ADOPTION OF CLOUD COMPUTING TECHNOLOGY FOR LIBRARY SERVICES IN THE NATIONAL OPEN UNIVERSITY OF NIGERIA LIBRARY

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DECLARATION

I declare that the work in this thesis "Adoption of cloud computing technology for library services in the National Open University of Nigeria Library" was carried out by me in the Department of Library and Information Science. The information derived from the reference provided. No part of this thesis was previously presented for another degree or diploma at this or any other Institution.

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CERTIFICATION

This is to certify that this thesis titled ADOPTION OF CLOUD COMPUTING TECHNOLOGY FOR LIBRARY SERVICES IN THE NATIONAL OPEN UNIVERSITY OF NIGERIA LIBRARY by Okwoli Mercy ENEFU meets the regulations governing the award of the degree of Master in Information Science (M.Sc) of Ahmadu Bello University, and is approved for its contribution to knowledge and literary presentation.

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DEDICATION

This research work is dedicated to God Almighty for His divine knowledge, wisdom and understanding upon my life. And I also dedicated this work to my beloved husband Engr. Peters Okwoli for his understanding.

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Abstract

The study investigated the adoption of cloud computing technology for library services in NOUN Library. Issues related to the existing computer network available in NOUN library such as LAN, WAN, the rationale for the adoption of cloud computing in NOUN library, information services provided in NOUN library such as building digital library, searching library data, building community power were also enumerated. In addition, the implications in terms of cost, staff and maintenance of cloud computing in NOUN library were investigated. Objectives of this study include among others identifying how NOUN library provides its information services and access to its students who are spread across the nation. Four research questions were raised, among which are: the existing computer network available in NOUN library and the rationales for the adoption of cloud computing in NOUN library. Qualitative research method was adopted; Focus group method, NOUN University Librarian and four IT staff were used as sample size of the study. Guided interview constituted the instrument for data collection, while descriptive method was used to analyze the data collected. The finding revealed that LAN, WAN, CAN, Internet and Network were the existing computer networks in NOUN library; another finding of the study shows that NOUN library use cloud computing to provide library and information services to its students who are spread across the country where access to information must not be location specific. The major implication faced by the adoption of cloud computing in terms of cost, staff and maintenance were: budgetary issues which lead to inadequate training of staff and recruiting the right staff to do the job among others. Based on the forgoing, the major way to overcome budgetary issues in the adoption of cloud computing is for NOUN library to solicit for grants from financial institutions like banks, NGOs, and other foundation, more so, since cloud services are usage based or pay as you go pricing, NOUN Library should adjust the usage and cost of its IT services in an efficient way. NOUN library can experience cost reduction and flexibility of cost management.

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LIST OF ABBREVIATION

AEC - Amazon Elastic Cloud

API - Application Program Interfaces

ASP - Application Service Provider

EPN - Enterprise Private Network

IaaS - Infrastructure as a Service

ILL - Inter-Library Loan

ILS - Integrated Library System

IT - Information Technology

KPMG - Klynveld Peat Marwick Goerdeler

LAN - Local Area Network

LMS - Library Management System

NOUN - National Open University of Nigeria

OCLC - Online Computer Library Center

OPAC - Online Public Access Catalog

PaaS - Platform as a Service

PAN - Personal Area Network

SaaS - Software as a Service

SAN - Storage Area Network

VPN - Virtual Private Network

WAN - Wide Area Network

WWW - World Wide Web

CHAPTER ONE

INTRODUCTION

1.1 Background to the Study

There is a great deal of debate about what cloud computing is, or is not. Hayes (2008) defined "cloud computing as a kind of computing which is highly scalable and use virtualized resources that can be shared by the users. Users do not need any background knowledge of the services before using it. Moreover, a user on the internet can communicate with many servers at the same time and these servers exchange information with one another. Basically, data and adoption in the cloud are available through the internet; it can also be accessed from everywhere and from any device with internet connectivity.

Stroh et al, (2009) defined "cloud computing as "the computing software and services that can be accessed via the internet rather than residing on a desktop or internal server." Gartner (2012) defined cloud computing as "a style of computing in which massively scalable and elastic IT-enabled capabilities are delivered as a service to external customers using internet technologies. "In various presentations Klynveld Peat Marwick Goerdeler (KPMG) broke this into four different types of cloud computing, namely: Infrastructure, Platform, Applications and Services. Infrastructure is buying Space/ times on external servers, Examples are Amazons, A3, and Bungee. Platform on the other hand, is an existing software platform in which one can build its own application on, such as Facebook. While Application is a software application accessed with a Web browser, examples are Google Docs, Salesforce.com, whereas, Service is a ready to use services accessed with a Web browser such as ADP. Mell and Gance (2011) defined each of the

three services models thus: Software as a Service (SaaS) which allows users to use the provider's applications on a cloud through a web browser, while Platform as a Service (PaaS) allows users to deploy their own applications on the provider's cloud infrastructure under the provider's environment. Infrastructure as a Service (IaaS) allows users to control and manage computing resources.

Cloud computing can transform the way information systems are built and services delivered. This provides library with an opportunity to extend its impact to its users anywhere anytime. Anyone connected to the internet is probably using some type of cloud computing on a regular basis. Whether they are using Google's Gmail, Organizing photos on Flickr or searching the Web with Bing they are engaged in cloud environment. As Geoffrey (2013) pointed out, the interesting thing about cloud computing is that it did not start as a technology for the business enterprise, but was driven by the public with services like Facebook and Flickr.

Education today is becoming completely associated with Information Technology (IT) on content delivery, communication and collaboration. The need for server, storage and software are highly demanding in the Universities, For example, the National Open University of Nigeria (NOUN), that provides its services via online, operates an e-learning Management System known as ILEARN for lectures and notes. It also operates a digital library known as INFORMATION GATEWAY which offers Multimedia tutorials. Whong (2014) remarked that the primary purpose of University libraries is to support University functions of teaching, learning, research and community services in ways consistent with and supportive of the institution's mission and goals.

According to Tuncay (2010), library can benefit from using cloud computing technology by increasing computing performance, storage capacity, universal accessibility and cost reduction. This can help library in terms of fixed and maintenance cost reduction in the IT investment of both hardware and software as well as computer services. With cloud computing, libraries may prevent financial waste, better track staff activities, and avert technological headaches such as computer viruses, system crashes, and loss of data. When cloud computing is used in the library, this will likely have a significant impact on library services. According to Spreeuwenberg (2012), with cloud computing, it becomes easier to access data with several devices. Especially for mobile devices, this can be really useful since the only thing that is needed is an internet connection. Libraries are shifting their services to cloud computing technology to facilitate its services anywhere and anytime. In libraries, the following have been identified as possible areas of applying cloud computing: Building Digital Library/Repositories, Searching Library Data, Web Site Hosting, Searching Scholarly Content, File Storage, Building Community Power and Library Automation.

Nevertheless, the biggest benefit of the adoption of cloud computing technology is that one does not “buy” the cloud as purchases for software and hardware and hitherto being made for library automation. Much like a common utility, one just pays for what was used, and then turn it off when one is done. The ability to have a server somewhere, to not have to worry about it, turn it up as needed, and pay for only what is used attracts a lot of people to cloud deployment (Creeger: 2009), Library community can apply cloud infrastructure to amplify the power of cooperation and to build a significant, unified presence on the Web. This approach to computing can help libraries save time and money

while simplifying workflows. To date, the main focus of libraries moving into the cloud has been due to, the need to disclose their vast collections. (Gbaje and Aliyu 2014).

In order to contend with the barrage of information available in today's society, a medium, and an educational institution such as library needs to be put in place for proper acquisition, processing, documenting, retrieving and disseminating of information. The mode of information storage and transmission has undergone many radical changes in format; ranging from print materials to other information storages and transmitting media like non-print sources such as Compact Disc (CD); Diskettes; Magnetic tapes; CD ROMS; hard disks; punched paper tapes; Internet publications; zip disks; educational video and transparencies; books on cassettes; micro form publications; electric publications; machine readable tape; and cloud computing. Libraries have been using some cloud computing services for over a decade. Online databases are accessed as cloud applications. Large union catalogs can also be defined as cloud applications. The selection of which of these information resources to use is a continuous process dictated by changing curriculum, availability of new materials for Library Services. Ordi (2006) observed that these media are useful for storage of data, information, and programs for safe keeping. Creeger (2009), as cited by Gbaje & Aliyu (2014), asserted that cloud computing comes into focus when there is need for increased capacity or added capabilities of computer without investing in new infrastructure, training new personnel, or licensing new software. Users can access database resources via the internet from anywhere for as long as they need without worrying about any maintenance or management of information technology infrastructure.

1.2 Statement of the Problem

There are challenges still facing libraries in Nigeria today despite the availability of computerization and automation of library resources. Nok (2006) explains that, some of these challenges include: unreliable WAN/LAN connections that are usually exposed to effects of fire, storms and vandalization, shortage of computer literate staff in the libraries, poor state of power generation, poor maintenance and update culture and poor funding of libraries. Adegbore (2010) further explains that hardware breakdown, software problems, unreliable and epileptic power supply, inadequate funding, staff training deficiency and planned obsolescence of commercial software are part of the challenges facing automation of libraries. Gbadamosi (2012) posits that band with subscription, daily and routine maintenance of computer set and lack of steady funding of library services are some challenges facing library automation.

According to Goldner (2012) libraries can take advantage of cloud computing to get out of technology headache such as hardware breakdown, software problems, staff training deficiency and focus on collection building, patron services and innovation. Geoffery (2013) also added that with the adoption of cloud computing technology in libraries, data can be easily shared among users, and the need for local storage, maintenance and backups will equally be a thing of the past for libraries. Breeding (2012) pointed out that libraries can also take advantages of cloud computing to build digital libraries/repositories, search library data, host website, search scholarly content, store files, build community power and improve library automation.

