

## Challenges affecting the Application of Cloud Computing Services in Federal University Libraries in Nigeria

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### ABSTRACT

*This study seeks to explore the challenges that impact the utilization of cloud computing services within federal university libraries in Nigeria. The specific objectives of this research encompass the identification of challenges associated with employing cloud computing services and the determination of measures taken to alleviate these challenges within federal university libraries in Nigeria. The study adopts a descriptive survey research design. The study population comprises 2,883 librarians. The sample size, consisting of 340 professional librarians and Heads of ICT units, is drawn from the total pool of librarians within the six federal university libraries in Nigeria that constitute the study setting. The sample size is derived through a multistage sampling technique. The researcher employs a stratified sampling technique to categorize university libraries into six geopolitical zones, ensuring an impartial selection of federal university libraries for the research. Data collection is facilitated through questionnaires and observation checklists. The gathered data is subjected to both descriptive and inferential statistical analyses. The research findings reveal that the studied libraries encounter challenges such as limited ICT expertise, inadequate or sluggish internet connectivity, erratic electric power supply, insufficient ICT personnel, funding constraints, unstable wireless access networks, and high costs associated with applying cloud computing services within federal university libraries in Nigeria. Based on the conclusions drawn from the study, recommendations are put forth. University management is advised to provide comprehensive support to libraries, including upgrading internet connectivity to ensure ample bandwidth for cloud services. The utilization of content delivery networks (CDNs) is suggested to reduce latency and enhance content delivery. Additionally, prioritizing critical library services is recommended to ensure optimal network resource allocation and to manage resource usage efficiently to avoid unnecessary expenses. University librarians are encouraged to leverage cost management tools offered by cloud service providers to monitor and regulate expenses. Implementing automated scaling to adjust resource allocation based on demand is also recommended to mitigate overprovisioning. Furthermore, a well-structured data migration strategy should be devised and executed by university librarians to transition existing library data to the cloud.*

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### INTRODUCTION

A novel shift in the realm of cloud computing has emerged, involving the outsourcing of data and/or processing. This shift encompasses features such as limitless and

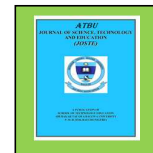
flexible resource scalability, on-demand "just-in-time" provisioning, and pay-as-you-go facilities. Cloud computing, heralded as the third technological revolution after personal computers and the Internet, grants users the

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ability to utilize resources according to their needs, precisely when needed, and only paying for actual usage. As this paradigm continues to evolve, spirited debates between the public and private sectors will persist, addressing enhancements in definitions, use cases, underlying technology, challenges, risks, and benefits.

The National Institute of Standards and Technology (NIST) (2018) defines cloud computing as a model enabling convenient, on-demand network access to a shared pool of reconfigurable computing resources (including networks, servers, storage, applications, and services), swiftly provisioned and released with minimal management effort or interaction with service providers. To elaborate further, cloud computing has enhanced various computing domains, such as distributed computing, parallel computing, grid computing, and distributed databases.

Put simply, cloud computing integrates and centralizes vast amounts of data and resources stored on personal computers, mobile devices, and other equipment within the public cloud, accessible to users. It serves as an advancement-oriented platform that integrates hardware and software, facilitating effective deposit and organization within digital libraries. This platform ensures technical and product integration while delivering efficient network services (Okwoli, 2019). Cloud computing paves the way for the dissemination of high-quality materials through the extensive application of digital library technology. However, economic zone limitations have led to persistent inquiries.

University libraries stand as integral components of their parent institutions, primarily established to support teaching, learning, and research endeavors. By procuring, organizing, preserving, and distributing information resources, these libraries fulfill their institutional objectives. As noted by Romero (2016), university libraries serve as the nucleus of academic establishments, influencing their vitality and intellectual vigor. Evolving into a system of service-oriented information providers, university libraries are progressively supplanting their role as mere repositories or guardians of information resources.

In the pursuit of efficiently gathering, organizing, processing, preserving, and

delivering information resources, university libraries in developing nations like Nigeria have embraced modern information and communication technologies. Shifting their focus from extensive physical collections, these libraries are now prioritizing the delivery of more robust, dynamic, and web-based services.

In line with this transformation, the findings of Kumar et al (2017) highlight a significant shift in university libraries from manual to automated activities, driven by the adoption of new technologies. The proliferation of digital and smart technologies, the expansion of broadband Internet networks, hardware and software virtualization, and service-oriented design have collectively facilitated this paradigm shift.

