\bar{X}$ Square	F	p
Utilities	IT Company	4.53	0.57			
	Non-IT C.	4.50	0.54	1.238	4.212	0.14
	Others	4.50	0.51			
Deficiencies	IT Company	2.67	1.03			
	Non-IT C.	2.91	1.05	0.271	1.2571	0.128
	Others	2.74	0.95			
Determinants	IT Company	4.64	0.52			
	Non-IT C.	4.74	0.54	0.039	0.86	0.751
	Others	4.95	0.51			

*The mean difference is significant at the 0.05 level.

In the Utilities dimension, IT company had the highest mean value ($\bar{X}$=4.65) and there is no significantly difference under this dimension for all company type. In Deficiencies, Non-IT companies is the highest with the mean value of ($\bar{X}$=2.91) and there is significant difference under this dimension for all company type. In the Determinants category, Other companies came highest with ($\bar{X}$=4.95) and there is significant difference under this dimension for all company type.

5.4. Businesses Perceptions on the Acceptance of Cloud Computing on Budget

In order to understand the participant's perception on the acceptance of Cloud Computing between different budget levels. One-way ANOVA was employed. As indicated in table 13, in the study there are no statistically significant differences between in the budget levels of the companies adopting cloud computing into their business ($p>0.05$). Similar studies conducted by Cohen et al. (2010) also showed that there was no significant difference on budget and the adaptation of cloud computing into the business.

Table 5.4: Differences between budget (N=208)

Dimensions	Budget	$\bar{X}$	SD	$\bar{X}$ Square	F	p
Utilities	0-1%	4.53	0.57			
	1%-5%	4.54	0.53			
	5%-20%	4.56	0.56	0.083	0.284	0.855
	>20%	4.58	0.55			
	No Answer	4.55	0.52			
Deficiencies	0-1%	2.67	1.04			
	1%-5%	2.45	1.06			
	5%-20%	2.62	1.02	0.214	1.248	0.245
	>20%	2.33	1.05			
	No Answer	2.45	1.07			
Determinants	0-1%	4.85	0.35			
	1%-5%	4.35	0.32			
	5%-20%	4.81	0.31	0.279	2.243	0.084
	>20%	4.73	0.36			
	No Answer	4.55	0.35			

*The mean difference is significant at the 0.05 level.

As shown in table 12 above. For utilities, the highest mean was found in the budget >20% ($\bar{X}$=4.58), for deficiencies the highest mean was found in the budget of 0-1% ($\bar{X}$=2.67) and for determinants the highest mean was found in the budget 0-1% ($\bar{X}$=4.85).

CHAPTER 6

CONCLUSION AND RECOMMENDATIONS

If the present challenges militating against the adoption of Cloud Computing in Nigeria are resolved it has the potential to deliver immense benefits to businesses including SMEs. SMEs 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 SMEs trying to compete with other businesses in other 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 creating investment in setup that it might stop to use in future. So in essence the problem of underutilization of technology infrastructure will be taken care of. SMEs 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 are 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.

Following the outcome of the research, the following recommendations are put forth to boost the growth of cloud computing in Nigeria.

1. Proper awareness by the cloud service providers on the risk and benefits of cloud, for instance, what it takes to migrate to cloud and how to migrate to cloud should also be given consideration by cloud service providers.
2. Availability of more cloud service providers will encourage adoption of cloud computing. This will increase the awareness of cloud computing and reduce issues of distance between computing resources and consumers.
3. Cloud providers should provide free trial of cloud services to clients for a stipulated period to encourage adoption of cloud computing.

The findings showed that Cloud computing will be the next generation computing model in Nigeria. The adoption of cloud computing in Nigeria is low as surveyed in this research. SaaS (Software as a service) is the most used cloud service in Nigeria. Increased focus on primary services, collaboration, easy access of data and provision of basic infrastructures were identified as the motivating factors for cloud computing adoption in Nigeria. The research revealed three factors that have greatly affected the adoption of cloud computing in Nigeria. These factors are:

1. Poor awareness of cloud computing
2. Unstable power supply
3. High cost of internet bandwidth and unreliability of internet service.

Based on the outcome of the research. The extent of cloud adoption in Nigeria is low, current factors affecting the adoption of cloud computing were analyzed and the factors that will motivate the adoption were stated in this paper. Future research on this topic should focus on identifying the extent of adoption of cloud computing, after the current factors identified in this research have being considered.