With these challenges facing automation of library resources, the National Open University of Nigeria Library adopted cloud computing in the provision and management of its

resources. More importantly the nature of the institution is that of Open and Distance Learning. This implies that learning is relatively virtual and online. Hence most of the resources are electronic and web-based. Unlike conventional universities where teaching and learning is situated in a centralized place, National Open University of Nigeria has 69 Study Centres scattered across the nation and its students are spread across the nation. Consequently the library in order to provide its services and access to its users, need to secure a platform where access must be unfettered and not location specific.

This study examined the level of adoption of cloud computing technology in NOUN library and how its adoption has help solve the challenges of automation and management of physical resources. And to also find out how NOUN library is able to adopt the use of cloud computing in its library despite the budgetary issues, as fear of eliminating staff and concerns over high subscription of cloud computing adoption.

1.3 Research Questions

The study will answer the following research questions:

1. What are the existing computer networks available in NOUN Library?
2. What are the Rationales for adopting cloud computing in NOUN Library?
3. What are the Information services provided using cloud computing in NOUN Library?
4. What are the implications in terms of cost, staff, and maintenance in the adoption of cloud computing in NOUN Library?

1.4 Objectives of the Study:

The broad objective of the study is to examine the adoption of cloud computing technology for library services in NOUN library. The specific objectives are:

1. To determine the existing computer networks available in NOUN Library.
2. To determine the Rationale for adopting cloud computing in NOUN Library
3. To determine the Information services provided using cloud computing in NOUN Library.
4. To proffer solutions to the implications in terms cost, staff and maintenance of cloud computing in NOUN Library.

1.5 Significance of the Study.

The study will be significant in a number of ways:

First of all, it will be beneficial to NOUN library and its management in the sense that it will reveal to them the degree of effectiveness of the cloud computing technology in meeting the information needs of the users and consequently encourage them towards working out modalities to improve the functionality of cloud computing technology if the need arises.

More also, it will help to reveal the extent to which cloud computing technology is being adopted for NOUN library as it will highlight the past and present state of the adoption of cloud computing technology in the library for its services. The improvement of cloud computing in the library will lead to better library services for the fulfilment of the objectives for NOUN Open and Distance Learning Programmes.

In addition, it will be useful to academics and management of academic institutions in their research. It will also serve as an important knowledge contribution in the area of adoption of cloud computing for library services.

1.6 Scope of Study.

The study examined the adoption of cloud computing technology for library services in the National Open University of Nigeria Headquarter Library Lagos. NOUN has sixteen (16) libraries located in the six geopolitical zones of the country. The Libraries are located in the following zones: Kaduna , Kano Study Centre (North West); Abuja, Lokoja, Makudi Study Centre (North- Central); Enugu, Akwa Study Centre (South-East); Calabar, Benin, Asaba Study Centre (South- South); Bauchi, Jos, Maiduguri, Dutse, Study Centre (North East) Apapa, Lagos main Library, (South-West) For the purpose of this study, the researcher will focus on the Lagos Main Library, and the reasons is due to the fact that cloud computing administration takes place in NOUN Headquarter Main Library.

1.7 Operational Definition of Terms

Cloud: Public or Semipublic space in the cloud used for transmission.

Scaling: The measurement of dimensions using a scale.

Software as a Service (SaaS): Allows users to use the provider's applications on a cloud through a web browser or an application programming interface.

Platform as a Service (PaaS): Allows users to deploy their own applications on the provider's cloud infrastructure under the provider's environment.

Infrastructure as a Service (IaaS): Allows users to control and manage computing resources.

Client platform: Device(s) to access cloud resources. E.g. mobile phone, tablets, laptop, etc.

Multi-tenancy: many application users

Virtualization: Act of creating virtual object (rather than actual).

Resource pooling; Enables provider's computing resources to serve multiple consumers or users, using a multi-tenant model with different physical and virtual resources assigned and reassigned according to user's demand.

Rapid elasticity: Allows for resources and capabilities to be elastically provisioned and released in some cases automatically to scale rapidly outward and inward commensurate with demand.

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CHAPTER TWO

REVIEW OF RELATED LITERATURE

2.0 Introduction

This chapter presented under the following sub- heading:-

2.1 Computer Networks available in the Libraries

2.2 Rationales for the adoption of cloud computing in Libraries

2.3 Information Services provided through cloud computing in Libraries

2.4 Implication of cloud computing in Libraries

2.5 Summary of literature review

2.1 Computer Networks in Libraries

Library network is a collective or co- operative activity of linking members/users to the resources hosted on computers by means of telecommunication connections. Lihitkar, (2012) asserted that a network is developed when a group of libraries and information centers have common interest to exchange information through computer and communication technology. Dhenavandah & Tamizhchelvan (2014) identified classification of Networks based on Utility criterion: Resource sharing network, Data sharing network communication and data exchange network. Resource sharing network main purpose is sharing of resources and other applications that are subordinate in nature, data sharing network provides access to unique databases from workstations situated at distance apart, while communication data exchange network allows users to exchange data, graph or documents and to communicate with each other using such devices as electronic mail, bulletin board etc.

The state of library networking system depends on the availability and quality of electrical power and the type and distribution of electrical wiring in the library through computer network observed by Eric (2012). Computers operate better and last longer when the computer network that powers the library is continuous and of consistent voltage. Many libraries, especially academic libraries need sufficient supply of network to withstand the additional demand made by the computers asserted by Kessler (2013). Furthermore, networks cables may not be the correct gauge to withstand the additional load caused by computers being connected to the library's networking system according to Eric (2012). One reason why many libraries decide to install computer network in libraries is to overcome the challenges and issues of poor computer networking that may require the library to refurbish the existing network system or add a whole new network supply system which reduces the amount of electrical wiring needed. Also, computers, especially those connected to a local area network (LAN), require a grounded electrical system to operate smoothly and trouble-free. Again, this is less costly if done to one or two computer in the library rather than to the entire library.

The computer network used during the last several decades in libraries has made a massive shift from traditional concepts of "the library". The catalyst for this shift has been the computer network asserted by Kessler (2012). The computer network has been developed to provide access to information promised by traditional library work. Today, developments like high-capacity networks and broadband communications offer physical access to data to average users on a level never dreamed of by the inventors of the paper-and-cardboard book or the library card catalog. And yet intellectual access to that data

appears to be impeded, by lack of organization and by the inability of average users to find useful information within it.

Ineffectual hand wringing often characterizes the response of the profession traditionally concerned with the provision of information in the library community. Mark (2014) asserted that reaction of "information-overloaded" results to the recent history of the interaction between libraries and the computer. Network is a system of interconnected computers for sharing information and resources that may involve two or more computer in a single office or several computers in different units across a library or across so many in a country. Networks include: Local Area Network (LAN), Wide Area Network (WAN) and World Wide Web (WWW). With computer networks, library can access and see information from different locations and download for users need.

Krubu and Osawam (2011) noted that the impacts of computer networks are felt by libraries in every aspect. They further added that computing technology, communication technology, and mass storage technology are some of the areas of continuous development that reshape the way libraries access, retrieve, store, manipulate and disseminate information to users. Gbaje and Aliyu (2014) however lamented that unfortunately, in developing countries particularly Nigeria, libraries started automating with an underdeveloped information and telecommunications infrastructure which include inadequate computer network. Similarly, the use of open source library automatism software often sees as a panacea for library automation in developing countries has been very gradual in Nigeria. Reason being the dearth of its skills required for both development and maintenance of open source software, it is expensive and high storage capacity which are poorly developed or beyond the financial reach of most academic libraries.

Creeger (2009) cited in Gbaje and Aliyu, (2014) asserted that cloud computing comes into focus when there is the need to increase capacity or add capabilities of computer without investing in new infrastructure, training new personnel or licensing new software that can be built on the existing network in the library.

Several types of computer network can be characterized by their size as well as their purpose in the library. The size of the network can be expressed by the geographic area they occupy and the numbers of computer that are part of library network. Eric (2012) also posited that networks can cover anything from a handful of devices within a single library to millions of devices spread across the entire globe. Some of the different computer networks based on size are: Personal Area Network (PAN), Metropolitan Area Network (MAN), Storage Area Network (SAN), Enterprise Private Network (EPN) and Virtual Private Network (VPN).

A network as asserted by Lihitkar, (2012) can be kept entirely private by restricting some communications to the connection within the network. This means that those communications never go over the internet. Geoffrey (2012) posited that one approach to libraries having private network is to build an enterprise private network (EPN) and it is use to connect multiple locations and the library can also use it to control its services and data.

The diagram below explains how users on the internet can communicate with many servers at the same time and these servers exchange information among one another, and this information can also be accessed from everywhere and from any device with internet connectivity based on the existing computer network available in the library.

Technology progresses, new application emerge that offer specialized functionality on a mobile device such as phones or tablets. Often, these apps include social aspects where users share information online ascertained by Burckhard et, al (2013). The capability of sharing data between devices is typically achieved by developing web services. Increasingly, such services are deployed in the cloud, hosted environment that offer virtualized storage and computing resources.

2.2 Rationales for the adoption of cloud computing in libraries.

Some many reasons were provided for the acceptance of cloud computing technology in the libraries. Goldner (2012) pointed out that libraries moving into the cloud have been discovery services, the need to disclose their vast collections on the Web. Combining systems into a cloud environment reduces the carbon footprints, making libraries greener these improvements can be grouped into three basic areas: technology, data and community. Each offers some general and some unique opportunities for libraries. Looking first at the technology that most current library systems employ several benefits of cloud computing solutions surface include:

2.2.1 Technology improvements

Cloud computing solutions at their essence are built on current technology and should be architected to allow for technology shifts. Looking at the explosion of mobile devices one sees how businesses, organizations, and libraries operating in a cloud environment are able to adapt and deliver their services to the new devices much more quickly and less expensively.