University libraries play a pivotal role in providing remote access to information in the current digital library landscape. The ongoing digital revolution and evolving user information needs have compelled these libraries to adopt novel approaches for data storage, retrieval, and information dissemination. To remain pertinent, libraries must harness the most advanced digital services available today. The dependence of university libraries on information and communication technologies has transformed their operations and service offerings. The technological tools that underpin cloud computing in libraries encompass ICT systems, including the internet, software, computers, and networking systems that enable digital communication (Liu, 2016).

#### **Statement of the Problem**

To meet the information needs of its users in the current digital library environment, most university libraries, particularly in developing nations, are at crossroad. The traditional library clientele have been declining recently. According to Sosa & Hernandez (2018) university libraries are losing out on patronage because of people accessing material online via PCs like laptops, palmtops, and even phones. Since practically all the services that libraries have historically offered are now available on the World Wide Web (WWW) via the internet, university libraries are today operating in a competitive environment. With the advent of the internet, individuals now have access to a deluge of electronic materials that are limitless in accessibility. Currently,

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library patrons can speak to their smartphones, type on their keyboards, and access endless global current information from the comfort of their homes. The availability of cutting-edge technologies, like smartphones, tablets, laptops, and other computer systems that provide instant access to information on the cloud, has made this possible. Despite the significant potentials of cloud computing services in libraries, most university libraries in Nigeria have not yet started using them to their fullest extent.

Hence, the focus of this paper is to investigate the challenges faced with the application of cloud computing services in federal university libraries in Nigeria.

### **Research Objectives**

1. What are the challenges faced with the application of cloud computing services in federal university libraries in Nigeria?
2. What are the measures taken to mitigate the challenges faced with the application of cloud computing services in federal university libraries in Nigeria?

## **LITERATURE REVIEW**

### **Concept of Cloud Computing in Libraries**

Cloud computing according to the findings of Romero (2016) are features and its usefulness in information delivery services and how it can be used in a professional environment. The author found that, "cloud computing is a highly scalable platform promising quick access to hardware and software over the internet relying on new technologies such as virtualization, programming techniques such as multi-tenancy and/or scalability, load balancing that ensured relatively easy and quick access to information resources". Liu et al, (2016) studied the use of cloud computing in university employment information library by examining the relationship between companies and graduates to build a cloud of labour market information, namely cloud computing database.

Cloud computing as a recent operational model allows help the provision of information technology resources on demand, lowering management complexity. In emphasizing the implementation of cloud

computing exclusively for resource sharing in academic library systems, Shivalingaiah & Sheshadri (2012) identified the potential areas that a certain library needs to be consider before switching over to its implementation. Lai (2017) in his paper stressed that cloud computing would help us in bridging the gap between digital libraries and IT by facilitating huger sharing of data among other which in turn can reduce the overall cost incurred by the individual libraries. The cost reduction and easy maintenance factor in implementing cloud computing was also addressed by Bansode & Pujar (2017) in their respective studies addressed the feasibility of setting up cloud based digital libraries, digital library architecture and security issues.

Libraries can easily collaborate with one another because to cloud computing, each library has access to unique digital data sources. The total size of the electronic data base will increase if all available electronic data resources are gathered in one location that several libraries can access (Lei, 2017). This area, which houses all the electronic data, could be a cloud, like one belonging to a library. This library cloud will include all the digital data from various libraries, making it easier for libraries to combine their data as noted in the findings of Dastagiri and Kumar (2017).

### **Challenges Faced in the Application of Cloud Computing Services in Libraries.**

Challenges faced in cloud computing services in libraries in this domain, including automatic resource provisioning, power management and security management. Challenges associated with cloud computing services is explained below:

### **Poor ICT Knowledge**

University libraries play a prominent role in providing information services in various forms to researchers, scientists, policy makers, planners. A well-organized university library should have I.C.T. to assist both patrons and information professionals in the libraries Elisha (2019). Despite the relatively huge ICT investment and policy deployment in university libraries in Nigeria, there is still scant information about the success of implementation of the Information Communication Technology (ICT) in the higher education. Poor ICT knowledge can

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have several negative impacts on the application of cloud computing services in libraries. Here are some ways it can affect the utilization of these services: limited Understanding: Staff with poor ICT knowledge may struggle to grasp the concept and benefits of cloud computing, hindering its adoption and implementation in the library. More so, Murigi and Mutuku (2022) also argued that without proper ICT knowledge, library staff might not be able to efficiently use cloud services, leading to a suboptimal utilization of resources and features, and lack of knowledge about cloud security measures may expose the library's data and information to potential breaches and cyberattacks. The added that incompetence in managing cloud services can result in data loss, system downtime, and overall inefficiency in library operations.