The following are the core finding of the research. Overall, cloud computing is no longer a hype but a technology that is set to change the way business operation are implemented. It allows computing resources readily available on demand, flexible and scalable. This study reveals that the perception of cloud computing being the next computing tool is similar with findings of previous surveys. Cloud computing is the next computing technology but the extent of adoption in

Nigeria is low compared to some countries. This shows that the adoption of cloud computing varies across countries as stated by (Wyman, 2008). This can be as a result of lack of adequate infrastructure as in the case of Nigeria. This study also reveals there is need for continuous improvement on basic infrastructure. The availability of basic infrastructure and awareness of cloud computing are necessities for more businesses to consider cloud adoption. While in developed countries, the major factor slowing down the adoption of cloud computing is security. This is also a concern for cloud adoption in Nigeria but awareness and availability of adequate infrastructure are the major determinant for cloud adoption.

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APPENDIX

THE ACCEPTANCE OF CLOUD COMPUTING IN THE SMALL AND MEDIUM SCALE-SIZED ENTERPRISES OF NIGERIA

Dear Respondent,

The aim of thesis questionnaire is to find out about your opinions on cloud computing. This is an academic survey about the acceptance of cloud computing in the small and medium scale-sized enterprises of Nigeria. This questionnaire will be anonymous and the result of question will be used for academic purpose only. It may take you no more 15 minutes to complete it, thank you for you for patience and cooperation.

Assoc. Prof. Dr. Nadire CAVUS
Temitope Emmanuel Mobolade

Section A: General Information

1) Are you aware of Cloud Computing?

- Yes
- No
- Partially

2) The size of the enterprise you represent is:

- 1-9 Employees
- 10-50 Employees
- 50-250 Employees
- Over 250 Employees

3) Which of the following best describes the type of your company?

- IT Company (Software/Hardware/IT Service/Internet/E-commerce)
- Non-IT Company
- Other

4) How much did your company budget on IT-related projects in 2015?

- 0-1%
- 1%-5%
- 5%-20%
- >20%
- No Answer

5) Do you use or have deployed any cloud computing service and what do you think or know about cloud deployment and usage in your Business?

- Cloud Computing Services offer greater flexibility in delivering IT services.
- Cloud computing gives you the ability to refresh an aging infrastructure without incurring CAPEX costs.
- Cloud is an economical way to support more users and new IT services.
- High level of security gotten from Cloud applications and services.

6) What do you think the current issues affecting the adoption of cloud computing in your business?

- Poor Awareness
- Unstable Power
- Inconsistency
- Trust of a Cloud Provider
- Cost of Cloud Computing

Section B: Perceptions of Cloud Computing

Read the statements below. Place (X) on the heading that best suits your choice

	Strongly Agree	**Agree**	**Neutral**	**Disagree**	**Strongly Disagree**
Utilities					
An increased focus on core business is a major factor for adopting the cloud.					
Easy accessibility of data using any device and at any time is a motivating factor for adopting cloud computing.					
Collaboration is a motivating factor for cloud adoption.					
The reduction in IT staff motivate the adoption of the cloud computing.					
Deficiency					
Poor Awareness					
Unstable Power					
Inconsistency					
Trust of a Cloud Provider					

Cost of Cloud Computing					
Determinants					
Reputation of service Provider					
Company size					
Established business relationship					

Section C: Cloud Computing Usage

Read the statements below. Place (X) on the heading that best suits your choice service for Cloud Computing.

Services	Strangely Agree	Agree	Neutral	Disagree	Strongly Disgree
Storage					
Servers					
Development Software					
Photo Editing and Video Editing Applications					
Human Resources application, payroll, tracking					
Project Management Application					
Collaboration tool (wikis, Google Doc e.t.c)					
Web based email (Gmail, Hotmail)					
CRM & EPR software applications for managing					

What is the advantage of using Cloud Computing services for your business?

(Tick the boxes that apply)

- Storage, archiving and disaster recovery
- Raw Computing power (CPU, Memory etc.)

- Dedicated data center space or servers (e.g. Dell HPC etc.)
- Basic office applications (e.g. MS Office)
- Business applications (e.g. on-demand CRM, ERP etc.)
- Specialized applications or solutions (e.g. simulation software's etc.)
- Specialized IT services such as security management and compliance
- Cloud Operating System (e.g. Google Gears + Google Chrome etc.)
- Online Application Exchange Platform (e.g. Salesforce, Coghead etc.)
- None of the above