The mainstay of libraries is the library management system (LMS, also known as the integrated library system or ILS). Library management systems were developed before the Internet and Web existed and is generally closed proprietary systems. It has been difficult and costly for these closed systems to take advantage of new technologies as they emerge. It is also challenging to integrate to external systems and libraries must rely on their vendors to do any such integration. Over time libraries have needed to add more systems to manage their changing collections which moved from strictly physical

collection management to a combination of physical, licensed and digital collections. Since each of these systems has stood alone integrating them has been difficult and at times not possible.

First would be the possibility of open service oriented architecture. Many cloud solutions offer this type of openness with published application program interfaces (APIs) that any programmer can take advantage of. This means if a new service or technology emerges libraries will not always be dependent on a vendor or other third party to start taking advantage of these services and technologies Geoffery (2013). Existing library systems have used is a set of routines, protocols and tools for building software applications. APIs to connect to external services but they have remained closed proprietary systems making it hard to integrate them into external services. This makes it possible to integrate two services once and re-use it across the community with the help of cloud computing.

Libraries can equally get out of the business of technology such as hardware breakdown, software problems and focus on collection building, patron services and innovation posited out by Goldner (2012). Servers can be decommissioned and no longer require replacement every five years (or less). Staff no longer has to maintain the complex software stack necessary to run local systems and worry about compatibility of the tack during upgrades. Instead technical skills can be re-deployed for extending cloud services into their environment and their environment into other cloud services.

2.2.2 Data efficiencies

Geoffery (2013) added that when data is stored in the cloud, it offers several advantages such as common data can now be easily shared among services and users. The need for local storage, maintenance and backups is removed. Agreements can be forged to share data that normally would be considered private to a single library or organization. He also added that libraries can achieve Web scale when they massively aggregate data and users, sometime a cloud environment makes possible.

Like the advantages of technology deployed and accessed as cloud solutions, data storage in the cloud brings many benefits for libraries. The easy one to recognize is the same data being stored hundreds and thousands of times across libraries. Consider how many copies of the cataloging data there are for a serial publication such as the Economist. And if a change is needed to the cataloging data to keep it current each library must perform that change. When this data is maintained in the cloud, maintenance and backup of this data is now done once and if a change is needed, once one library performs the change all share it.

2.2.3 Community Power

Another rationale for the adoption of cloud computing is the opportunity for collaboration and cooperative intelligence Breeding (2012). Libraries can agree to share pools of data for cooperative collection building, cooperative preservation or digitization, cooperative sharing of materials, etc. And with massively aggregated data new services can be created such as recommender services based on a broad base of usage data.

2.3 Information Services Provided through Cloud Computing in Libraries.

Cloud computing provides the Libraries with a cost effective infrastructure or environment. It has attracted significant attention in the realms of academia, industry, governing, military and the library to solve storage and computerization problem. Yang (2012) opined that starting from 2011, more and more library vendors began to deliver Integrated Library System (ILS) and discovery tools as cloud solutions. While many vendors offer options to host the classic ILS as cloud solution, some are developing a new generation of ILS especially for the cloud she stressed further. Analysis of literature on library and cloud computing reveals that libraries can use this technology to build digital library/repositories, search library data, host website, search scholarly content, store file, build community power, and automate library.

2.3.1 Building of Digital Library/Repositories

Cloud computing can only be efficient in a digital library, digital library is not an offshoot of cloud computing but cloud computing provides an opportunity for libraries to use a cost effective platform to build a functional and efficient digital library. It has been observed that cloud computing is not all together a new technology but an adaption of existing technologies and paradigms. Dhanevandin & Tamizhcheven (2014) provided the following as the characteristic of digital library:

- Digital object that include video, audio, and multimedia,
- Numeric components automated knowledge discovery tools.
- Access from user's desk
- Remote to rare and expensive material.

For these authors, digital library is only a step away from virtual library. It has its deficiencies which cloud computing can provide remedy for. Kumar et al (2012) highlighted the problems of digital library that is housed in the server and maintain by Library locally thus:

3 Data resources of various libraries are relatively independent and therefore lead to building of redundant projects.

4 Uneven economic development in different regions causes DL's resources to be relatively short. The cost of procuring, maintaining, installing and so on is high to solve this problem; they advocated an improvement in the user services model in libraries which includes the adoption of cloud technology in digital library.

Cloud computing provides library the opportunity of building digital library in the cloud, digital library built in the cloud makes resources, information, and services, at an efficient level, accessible via the network. Kumar et al (2012) posited that although there are OPAC (Online public access catalog) and ILL (Inter-library Loan) services already, library users still cannot access platform. However, cloud computing provides an integrated library resource that supports distributed uniform access interface. Simultaneously, the uniform access platform can promote library resources, guide and answer user's questions by using high–quality navigation. They further stressed that since library, by nature stores, processes, and spreads knowledge, the knowledge service model could provide users with efficient transmission of information and knowledge services. Kaushik and Kumar (2013) submitted that in connection to cloud based digital library software, Duraspace has two software's; namely, Dspace and Fedora Commons but Duraspace is widely used for

building digital libraries/ repositories with standard interfaces and open source codes for the both software.

2.3.2 Search Library Data

Digital library build on cloud infrastructure provides a unified search service this enables users to search a pool of library data through any device with internet connectivity. Cloud computing provides an integrated library resources opined Kumar et al (2012). Kaushik and Kumar (2013) suggested that OCLC is one of the best examples for using cloud computing for sharing libraries data for years. OCLC, they stressed further, offers various services, pertaining to circulation, cataloguing, acquisition and other library related services on cloud platform through the web share management system. Web share management system facilitates an open and collaborative platform that allows each library to share their resources, services, ideas, and problems with the library community on the cloud.

2.3.3 Website Hosting

Breeding (2012) noted that many libraries rely on institutional or commercial hosting services for their websites. Thus, library's web presence is not provided directly by the library itself but by its parent organization. With cloud computing, libraries have the forum to host their own website on a third party service provider's services. This takes the responsibilities of hosting and maintaining their own servers. Google sites serves as an example for hosting websites outside of the library's servers and allows for multiple editors to access the site from varied locations.

2.3.4 Searching Scholarly Content

Cloud based research platform facilitates the discovery and sharing of scholarly content. Kaushik and Kumar (ibid) cited Knimbus as a knowledge cloud which is dedicated to knowledge discovery and collaborative space for researchers and scholars. Started in 2010 by entrepreneurs Rahul Agarwalla and Tarun Arora to address the challenges faced by researchers in searching across and accessing multiple information sources, currently, Knimbus makes use of over 600 academic institutions and R & D labs by scholars, researchers and scientists as well as over 50,000 researchers. According to Yang (2012), the cloud based new generation of ILS allows many libraries to share useful data. For instance, sharing of full-text journal titles from electronic databases where many libraries subscribe to the same databases. In acquisitions section, all the data bases are listed in a pull down menu. A library can highlight a database for purchase and activate the journal list by clicking on the button.

2.3.5 File storage

Data storage in cloud is necessitated by the inherent fragility of all physical storage devices. A USB flash drive can be misplaced, a laptop or desktop could crash, or even be hacked; there are also incidences of hardware failures, software malfunctions, and malware attacks and so on. File storage capacity provided in the cloud is virtually limitless in addition to a much higher of level of reliability than most libraries can accomplish within their own data center according to Breeding (2012 cited in Gbaje & Aliyu 2014). Turner (2009) also noted that backups are much easier to create and risk associated with hardware failure is minimized with cloud computing.

2.3.6 Building Community Power

Cloud computing technology offers great opportunity for libraries to build networks among the library patrons and information science professionals as well as other interested people, including information seekers by using social networking tools. The most famous social networking services are Twitter and Facebook. They play a key role in building community power. Such cooperative effort of libraries will promote time saving, efficiencies, wider recognition, and cooperative intelligence for better decision –making. It also provides a platform for innovation and sharing of intellectual conversations, ideas and knowledge

2.3.7 Library Automation

Library automation refers to the transition from traditional library which sources, organized and provides library services and resources in hard copies to computerization of library resources. Automated library according to Dhanevanden et al (2014) computerizes catalogue, circulation, acquisition, etc and the functions of library are fully automated. Kaushik & Kumar (2013) observed that for library automation purpose, Polaris provides variant cloud based services such as acquisition, cataloguing, process system, digital contents and provision for inclusion of cutting edge technologies used in libraries. It also supports various standards such as MARCZI, XML, 239.50, Unicods and so on. They further stressed that these ones directly related library and Information Science. Dhenavandan & Tamizhchelvan (2014) added the following four to the above areas of adopting Cloud Computing in library:

-Library systems (e.g. catalogue, discovery systems, request man-system)

-Education Initiatives (e.g. outreach to students, instructional support)

-Scholarly communication (e.g. digital repositories)

-Public services (e.g. enhancing online conversations with patrons.

In addition, cloud computing allows pooled of resources that customers draw from usually in remote data Centre. Services can be scaled larger or smaller; and use of a service is measured and customers are billed accordingly. Different services can be provided by cloud computing company over the Internet. According to Han (2012) three main service models of cloud computing includes**:**

- **Infrastructure-as-Service (IaaS**)

The IaaS model provides just the hardware and network; the customer (Library) installs or develops its own operating systems, software and applications. The hardware and other basic services are provided through virtual machine accessible through a Wide Area Network or the Internet. Under this model, the IaaS service provider owns the equipment and is responsible for housing, running and maintaining it, and the client library typically pays on a per-use basis.