#### **Poor or Slow Internet Services**

The adoption of cloud computing in academic libraries in Nigeria is poor Internet connectivity and low bandwidth. This is a very serious impediment to achieving the goal of academic libraries in supporting research and development in the current digital/virtual library environment. Since everyone has a connection of at least 1 Mbps at both their place of employment and home, this disadvantage is not very significant today. However, it is crucial to note that cloud computing cannot function with sluggish Internet connections, such as dial-up, because huge documents and web-based programs sometimes require a lot of download capacity. Even with fast connections, there may be instances when you suffer delays since using web-based apps can occasionally be slower than using an equivalent desktop PC program. This is due to the demanding upload and download bandwidth requirements of web applications (Zhang, 2016). Poor Internet connectivity and limited bandwidth are two issues that academic libraries in Nigeria are confronting as they try to utilize cloud computing. The purpose of academic libraries to assist research and development in the present digital/virtual library environment is seriously hampered by this.

#### **Interruptible Power Supply**

Interruptible power supply in Nigeria is a very serious challenge facing the adoption

of cloud computing in academic libraries in Nigeria. If there is no constant power supply, it is difficult to get access to application and services on the cloud. However, all these challenges should not be considered as roadblocks in the pursuit and adoption of cloud computing in academic libraries. It is rather important to give serious consideration to these issues and the possible ways out before adopting the technology.

#### **Inadequate ICT Personnel**

The initial cost of adopting cloud computing such as cost of backing up, maintaining, and updating hardware and software could be very high. but may reduce subsequently after the initial subscription cost. The cloud computing service providers determine the running cost; hence academic libraries may end up paying higher charges in future.

#### **Insufficient Fund**

The strong relationship between this service and a lack of funding for proper internet access raises severe concerns about network connectivity and bandwidth. If there is not enough money to cover the necessary expenses, the user cannot access this service. It also needs more bandwidth because it cannot function with slow Internet connections (Ahmat, 2017).

One of the bottlenecks in managing academic libraries in Nigeria is poor funding a lack of staff training A very significant difficulty has been created by the current lack of employee training and retraining, particularly in the field of ICT application in academic libraries in Nigeria. Most academic librarians in Nigeria lack the necessary ICT abilities for efficient cloud computing integration. This has always impacted how cloud computing services are used to support e-learning, particularly in the current Covid-learning environment.

#### **Unstable Wireless Access Network**

Wireless congestion is a common cause of unreliable Wi-Fi. When there are too many Wi-Fi users, it can cause overlapping networks, jumbled signals, and poor Wi-Fi performance, which are frequent in apartment buildings or other highly populated areas (Kelley, 2012).

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### Exorbitant cost

Adopting cloud computing may come with hefty upfront costs for things like backing up, maintaining, and updating hardware and software. After the initial subscription fee, it can decrease. Academic libraries may eventually pay more because the running costs of cloud computing services are decided by the service providers. Inadequate finance is one of the problems with operating academic libraries in Nigeria (Ambrust et al).

### Measures taken to Mitigate Challenges Faced with the Application of Cloud Computing Services in Libraries

To mitigate challenges faced with the application of cloud computing services in libraries, the following multilayered system is required as observed by Whitman and Mattord (2019) as security layers:

Libraries should receive funding on a regular basis. No matter the type, all libraries require substantial financial support from the parent organization for the library administration to increase employee ICT proficiency. For efficient library operations and information transmission, the Nigeria Library Association (NLA) and National Library of Nigeria (NLN) must promote and ensure that libraries acquire ICT tools as observed in the finding of Doolin (2017).

The university management should ensure that they provide necessary support, such as regular impress for the libraries so that they can deliver proper and efficient services to patrons anytime anywhere. There is a need to prioritize steady electricity supply to the libraries to make proper use of cloud services in libraries as it observed in the finding of Edward (2019).

Another typical obstacle in cloud computing is the difficulty that libraries have in identifying and hiring the right cloud talent. Professionals with the necessary credentials are in short supply in the sector. The amount of work being done is growing, and more tools are being introduced to the market. To use these technologies and determine which ones are best for them, businesses need good expertise. Companies should retrain their existing IT staff and help them in upskilling their careers by investing in Cloud training programs (Lei, 2017).