Some writing on adoption of cloud computing in libraries appears to favour IaaS over other service models. Liu & Cai (2012), for one, explained that in this service model, the server administration and maintenance responsibilities are moved from local personnel to the hosting vendor, while the management of the application remains in the traditional way, that is, systems librarians are still able to access the backend of the system for local customizations as if they were managing the system locally. Breeding (2012) defined IaaS as subscribing to computing and storage capabilities on an as-need basis. It allows a library

to gain access to computing resources – such as Linux or Widows scaled to the demands and duration of a project. With IaaS, libraries will not see the physical hardware involved but will perform much of the system administration tasks as they would for local servers. Operating an application through IaaS saves the library from the purchase of its own hardware but retains the tasks associated with installing and maintaining software application. A library might use IaaS to operate its integrated library service (ILS) rather than purchase local hardware. Examples of IaaS according to Kaushik and Kumar (2013) are Amazon Web services, Rackspace, Savis, HP, IBM, Sun and Google Base.

Furthermore, IaaS offers data storage capacity. Thus with IaaS, the fear associated with sensitive file leaking, lost or crash or software malfunction or malware associated with laptop or desktop is eliminated. Han (2011), however, lamented that from his analysis and study of the use of IaaS in library automation, libraries do not exploit fully the storage capacity availed by IaaS. Breeding (2012) provides examples of storage facility available in the cloud for libraries to consider in their quest to take advantage of cloud infrastructure. They include drop box (http://www.dropbox.com), windows Live SkyDrive (http://explorelive.come/windows.live-skydrive), Amazon Cloud Drive (http://www.amazon.com/clouddrove/learnmore), Box.net (http://www.box.net), and so on.

❖ **Software–as–a Service**

In Software as a Service model, a pre- made application, along with any required software, operating system, hardware, and network are provided. SaaS delivers a single application through the browser to thousands of customers using a multitenant architecture. From the customer's end, it means no upfront investment in servers or software licensing;

on the provider side, with just an app to maintain, cost are low compared to conventional hosting. Breeding (2011), asserted that most Software -as -a- Service offering involve many libraries or individuals sharing a single instance of the software, where all updates and enhancements can be applied once and for all. The different individuals or institutions using the service can configure their software as needed, customize the branding, color schemes, and navigation controls and to set functional preferences and policies according to local needs. Since the service provider takes care of enhancement, upgrades and patches, users are relieved from the burdensome responsibility as it would apply to local software.

In this service model, users can access and use any software available with cloud vendors. With SaaS, it is not necessary for users to buy the software, install and run, or maintain the applications on a system or a server. Kaushik and Kumar (ibid) noted that SaaS provides online email applications, free services, limitless storage and remote access from any computer or device with an Internet connection. Breeding (2012) however reminded that the concept of using software applications via the Internet is not especially recent, with many software firms offering their products in hosted arrangement since the 1990s through an arrangement called Application Service Provider or ASP. Han (2012), on the other hand, opined that the SaaS primary users are the general public. Gmail, Google Drive, Google Calendars, Windows Sky Drive and dropbox are popular SaaS Service

- **Platform-as-a-Service**

In PaaS, an Operating System, Hardware, and Network are provided, and the customer installs or develops their own software and applications. The consumer does not manage or control the underlying cloud infrastructure including network, servers, operating

systems, or storage, but has control over the deployed applications and possibly configuration settings for the application.

Platform as a Service model helps in generating the computing platforms to run the software and other tools over the Internet without managing the software and hardware at the end of user side. PaaS offers a complete development and production environment, abstracted from concerns with details of underlying infrastructure. Amazon Elastic Cloud (AEC), EMC Atmos, Aptana are examples of PaaS model which provide platforms to users in maintaining and supporting their IT infrastructure without spending huge amount in buying hardware, software and related/technology.

2.4 Implication of cloud computing in libraries.

While cloud computing technology have arrived in the mainstream, libraries have been reluctant to apply and adopt a cloud- based system to enterprises users (Bleeding, 2012) Cost, staff and maintenance implication in the adoption of cloud computing.

2.4.1 Cost implication of cloud computing in libraries

Cloud is moving past the hype stage and starting to deliver tangible benefits, primarily increased flexibility and agility. But moving to the cloud can be also mean added cost posited out by Breeding (2012). It can cost tens of thousands of dollars per year to move large volumes of data to public cloud services and to store that data for long periods of time.

Network bandwidth accounts for much of the cost of moving data, cloud providers might charge upload and download fees and even though data and systems are being hosted off – site, as Ambrust et al (2010) posited out that there are internal labor cost,

"People think there are no labor costs with cloud, but as you scale up to handle workload, there is a complexity with managing large numbers of cloud instances just like managing a large number of servers".

Creeger (2009) asserted that using cloud can reduce total cost of ownership of infrastructure significantly. Some clients report savings of fifty to seventy – five percent. Because each client is unique, the potential saving achieved by leveraging cloud technologies or services will vary. Several factors impact the overall total cost of ownership of operating infrastructure:

- Reduced Upfront Cost: spending capital on equipment allows companies to depreciate the cost of over three to five years; however, this mean that a library will recognize the same CapEx (Capital Expense) each month of the project regardless of the actual usage.
- Usage – based Pricing: temporary workloads such as software testing and development; load testing and quality assurance; troubleshooting; big data analytics; and seasonal web sites require IT typically needs to spend time acquiring the equipment, deploying the equipment in data centre and then configuring the environment for the end users of cloud computing pay only for the resources they use.
- Automation: cloud computing simplifies provisioning, de-visioning and re-deploying resources through automation and easy – to use web consoles and APIs. The efficiency of cloud computing reduces the amount of time an IT

systems administrator has to spend on managing and supporting infrastructure.

- Operational Services and Support: the automation and self- provisioning benefits with managing infrastructure. Additionally, by leveraging the managing infrastructure. Additionally by leveraging the managed services of a cloud provider and systems integrator, libraries can reduce the cost of managing and maintaining their web server, database and middleware software and system; collaboration; mobility; storage; backup; and enterprise application.
- Reduced Downtime: being able to spin up a temporary environment of servers, storage and networking allows it to more quickly troubleshoot issues that lead to system downtime. Adjusting the processing power, memory and storage performance of a server during troubleshoot issues that lead to system utilization being a constraint.
- Virtualization: using virtualization technology creates multiple virtual machines on a single physical machine can significantly reduce the hardware and power costs. Most large enterprises have already implemented virtualization.
- Resource leverage: multi- tenant architecture in a private or public cloud allow users to take advantages of better leverage and economies of scale for resources

The cost advantages between local storage and cloud storage change dramatically with very large- scale data set. This is worth noting for libraries that deal with very large

sets of data, involving many terabytes such is video collections, and large image collection (Gbaje & Aliyu 2014).

2.4.2 Staff implication of cloud computing in libraries

As more mid-sized libraries move to the cloud, the staffing implications for IT departments are becoming clearer. Whether the size of a giving library's IT staff will need to change as it ascends into the cloud depends on current staffing and staffing shifts will take place: individuals who are working in IT today will need new skills, and certain jobs will shift from the enterprise to the cloud service provide posited by Geoffery (2013).

Experts have pointed out that it is wishful to think that cloud – based systems will manage themselves. If the library IT department is working in a cloud computing environment, then the library will continue to need individuals who understand the library's software applications and how the applications relate to the business. Cloud computing challenges are interdisciplinary in nature and cannot be fully addressed from a purely technical perspective (Khajeh & Sriram,2010).To successfully adopt cloud computing in library services, cooperation among library administrators and practitioners, other library personnel, cloud users (Lecturers and students), and cloud services providers is needed. It is important to note that the migration of IT applications and system to the cloud takes time. The timeline for cloud adoption can vary from several months to several years (Thethi, 2009, Sullivem, 2009).

It is of great importance that qualified and adequate staff be involved in the running and adoption of cloud computing. Inadequacy and incompetency of the staff might lead to ineffective utilization of cloud computing for library services according to Breeding

(2012). He further observed that regular training and retraining is needed to have a positive outlook of the provision of relevant library services.

Resolutions passed on all these issues are favorable although there are reservations on security. Breeding (2012), for one, noted that from a privacy and security perspective, comfort levels for using cloud –based products vary depending on the type of information and activity involved. Thus, libraries involved with highly sensitive information may gravitate towards private rather than public cloud offerings for instance, Kaushik and Kumar (2012) maintained that although the issues were not fully resolved, there is no doubt that libraries are moving towards cloud computing technology in present time and taking advantage of cloud-base services especially in building digital libraries, social networking and communication with manifold flexibilities. Romero (2012) added confidentiality, theft, and loss of file to the list. It stands to reason, therefore, that IT departments will need individuals who understand security issues at a deep level.

2.4.3 Maintenance implication of cloud computing in libraries

Romero (2012) posited that the ability to stores seemingly endless amount of documents, photos, and videos is enticing- the ability to access these things from the any phones, tablet, or computer is what is driving the popularity to cloud computing. Despite its brilliance, cloud computing raises many concern regarding maintenance. It seems very few people feel comfortable having personal, confidential information stored up in some "cloud'' of unknown location.

Geoffery (2013) noted that because cloud computing is invisible and intangible does not mean that it is not a safe way to store information. However, the major benefits of cloud computing is maintenance of data which is handle by cloud provider.

NIST (2012) recommends the following solution to maintenance of cloud computing. Nine concerns: Nine solutions

1. Governance: Develop organization policies, procedures, and standards of use.
2. Compliance: Ensure that the cloud provider's offerings adequately meet the data security controls, and records management requirements.
3. Trust: Create a service arrangements with cloud provider that characterized by high visibility into the security and maintenance actions of cloud provider
4. Architectural: Develop an understanding of the technology the cloud provider utilizes.
5. Identity Access Management: Ensure the correct controls are communicated to the service provider so as they can secure authentication, and other identification and access management functions.
6. Software Isolation: Understand virtualization and other isolation techniques of the cloud provider will implement.
7. Data Protection: Evaluate the cloud provider's data management solutions and maintenances.

8. Availability: Ensure that the contract provisions and procedures for availability, data backup and recovery, and disaster recovery meet the library's continuity and contingency planning requirements.

9. Incident Response: Ensure that the contract provisions and procedures for incident response meet the requirements of your library.

Geoffery (2013) explained that once the relationship is established the library can rest that the information is safe and well maintained in a capable hands. Much of the works on cloud computing attempts to allay the concerns and fears of potential users of the service. Although, as Gates (2000) observed, the main advantage of any new technology is that it amplifies human potentials, which of course that can be settle by maintenance as Goldner (2012) posited out that with the adoption of cloud computing technology, libraries can get out of the business of technology and focus on collection building, patron services and innovation. Servers can be decommissioned and no longer require replacement every five years (or less).

Staff will no longer maintain the complex software stack necessary to run local systems and worry about compatibility of the stack during upgrades. Instead technical skills can be re-deployed for extending cloud services into their environment and their environment into other cloud services asserted by Geoffrey (2013).

2.5 Summary of the review

This chapter reviewed literature that is related to the adoption of cloud computing technology for library services. It reviewed literatures on computer networks in libraries, rationales for adopting cloud computing in libraries, information services provided through

cloud computing in libraries, implication of cloud computing in libraries in terms of cost, staff and maintenance and summary of the literature review. However, it has been revealed that although much works have been done in this area, and equally much more work still remained to be done especially on the adoption of cloud computing technology for library services in the National Open University of Nigeria (NOUN) library. This revelation has offered the opportunity for the researcher to fill the missing gap with information on cloud computing technology for library services in NOUN library.

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CHAPTER THREE

RESEARCH METHODOLOGY

3.0 INTRODUCTION

This chapter is presented in the following sub-headings: research method adopted population of the study, sampled population and sampling procedures, research instrument, procedures for data collection and analysis.

3.1 Research Method Adopted for the study

This study adopted the qualitative methodology approach. Qualitative research is defined as "any kind of research that produces findings not arrived at by means of statistical procedures or other means of quantification" (Strauss & Corbin, 1990). According to Creswell (2003), qualitative research takes place in the natural setting. He states that the qualitative researcher often goes to the site (office) of the participants to conduct the research. This enables the researcher to develop a level of detail about the individual or place and to be highly involved in actual experiences of the participants.

According to Denzin and Lincoln (1994), qualitative methodologies include "interviewing; observing; artifacts, documents, and records; visual methods; personal experience methods; data management methods; computer-assisted analysis; and textual analysis". All of these methods may be useful in gaining an insight into the adoption of cloud computing technology for library services.

3.2 Population of the Study

The population of this study consists of five (5) members of National Open University of Nigeria Library. The target population of the study includes the University Librarian and the (4) staff of the Information Technology (IT) unit of the National Open University of Nigeria Library who are responsible for the administration of cloud computing technology.

3.3 Sample and Sampling Procedure

Purposive sampling technique was used to select four (4) staff of the Information Technology unit and the University Librarian of the National Open University of Nigeria Library. According to Crossman (2012), '' a purposive sampling is very useful for

situations where you need to reach the targeted sample quickly and the sampling is not proportional in nature". Therefore, the subject of the study is made up Four (4) Information Technology (IT) staff and the University Librarian of the National Open University of Nigeria Lagos Main library.

3. 4 Instruments for Data Collection.

The instruments used to collect data for this study were direct observations, semi-structured, unstructured interviews and the use of digital recorder to record the interview process. The semi-structured interview involve the researcher personally interviewing staff of the Information Technology (IT) unit, based on a structured set of questions that have been prepared before the interview. This enabled the researcher to explain or elaborate on any question that is not well understood by the respondents.

3.4.1 Interview

The semi-structured interview was directed at finding out the existing computer networks available in NOUN library; the rationale for the adoption of cloud computing in NOUN library; the information services provided through cloud computing in NOUN library; the implications in terms of staff, costs and maintenance of the adoption of cloud computing in NOUN library.

The other question was directed towards finding out the level of the adoption of cloud computing in NOUN library, areas that NOUN have implemented cloud computing in its library; any positive effect of the adoption of cloud computing in NOUN library; devices that NOUN Library use for cloud computing; layers of cloud services in NOUN library; cloud computing deployment model in NOUN library, cloud services provided in NOUN Library; cloud based library services for NOUN library; In conclusion the Interviewees was asked to comment on how NOUN library feel in storing data online.

The unstructured interview emanated from follow-up questions in response to some of the structured questions as well as observations during visit. The response was captured using digital recorder and analyzed thereafter.

3.4.2 Observation

Observation involves the use of eyes of the researcher rather than ear and voice (Lofland and Lofland 1995). Direct observation on the facilities that is available for cloud adoption, such as computer hardware and software. A condition of storage medium was also conducted to provide additional information that may be needed for the research.

3.4.3 Focus Groups

The researcher systematically questioned the University Librarian and staff of the Information Technology (IT) unit of NOUN Library as a focus group. The focus group was unstructured and semi-structured questioning techniques in order to elicit information on the adoption of cloud computing technology for library services in NOUN library and the strategies adopted for long-term cloud solutions, (Fontana & Frey, 2003). The focus group interview was used to build on data collected from individual interviews by verifying and elaborating on information supplied by the informants individually. The interview was audio taped and transcribed verbatim. Lofland and Lofland (1995) recommended considering focus group interviews as a supplement to intensive, one-on-one interviews if the topic is reasonably public and not something that would cause embarrassment to participants. They believe that the focus group offers "the advantage of allowing people more time to reflect and recall experiences.

3.5 Validity and Reliability of the Instrument

The instruments used for collecting data were validated by the supervisor(s), academic staff, research experts and colleagues in the Department of Library and Information Science, Faculty of Education, Ahmadu Bello University Zaria. Corrections, vetting and suggestions by the aforementioned were incorporated in the final copy before administering it.

The reliability of the instrument was established by conducting a pretest within two weeks at the Kogi State University Library with the following purpose:

i. To test the method of data collection, and

ii. To pre-test the interview schedule.

Reliability deals with the face validation of the interview and questions, some questions were used to ascertain the reliability of the result. This is because reliability deals with the consistency of measure and stability. According to Bryman (2008), reliability of instrument is very important as it deals with consistency, stability and detail treatment of issues using appropriate techniques.

3.6 Procedure for Data Collection

The researcher personally visited the site selected for this study, and conducted the semi-structured and unstructured interviews, examined appropriate documents and conducted observations. The researcher spent three days in the selected site observing the process and strategies of cloud adoption as well as examining relevant documents.

3.7 Procedure for Data Presentation and Analysis

The data collected from the research instruments was first organized for analysis and transcribed into different types, depending on the source of information. The data was then tabulated and discussed descriptively.

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CHAPTER FOUR

DATA PRESENTATION, ANALYSIS AND DISCUSSION

4.0 Introduction

This chapter is presented in the following sub- headings: Response rate of the respondents in the IT unit of the National Open University of Nigeria library and the University Librarian; Data Presentation, Analysis and Discussion.

4.1 Response Rate

The entire five (100%) target respondent in the Information Technology unit and the University Librarian of NOUN library participated in the semi-structured and structured interviews. (Table 4.1)

TABLE 4.1: RESPONSE RATE

S/N	National Open University of Nigeria Library	Category of Staff	Sample Size	Response rate
1.		University Librarian	1	1
		Staff of Information Technology unit	4	4
Total			5	5

A hundred percent response rate was achieved for the structured and semi-structured focus group interviews. This high response rate was achieved because of the fact that the population was very small, and the researcher had to formally seek for permission from the University Librarian, who instructed the staff of the Information Technology unit to give the researcher all the necessary support and cooperation in the data collection exercise.

The entire respondents in the Information Technology Unit and the University Librarian of NOUN library participated in the structured and semi-structured interview.

4.2 Data Presentation, Analysis and Discussion

In this section, data collected in respect to the four research questions raised in the study were presented, analyzed and discussed using descriptive and statistics analysis. This involved the description of adoption of cloud computing technology for library services in NOUN library as derived from the interview administered.

4.2.1 Existing Computer Networks Available in NOUN Library

The first research question raised in this study sought to determine the availability of the existing computer network in NOUN Library.

Table 4.2: **Existing Computer Networks available in NOUN Library**

NOUN LIBRARY	INDICATIONS
Local Area Network (LAN)	√
Wide Area Network (WAN)	√
INTERNET	√
Campus Area Network (CAN)	√
Storage Area Network (SAN)	X
Metropolitan Area Network (MAN)	X
Enterprise Private Network (EPN)	X
NETWORK	√
Virtual Private Network (VPN)	X
Personal Area Network (PAN)	X

Key: √ = Applicable x = Not Applicable

From the table 4.2, it is obvious that LAN, WAN, Internet, CAN, and Network are the existing computer networks available in NOUN library. This therefore made the researcher to conclude that SAN, MAN, EPN, VPN and PAN are not applicable to NOUN

Library. This finding agrees with Lihithar (2012) who stated that "Local Area Network (LAN), Wide Area Network (WAN) and internet can be kept entirely private by restricting some communications to the connection within the network. The implications of the availability of SAN, MAN, EPN, VPN and PAN is that information using such connections might not be accessible, retrievable or store in NOUN library which might limit service delivery in that aspect.

Furthermore, the researcher also attempted to determine the speed of internet line in NOUN library via the adoption of cloud computing technology and respondents agreed with the option YES.