In the findings of Kumar *et al* (2013) he observed that libraries can address this by

doing routine system audits and putting in place resource use monitoring technologies. It's one of the best approaches to handle significant issues in cloud computing and manage finances. Another typical obstacle in cloud computing is the difficulty that libraries have in identifying and hiring the right cloud talent. Professionals with the necessary credentials are in short supply in the sector. The amount of work being done is growing, and more tools are being introduced to the market. To use these technologies and determine which ones are best for them, businesses need good expertise. Librarians should retrain their existing IT staff and help them to improve their careers by investing in Cloud training programs.

To reduce costs, libraries will need to increase their spending and recruit internal staff to manage their data migration to the cloud. Experts must evaluate the issues with and solutions to cloud computing before investing in the newest platforms and services offered by CSPs (Ekwehem & Ukwoma 2019).

### RESEARCH METHODOLOGY

This study adopted descriptive survey research design. This design was chosen because it allows the researcher to collect data or information from sampled elements to provide generalised descriptive and/or inferred results for quick decision making. It is also chosen because data collected is qualitative and quantitative, it gives a holistic understanding of a research topic.

The population for this study was two thousand, eight hundred and eighty-three (2,883) librarians from the National Universities Commission (NUC) approved federal university libraries that formed the research setting of this study. The breakdown of the research population shows the professional librarians and the ICT heads charged with the administration of cloud computing services in their various ICT units in federal university libraries in Nigeria.

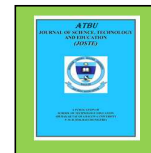
The sample size for this study was three hundred and forty (340) Professional librarians and Head of ICT units drawn from the two thousand, eight hundred and eighty-three (2,883) librarians in the six (6) federal university libraries in Nigeria that constituted the study setting. The sample size was the outcome of the multistage sampling technique employed for

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this study. The following university libraries were selected for the study. Instruments for data collection were questionnaire and direct observation. While frequency counts,

percentages, mean, standard deviation were used for the data analysis.

**Table 1:** Sample Size of the Study

S/No	Name of Library/ Institution	Head of ICT units	Librarians
1	John Harris Library, University of Benin, Edo State.	1	49
2	Nnamdi Azikiwe Library, UNN Nsukka	1	23
3	Kenneth Dikke Library, University of Ibadan.	1	59
4	Gabriel Afolabi Ojo Library, (NOUN)	1	11
5	Kashim Ibrahim Library, A B U Zaria.	1	149
6	Ramat Library, University of Maiduguri	1	44
	<b>Total</b>	<b>6</b>	<b>334</b>
	<b>Grand Total</b>	<b>6 + 334 =340</b>	

## RESULTS AND DISCUSSION

### Response Rate

**Table 2:** Distribution of Response Rate of Respondents According to their University Libraries.

S/N	Name of Library/ Institution	No. of Questionnaire Administered	No. of Retrieved	Percentage Retrieved
1	John Harris Library, Benin, Edo State	50	50	100
2	Nnamdi Azikiwe Library, Nsukka	23	20	96
3	Kenneth Dikke Library, Ibadan	60	60	100
4	Gabriel Afolabi Ojo (NOUN), Abuja	12	12	100
5	Kashim Ibrahim Library, Zaria	150	149	99
6	Ramat Library, Maiduguri	45	43	94
	<b>Total</b>	<b>340</b>	<b>334</b>	<b>98</b>

Out of the 340 (100%) copies of questionnaire administered to the respondents, a total of 334 (98%) copies were duly completed, retrieved, and found valid for this study. However, the high rate was attributed to the fact that the respondents were duly followed up and given two weeks within which to complete questionnaires and return them. The response rate of the respondents according to the university libraries was shown in Table 2, while an interview guide was conducted for the six (6) heads of Information Communication Technology (ICT) unit. Mugenda and Mugenda (2019) response rate of 50% was adequate for analysis and reporting; a rate of 60% was good.

Whereas a response rate of 70% and over was found to be excellent. Therefore, this response rate was found to be adequate for analysis.

Table 2 showed that John Harris library, Benin, Edo State, Gabriel Afolabi Ojo (NOUN), Abuja, and Kenneth Dikke Library and Ibadan recorded the highest number of respondents with the scores of 100%, followed closely by Kashim Ibrahim Library, Zaria with a score of 99% respondents. Nnamdi Azikiwe Library, Nsukka has 96% of respondents. The university with the least respondents was the Ramat Library, Maiduguri with the least score of 94%.