The researcher also attempted to determine the cloud devices that NOUN library use for its library services in line with this, others possible options were made available for the respondents. Details of the finding is shown on table 4.3

Table 4.3: Devices use for cloud computing in NOUN Library

NOUN LIBRARY	INDICATIONS
PC	√
Laptop	√
Mobile Phones	√
Smart Phones	√
Desktops	√

Key: √ = Applicable x = Not Applicable

It is shown that all devices indicated (table 4.3) are available for use in NOUN Library. The finding agrees with Burckhard et, al (2013) who stated that "as technology progresses, new application emerge that offer specialized functionality

on a mobile device such as phones or tablets. Often, these apps include social aspects where users share information online. The capability of sharing data between devices is typically achieved by developing web services. Increasingly, such services are deployed in the cloud, hosted environment that offer virtualized storage and computing resources". It implies that library services will be more robust and efficient in NOUN library.

Similarly, the researcher also attempted to find out what areas NOUN Library implements cloud computing. In line with this, possible options were made available for the focus group. Details of the finding are shown on table 4.4.

Table 4.4: Areas of Implementation of Cloud Computing in NOUN Library

Areas of Implementation of Cloud Computing in Noun Library	**Indications**
Cataloging And Metadata Storage, Retrieved And Generation	√
Hosting And Or Distributing Special Collection	X
Acquisitions	√
Cloud-based Electronic Resources	√
Budgeting Payroll Or Accounting	x

Key: √ = Applicable x = Not Applicable

Cloud computing has been implemented by NOUN Library in cataloguing, metadata storage, retrieval and generation. Likewise, Acquisitions and cloud- based electronic resources has also been implemented in NOUN Library. But not in hosting and or distributing special collection and budgeting payroll or accounting. This implies that if change is needed for the cataloguing data to keep it current,

once one library implements it, NOUN library will only copy it and tag it. Also in the aspect of Hosting and or Distributing special collection and Budgeting payroll or accounting, library services in that aspect will not be effective in NOUN library, this findings agrees with Goldner (2012).

4.2.2 Rationales for the Adopting of Cloud Computing in NOUN Library

The second research question is to determine the rationales for the adoption of cloud computing in NOUN Library. Hence, the researcher investigated the rationales behind NOUN Library going to the cloud. In line with this, several possible options were made available for the respondents.

Table 4.5: Rationales for the adopting cloud computing in NOUN library

Rationales for the adopting of cloud computing in NOUN Library	**Indications**
Need to disclose their vast collections on the web	√
Amplify the power of cooperation with other developed library	√
To build a significant, unified presence on the web	√
Save time	√
Save cost	√
Simplifying workflows	√
Makes work more effective and efficient	√
Local storage, maintenance and backup is removed	√
Opportunity for collaboration and cooperative intelligence	√
Cloud computing is the latest trend	√
To meet the information need of large number of student spread all over the country	√
Make work faster and much easier	√

Key: √ = Applicable x = Not Applicable

Table 4.5 shows that all the options above are the rationales for the adoption of cloud computing in NOUN Library. The finding agrees with Goldner (2012) who stated that the rationales behind library going cloud computing is "to disclose their vast collections on the web, amplify the power of cooperation with other developed library, build a significant, unified presence on the web, save time, save cost, simplify work flow, makes work more effective and efficient, local storage, maintenance and backup is removed, NOUN library also see cloud computing as also the latest trends". This implies that cloud computing has promoted time saving, efficiencies, wider recognition, and cooperative intelligence for better decision –making in NOUN library. It also creates a platform for innovation and sharing of intellectual conversations, ideas and knowledge.

Furthermore, the researcher attempted to find out how the adoption of cloud computing technology has help NOUN library to improve its quality of services to its users. The detail of the finding is in table 4.6.

Table 4.6: Quality of Services Using Cloud Computing

Quality Of Services Using Cloud Computing in NOUN library	**Poor**	**Low Quality**	**Moderate**	**High quality**
Cloud- based mailing services	x	X	√	X
Cloud-based forums	x	X	√	X
Cloud –based social networking	x	X	√	X
Cloud-based information collection	x	X	√	X
Cloud-based calendar services	x	X	X	X
Cloud-based file sharing service	x	**X**	√	X
Cloud based- video services	x	X	X	X
Cloud-based software and supplication	x	X	X	X

Cloud-based storing and supplication	x	X	√	X
Cloud-based operating services	x	X	X	X

Key: √ = Applicable x = Not Applicable

The finding on table 4.6 shows that cloud-based calendar service, cloud-based video services, cloud-based software supplication and cloud-based operating service, are not applicable in NOUN library in improving quality services to its patrons. The implication of this is that quality services using such cloud services might not be fully achieved. The researcher therefore concluded that for efficient library services, NOUN library should ensures that all these services are applicable in its library. The implication of this is that the quality services in that aspect might not be fully achieved.

Having seen the extent of the adoption of cloud computing in NOUN Library, options were made available for the respondents in (table 4.7) to identify the extent of the adoption of cloud computing in NOUN library.

Table 4.7: Extent of the adoption of cloud computing in NOUN library

Extent of the adoption of cloud computing	**Low Quality**	**Moderate**	**High quality**
Web-mail services	X	√	X
Store personal photos	X	√	X
On line application	X	√	X
Store personal video	X	√	X
Pay to store computer file online	X	√	X
Back-up hard drive to an online site	**X**	**X**	√

Key: √ = Applicable x = Not Applicable

Table 4.7 reveals that cloud computing is used for web-mail services in NOUN library, NOUN library also use to store personal photos, online application and storage of personal video, pay to store computer file online and back-up all applicable in NOUN library. The finding agrees with Goldner (2013) that stated that library community can apply the concept of cloud computing to amplify the power of cooperation and build a significant, unified presence on the web.

4.2.3 Information services provided using cloud computing in NOUN library

The third research question was formulated in order to determine the information services provided using cloud computing in NOUN Library. In line with this, the researcher investigated information services provided using Cloud Computing in NOUN library with some possible options in (table 4.8).

Table 4.8: Information services provided using cloud computing in NOUN library.

Information services provided using cloud computing in NOUN Library	Indications
Building digital library	√
Searching scholarly content	√
File storage	√
Building community Power	√
Library Automation	√

Key: √ = Available x = Not Available

Table 4.8 shows the information services are provided via cloud computing in NOUN Library. The pictorial chart displays information services provided through the adoption of cloud computing technology in NOUN Library which are building Digital library,

Searching Scholarly Content, File Storage, Building Community Power and of course Library Automation. This finding agrees with Yang (2012) who stated that cloud computing provides an opportunity for libraries to use a cost effective platform to build a functional and efficient digital library. It implies that library services will be more efficient.

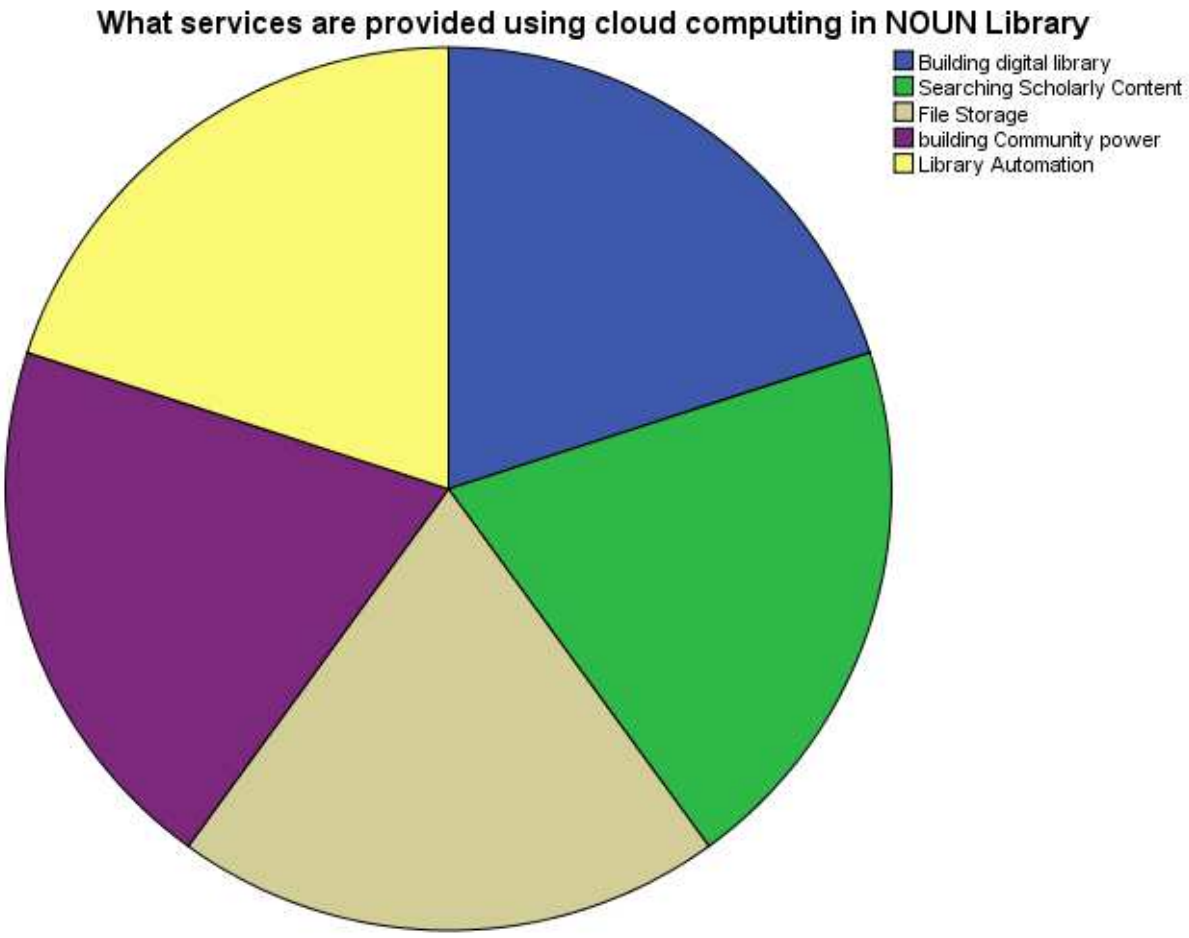

Fig2

After the researcher has gotten information on the services provided using cloud computing in NOUN library, the researcher sought to find out the layers of cloud computing services that NOUN Library is using. The details of the finding are on table 4.9.

Table 4.9: Layer of cloud computing services in NOUN library

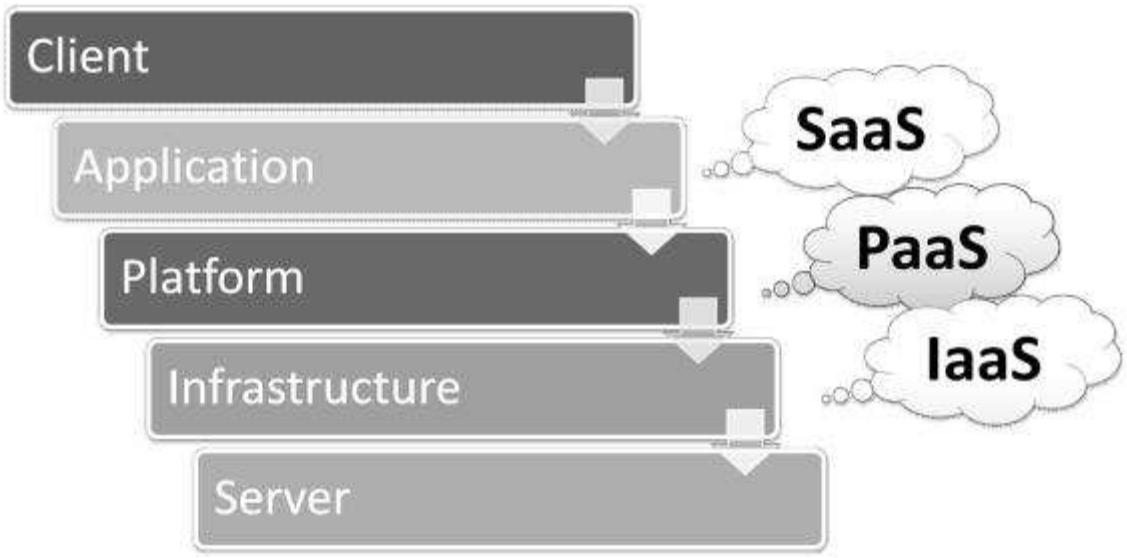

Figure. 3. Cloud Computing layers (Ahronovitz et al, 2010).

Layer of cloud computing services	**Indications**
Free software as a service (SaaS), i.e. Google apps, Skype, hotmail	√
Paid subscription Software as a Service, (PaaS) i.e. Sale force	X
Platform as a Service (PaaS) – Enables end users to build their own applications online i.e. window Azure, Google App, Engine and force. com	√
Infrastructure as a service (laaS)- Provides Computing Power and file storage i.e. Amazon cloud, Rackspace, Zyinga	X

Key: √ = Applicable **x = Not Applicable**

The finding in table 4.9 shows that free software as a service (SaaS) which is the Google apps, Skype, Hotmail are the layers of cloud computing in NOUN library. Platform as a Service (PaaS) which enables end- users to build their own applications online, Examples; Window Azure, Google App, Engine and Force.com are the layer of cloud

computing used in NOUN Library. The finding agrees with Breeding (2012) who stated that different individuals or institutions using the services can configure their software as needed, customize the branding, color schemes and navigation controls and to set functional preferences and policies according to local needs. It implies that NOUN library will not be able to enjoy some services that Infrastructure as a Service provides.

The researcher equally determined the cloud computing deployment model used in NOUN library for its library services.

Table 4.10. Cloud computing Deployment models in NOUN Library

Cloud Computing Deployment Models	**Indications**
Public cloud	√
Private cloud	√
Community cloud	X
Hybrid cloud	X

Key: √ = Applicable x = Not Applicable

Table 4.10 shows that only public and private cloud computing deployment models are in use in NOUN Library for its services according to the respondents due to financial constraint. The finding agrees with Kart et al (2009) who stated that libraries can exploit public and private cloud for e-mail services, searching scholarly contents, for building of community power, file sharing and networking of information. He equally stated that "private clouds make it possible in theory for libraries IT provider to let go of more complex, risky, and value- laden IT activities". It implies that NOUN library using private cloud can configure their software as needed customize the branding color scheme and navigation. NOUN library is relieved from burdensome responsibility of the software.

The researcher went further to determine the factors that led to the adoption of cloud computing technology in NOUN library. Details are in table 4.11.

Table 4.11: Factors that led to the adoption of cloud computing technology in NOUN library.

Feature	SA	A	D	SD
Developing the right Knowledge base to make sound decisions about cloud computing	√	X	X	x
Fears of data/file privacy and possible loss of confidentiality	X	√	X	x
Fears over the possible need to eliminate staff that had been h and ling it functions in house.	X	X	X	√
Concerns over high subscription and lack of adequate safeguards	√	X	X	x

Key: √ = Applicable x = Not Applicable

In table 4.11, it could be seen that NOUN library have the right knowledge base about the adoption of cloud computing, no fear of loss of data and file privacy, have no fear or idea of eliminating their staff as a result of the adoption of cloud computing technology but have a big concern about high subscription of cloud computing especially at the initial stage. This is in line with Goldner (2012) who stated that "libraries have nothing to hide but to disclose their vast collection to the world to access". The implication of high subscription is that NOUN library will depend on the parent organization and government for finance.

4.2.4: Implications in terms of cost in the adoption of cloud computing.

The fourth research question was to determine the implication of cloud computing in terms of cost, staff and maintenance.

Table 4.12: Cost implication of cloud computing in NOUN library

Cost Implication Of Cloud Computing	Indications
Budgetary Issues	√
Privacy	X
Staff training	√
Recruiting the right staff to do the job	X
Security	X

Key: √ = an issue x = Not an issue

Table 4.12 shows that NOUN Library is faced with financial, and management of staff as the major implication in the adoption of cloud computing in NOUN Library.

The finding tallies with that of Breeding (2012) whose study on challenges affecting the implication of cloud computing in developing countries noted that the use of cloud computing in the libraries is challenged with inadequacies funding, training of staff, recruiting the right staff to do the right job, privacy, security of data among others.

As a follow up, the researcher sought to find out if NOUN library has saved cost via the adoption of cloud computing technology.

Table 4.13: Saving using cloud computing technology

Saving Using Cloud Computing Technology	Indications
Staff time	√
Save cost	√
Electricity	√
Maintenance	√

Key: √ = Applicable x = Not Applicable

As shown by table 4.13, the adoption of cloud computing technology has helped NOUN library to saved cost, staff time, electricity and maintenance of library services. The finding agrees with Tuncay (2010) who stated that "with cloud computing the library may prevent financial waste, better track staff activities, and avert technological headaches such as viruses, system crashes, and loss of data." The finding implies that service delivery in NOUN library will be robust and efficient.

The researcher also sought to find out if the adoption of cloud computing has simplified the IT based services. The respondents further agree that the adoption of cloud computing in NOUN Library has simplified IT based services.

As a follow-up to the above findings, the researcher also sought to find out if NOUN Library feels safe storing data online, and the respondents, further agreed that they feel safe storing data online.

To ascertain this, the researcher tries to find out if NOUN library online files can be kept by the online services providers even when it is deleted from their system and the respondents further agrees that the online files can be kept by the online service provider.

The researcher further sought to find out if NOUN Library is concerned about the ability to retrieve its data from the cloud, and respond was No.

After ascertaining the level of data retrieval using cloud computing, the researcher went further to find out whether cloud computing is an attractive economic option for NOUN library and their responses was YES.

In this effect, the researcher sought to find out if NOUN library equally provides training relating to the adoption of cloud computing to their staff.

Table 4.14: Staff Training on cloud computing

Staff Training	**Indications**
Quarterly	X
Yearly	X
Bi- yearly	√

Key: √ = Applicable x = Not Applicable

Table 4.14 shows that staff of NOUN Library had under gone training on networking, software, social media and cloud computing technology and this is done through attendance of workshops but most of the training is done bi - yearly. This can be attributed to the fact that NOUN Library has been constrained due to financial limitation according to the respondents. The implication of staff not having adequate training is that the staff will not be equipped to carry out cloud computing services efficiently. Staff no longer has to maintain the complex software stack necessary to run local systems and worry about compatibility of the stack during upgrades. Instead technical skills can be re-deployed for extending cloud services into their environment and their environment into other cloud services.

4.3 Analysis of the Observations

It was observed that NOUN Library staff and clienteles are using the following information services through the adoption of cloud computing: Gmail, Yahoo, Fast mail, Ilearn, LIS link, Facebook, What Sapp, Twitter, Delicious, Drop box. This has equally promoted innovations and sharing of intellectual conversations, ideas, problems, and solutions among NOUN Librarians and other developed library across the globe.

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Chapter Five

Summary of Findings, Conclusion and Recommendations

5.0 Introduction

This chapter is presented in the following sub-headings: summary, summary of major findings, conclusion and recommendation.

5.1 Summary of the Study

This chapter is presented in the following sub-heading: summary of the findings, summary of the major findings conclusion and recommendation.

The study investigated the adoption of cloud computing technology for library services in the National Open University of Nigeria library. It investigated the existing computer network available in NOUN library. It also identified the rationales for adopting cloud computing in NOUN library, it also attempted to ascertain the information services provided using cloud computing in NOUN library. The study has identified the implications of cloud computing in terms of cost, staff and maintenance in the National Open University of Nigeria library.