**Table 3.** Challenges faced with the Application of cloud computing in Libraries

S/N	Challenges faced with Application of cloud computing services in libraries. (N = 334)	SA 4	A 3	D 2	SD 1	$\bar{X}$	Std.	Remark
1	Poor ICT Knowledge and skills	108(32.3)	158(47.3)	12(3.6)	56(16.8)	2.95	1.015	A
2	Poor or slow Internet services	84(25.1)	217(65.0)	9(2.7)	24(7.2)	3.08	0.749	A
3	Interruptible electric power supply	138(41.3)	150(44.9)	12(3.6)	34(10.2)	3.17	0.910	SA
4	Inadequate ICT personnel	50(15.0)	183(54.8)	32(9.6)	69(20.7)	2.64	0.972	A
5	Insufficient funds	42(12.6)	198(59.3)	54(16.2)	40(12.0)	2.72	0.832	A
6	Unstable Wireless Access Network	24(7.2)	175(52.4)	63(18.9)	72(21.6)	2.45	0.908	D
7	Exorbitant Costs	129(38.6)	162(48.5)	9(2.7)	34(10.2)	3.16	0.894	SA

Source: Fieldwork, 2022

The findings of the study revealed that poor ICT knowledge and skills with mean of ( $\bar{x}$  = 2.95, Std. = 1.015), poor or slow Internet services due to insufficient bandwidth with mean of ( $\bar{x}$  = 3.08, Std. = 0.749), inadequate ICT personnel with mean of ( $\bar{x}$  = 2.64, Std. = 0.972), insufficient funds with a mean of ( $\bar{x}$  = 2.72, Std. = 0.832) agreed with option. Meanwhile, interruptible electric power supply, with a mean

of ( $\bar{x}$  = 3.17, Std. = 0.910) and exorbitant costs with the mean ( $\bar{x}$  = 3.16, Std. = 0.894) were strongly agreed that challenges faced with the Application of cloud computing services in their various in Libraries. However, unstable wireless access network with a mean of ( $\bar{x}$  = 2.45, Std. = 0.908) was regarded least challenging.

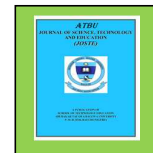
**Table 4:** Measures taken to mitigate the challenges faced with Application of Cloud Computing Services in Libraries

S/N	Measures to Cloud Computing Risks	Federal University Libraries in Nigeria					
		NOUN	UI	UNN	UNIMAID	UNIBEN	ABU
1.	Regular Funding	X	X	X	X	X	X
2.	Regular Imprest	X	X	X	X	X	X
3.	Standby Generator	X	X	X	X	X	X
4.	Cloud computing Professionals	X	X	X	X	X	X
5.	Routine system Audits	√	√	√	√	√	√
6.	Service Level Agreement	√	√	√	√	√	√
7.	Cloud Training Program	√	√	√	√	√	√

Source: Fieldwork, 2021; Key: Applied (√), Not applied (X)

The findings revealed that federal university libraries do not apply regular funding in their libraries, regular imprest, standby Generator and adequate cloud professional as

measures taken to mitigate the challenges faced in application of cloud computing services in their libraries. Consequently, all the federal university libraries in Nigeria investigated



applied routine system audits, service level agreement and cloud training program as the measures taken to mitigate challenges faced with the application of cloud computing services in federal university libraries in Nigeria.

## CONCLUSION

Based on the findings, it is possible to draw the conclusion that federal university libraries in Nigeria face challenges when applying cloud computing services, these challenges include poor ICT knowledge, poor or slow internet services, or interruptible electric power supplies, inadequate ICT personnel, insufficient fund, unstable wireless access network, and exorbitant costs.

## RECOMMENDATIONS

1. The university managements should make sure to give the libraries all the supports they need by upgrade internet connectivity to ensure sufficient bandwidth for cloud services and utilize content delivery networks (CDNs) to reduce latency and optimize content delivery.
2. The university management should also prioritize critical library services to ensure they receive adequate network resources and optimize resource usage to avoid unnecessary costs.
3. The University Librarians should also use cloud service providers' cost management tools to monitor and control expenses and implement automated scaling to adjust resources based on demand and reduce overprovisioning. There is a need for the university librarians to plan and execute a well-structured data migration strategy to move existing library data to the cloud.
4. There is a need to train library staff on new cloud-based systems to ensure smooth integration and provide staff training and skills. The university management should provide comprehensive training programs for library staff to familiarize them with cloud computing concepts and tools. And encourage staff to participate in

workshops and webinars to enhance their cloud-related skills. To overcome these challenges, NOUN library should invest in ICT training for their staff, encourage continuous learning, and seek expert guidance to ensure smooth integration and optimal usage of cloud computing services.

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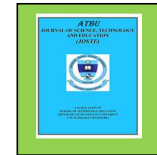
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