In order to achieve the objectives of the study, four research questions were formulated and tested. The review of relevant literature revealed that libraries can benefit from using cloud computing technology by increasing computing performance, storage, capacity, universal accessibility and cost reduction.

The instruments used to collect data were unstructured and semi-structured interviews, direct observation and the use of digital recorder. A semi-structured interview covered all the research questions which sought to find out the adoption of cloud computing technology for library services in NOUN Library.

The data collected for the study were organized for analyzed and transcribed into different types. The data were then tabulated and discussed descriptively.

5.2 Summary of Major Findings

The major findings of the study include the following:

1. The study discovered that Local Area Network, Wide Area Network, Internet, Campus Area Network, and Networks were the existing computer networks available in NOUN library.

2. The rationales for the adoption of cloud computing in NOUN library is to provide information to its students who are spread across the country and to equally make the information accessible and not location specific.

3. The information services provided using cloud computing in NOUN Library are- digital library/ repositories, searching library data, searching scholarly content, file storage, building community power and library Automation.

4. The implication in terms of cost, staff, and maintenance of the adoption of cloud computing technology in NOUN Library was mainly subjected to budgetary issues which lead to inadequate training of staff and the issue of recruiting the right staff to do the job.

5.3 Conclusions

Arising from the findings of the study, it can be concluded that NOUN Library adopt cloud computing to provide library and information services to its students who are scattered all across the country where access to information must be unfettered and not location specific. And to enable NOUN Librarians to get out of technology headaches such as computer viruses, system crashes, and loss of data, but save time, money, while simplifying workflow.

5.4 Recommendations

Based on the findings of this study the following recommendations are hereby made:

1. The National Open University of Nigeria in collaboration with the University Librarian should provide WAN in each Study Centre's with fast internet connection which will connect multiple locations to NOUN Headquarter Library and equally use it to control its services and data.

2. National Open University of Nigeria Library should incorporate community and hybrid cloud deployment model to its library services in order to benefit from all that cloud computing deployment models offers and to eradicate the fear that usually associated with sensitive file leakage, lost or crash of software, malfunction or malware associated with laptop or desktops.

3. The University Librarian in collaboration with NOUN Information Technology staff should introduce the cloud-based video service, and cloud-based software such as Ning, Survey Monkey, Wufoo, Stumbleupon, My goya and Ms online to its information services as these will equally boost the library services delivery.

4. In the case of cost, staff and maintenance implication, the Federal Government should increase budget allocation (TETfund) to the libraries. Meanwhile, NOUN Library should avoid overdependence on the government to fund their cloud application project. They need to solicit for grants from financial institutions like banks, NGOs and other foundations. Regular training and retraining of staff is equally needed to have a positive outlook of the provision of relevant library services. This approach towards cloud computing will equally help NOUN Library save time and cost while simplifying workflows. More so, due to the fact that the cloud services are usage based or pay as-you-go pricing, NOUN Library can initially adjust the usage and cost of its IT-related services in an efficient way. This idea is similar to the pricing of public utility such as water, electricity, and gas in which the user only pays for the usage and there is no need for investment in the

infrastructure or specific equipment, which may account for a lot of money. Therefore, NOUN Library can experience the cost reduction at the beginning and the flexibility of cost management.

5.5 Suggestions for further Studies

1. Adoption of Cloud Computing Technology in all the First and Second Generation University Libraries in Nigeria.

2. Adoption of Cloud Computing Technology in all the First Second Generation Polytechnics and College of Education Libraries in Nigeria.

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Appendix

Department of Library and Information Science

Ahmadu Bello University, Zaria

Dear Sir/Madam,

I am a postgraduate student in the above named department carrying out a research on the **"Adoption of cloud computing technology for Library Services in the National Open University of Nigeria library".**

Your library has been selected for the study. I therefore urge you to kindly assist to respond to the questions raised in the guided interview. Your response will strictly be used for research purpose only.

Thank you in anticipation for your cooperation.

Okwoli Mercy Enefu (Mrs.)

Mobile Number: 234-803-317-338-3

234-809-933-170-9

E-mail: okwoli.mercy@yahoo.com

Appendix 1

Department of Library and Information Science

Ahmadu Bello University, Zaria.

These questions were designed to be administered during the guided interview with staff of the Information Technology (IT) unit of NOUN Library.

Computer Networks available in NOUN library

1. What are the existing computer networks available in NOUN library

EXISTING COMPUTER NETWORK IN LIBRARY	**INDICATIONS**
Local Area Network (LAN)	
Wide Area Network (WAN)	
INTERNET	
Campus Area Network (CAN)	
Storage Area Network (SAN)	
Metropolitan Area Network (MAN)	
Enterprise Private Network (EPN)	
NETWORK	
Virtual Private Network (VPN)	
Personal Area Network (PAN)	

2. Does NOUN Library have high speed internet lines, and uninterrupted service?

3. Which device do NOUN Library use for cloud computing?

Cloud Computing Devices LIBRARY	INDICATIONS
PC	
Laptop	
Mobile Phones	
Smart Phones	
Desktops	

4. In what areas has NOUN library implemented cloud computing?

Areas of Implementation of Cloud Computing in Library	Indications
Cataloging And Metadata Storage, Retrieved And Generation	
Hosting And Or Distributing Special Collection	
Acquisitions	
Cloud-based Electronic Resources	
Budgeting Payroll Or Accounting	

Cloud computing in NOUN library

5. What are the rationales for the adoption of cloud computing in NOUN library?

Rationale for the adopting of cloud computing in Library	Indications
Need to disclose their vast collections on the web	

Amplify the power of cooperation with other developed library	**Indications**
To build a significant, unified presence on the web	
Save time	
Save cost	
Simplifying workflows	
Makes work more effective and efficient	
Local storage, maintenance and backup is removed	
Opportunity for collaboration and cooperative intelligence	
Cloud computing is the latest trend	
To meet the information need of large number of student spread all over the country	
Make work faster and much easier	

6. Which cloud services are NOUN using in its library?

Cloud Computing services in library	**Indications**
Cloud- based mailing services	
Cloud-based forums	
Cloud –based social networking	
Cloud-based information collection	
Cloud-based calendar services	

Cloud-based file sharing service	
Cloud based- video services	
Cloud-based software and supplication	
Cloud-based storing and supplication	
Cloud-based operating services	

7. To what extent is cloud computing adopted in NOUN Library?

Extent Of The Adoption Of Cloud Computing in library.	**Indications**
Web-mail services	
Store personal photos	
On line application	
Store personal video	
Pay to store computer file online	
Back-up hard drive to an online site	

8. Does the adoption of cloud computing technology in NOUN Library helps to improve quality of its services?

Yes [ ] No [ ]

9. Which of the following cloud based library services is NOUN Library using?

Cloud Based Library Services Available In NOUN Library	**Indications**
Serial solution Summon	
OCLC Web-Scale	
Talis Pris	
World Cat. Org	

10. What services are provided using cloud computing in NOUN Library?

Information services provided using cloud computing	**Indications**
Building digital library	
Searching scholarly content	
File storage	
Building community Power	
Library Automation	

11. What layer of cloud computing services is NOUN Library using?

Layer of cloud computing services	**Indications**
Free software as a services (SaaS), i.e Google apps, Skype, hotmail	
Paid subscription Software as a Services, (PaaS) i.e Sale force	
Platform as a Service (PaaS) – Enables end users to build	

their own applications online i.e window Azure, Google App, Engine and force. com	
Infrastructure as a service (laaS)- Provides Computing Power and file storage i.e Amazon cloud, Rackspace, Zyinga	

12. Which cloud computing deployment model is NOUN Library currently using for its services?

Cloud Computing Deployment Models	**Indications**
Public cloud	
Private cloud	
Community cloud	
Hybrid cloud	

13. Which of the following cloud services are provided in NOUN library?

Cloud Services Using Cloud Computing	**Indications**
Cloud- based mailing services	
Cloud-based forums	
Cloud –based social networking	
Cloud-based information collection	
Cloud-based calendar services	
Cloud-based file sharing service	

Cloud based- video services	
Cloud-based software and supplication	
Cloud-based storing and supplication	
Cloud-based operating services	

14. What are the factors that led to the adoption of cloud computing technology in NOUN Library. Please indicate your responses. SA (Strongly Agreed) A (Agreed) D (Disagreed) SA (Strongly Disagreed).

Feature	**SA**	**A**	**D**	**SD**
Developing the right Knowledge base to make sound decisions about cloud computing				
Fears of data/file privacy and possible loss of confidentiality				
Fears over the possible need to eliminate staff that had been h and ling it functions in house.				
Concerns over high subscription and lack of adequate safeguards				

15. What are the implications in terms of cost in the adoption of cloud computing in NOUN library?

16. What has NOUN library saved using cloud computing technology in terms of the following?

Saving Using Cloud Computing Technology in NOUN library	Indications
Staff time	
Save cost	
Electricity	
Maintenance	

17. Do you agree that the adoption of cloud computing has simplify the IT based services?

1. Yes [ ] No [ ]

18 Is NOUN Library safe in storing data online?

Yes [ ] 2. No [ ]

19. Can NOUN Library keeps copy of its online files with the cloud provider even when it is can delete?

Yes [ ] No [ ]

20. Is NOUN Library concerned about the ability to retrieve its data from the cloud?

Yes [ ] No [ ]

21. Does NOUN library trust internal IT systems over cloud-based technologies?

Yes [ ] No [ ]

22. Is cloud computing technology is an attractive economic option to NOUN library?

Yes [ ] No [ ]

23. What are the implications in terms of staff in the adoption of cloud computing in NOUN library?

24. Does the University provide training programs for NOUN Librarian relating to cloud computing technology?

Staff Training	**Indications**
Quarterly	
Yearly	
Bi- yearly	

25. What are the implications in term of maintenance of the adoption of cloud computing in NOUN library?