

Preparedness towards adoption of cloud computing technologies by academic libraries in Kenya

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ABSTRACT

In many developing countries including Kenya, there is a great challenge determining the preparedness of libraries towards the adoption of cloud computing technologies. Paucity of resources and Information technology capabilities, lack of manpower, inadequate skills, inadequate infrastructure, and inadequate power supply have been identified as key impediments to institutions towards successful adoption of cloud computing. Despite the benefits of cloud computing technologies, education sector has not fully implemented this emerging technology. The objective of this study was to assess the preparedness of academic libraries towards of adoption of cloud computing technologies so that academic libraries can have clear path on how to prepare and measures to put towards cloud computing adoption. The study was undertaken at Jomo Kenyatta University of Agriculture and Technology library, Kiambu County, Kenya where 40 librarians were involved in the study. Random sampling procedure was used to select the sample population. The study used descriptive study design to carry out research. The results from the study showed that the library was experiencing shortage in infrastructure due to low student to computer ration, low bandwidth, only one OPAC point and centralized servers. Most library staff posed basic ICT skills with just few staff being experts in areas where cloud computing skills are required. The study recommends that the government and the university should concentrate on ways of making cloud computing affordable by budgeting more funds to improve the ICT infrastructure in the library. The library should concentrate on impacting the library with skills; invest more to improve the ICT infrastructure in the library.

Keywords: Cloud computing, preparedness, ICT, adoption. Academic libraries.

INTRODUCTION

National Institute of Standards and Technology defines cloud computing as "a model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction". Examples of services and softwares that depend on cloud computing include

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library management softwares (KOHA), Duracloud, serial solutions, institutional repositories Google Apps, virtual storage, web servers, EZproxy.

Cloud preparedness assessment that was done in most firms identified technological capabilities which include the IT infrastructure, human resource deals with skills and attitude and external capabilities which include security, policies and regulations as key factors aspects of preparedness of cloud computing. (Workineh et al., 2017).

In most developing countries, paucity of resources and IT capabilities are key impediments to institutions towards successful adoption of cloud computing. Institutions of higher learning in developing countries have more interests in adopting cloud technologies but there are few empirical studies on organizational levels that guide towards the process (Workineh et al., 2017). This has led to a big question on the key organizational capabilities required for leveraging cloud computing readiness and increases the chances of adoption in the institutions.

85% of companies migrating to cloud architecture started by investing in company's infrastructure, this therefore means a stable infrastructure is very important in adoption of cloud computing technology confirming that adoption of cloud computing depend heavily in resources as key driver and barrier to adoption (Molla & Licker, 2014). Despite the benefits of cloud computing technologies especially for the public sector, the private sector has been leading the way in the implementation of cloud computing with limited availability, availability of internet, cost and skills required being the key challenges to adoption (Chavula et al., 2019).

Human resources capabilities refer to training and experience posed by the staff in an organization. Organizations where staffs have accumulated more knowledge and skills will easily adopt cloud computing successfully. This makes knowledge and skills key indicators to cloud adoption readiness in an institutions (Workineh et al., 2017).

Globally, a study conducted by AMD found that every region in the world appears to be at different stages of cloud computing implementation where organizations worldwide are implementing cloud-based solutions signaling a healthy uptake of the technology with North America leading followed by Asia (AMD, 2014).

Alliance business intelligence in the USA researched on usage of cloud computing in 72 academic, public and special libraries mainly in the USA, Canada, Australia, and the UK and the results showed that 22.5% of those libraries were using online subscribed and hosting cloud services signaling a change in service provision in libraries worldwide (Ramesh & Yadagiri, 2015). Academic institutions in Africa continue to adopt cloud-based services in different percentages South Africa (50%), Kenya (48%) and Nigeria (36%) (CISCO, 2013).

Most tertiary institutions in Africa have not fully adopted cloud computing in libraries due to challenges such as lack of manpower, skills, inadequate infrastructure, and inadequate power supply (Yusuf et al., 2017). These observations necessitated a study to determine the preparedness of academic libraries in terms if ICT infrastructure towards the adoption of cloud computing.

Statement of the Problem

Cloud computing adoption presents academic libraries with great opportunities in different dimensions of technology, data and community. Successful cloud computing adoptions can enable the academic libraries to save time, finances, and simplify daily workflows in line with Ranganathan's five laws of librarianship. Currently, adoption of cloud services in most academic libraries is very minimal with only basic services such as hosted corporate email services yet when fully utilized cloud computing can offer much solutions to many challenges being experienced in libraries such as limited budgets for books and infrastructure, limited space for books storage, changing needs of users, lack of trained human resource and high costs of maintaining the local infrastructure.

Even though there's an improving trend of adoption, academic libraries still face various impediments in the adoption process; such barriers include acceptance issues, limited infrastructure (internet, bandwidth, computers, and servers), skilled human resources and security concerns. The researcher intends to assess the level of ICT Infrastructure preparedness of academic libraries towards cloud computing. This will provide a roadmap and measures for academic libraries with intentions of adopting cloud computing.

Adoption and utilization of cloud services in academic libraries enhances transformation and quality services provision. Among the significance include wider access of library resources through EZproxy and Dspace cloud software's, reduction of cost of managing the library by utilizing e-journals, e-books, less infrastructure and experts by utilizing cloud infrastructure like servers and cloud experts for maintenances services. Saving on physical space is also a great solution from cloud computing. The study aims at establishing to what extent academic libraries are prepared in terms of ICT infrastructure towards adopting cloud computing.

Conceptual Framework

According to Camp (2001, p. 2), a conceptual framework “is a structure which the researcher believes can best explain the natural progression of the phenomenon to be studied”. A conceptual framework justifies why the research should be carried out, points out the scholars he/she agrees or disagrees with and assumptions of the researcher (Evan 2007). The conceptual framework gives the researcher a chance to bring together variables in the study if there's no existing theory that fits the study (Akintoye, 2015). This study was anchored onTornatzky and Fleischer (1990) Technological Organizational Environmental model (TOE). According to the theory, adoption and implementation of technological innovations are influenced by three contexts: technological, organizational and environmental. The theory fitted this study because it helped the researcher identify specific technological infrastructure that academic libraries need before adopting cloud computing due to its technological aspect. The independent variables in the above conceptual framework are infrastructure and staff skills while the dependent variable is the adoption of cloud computing technology. Below is the conceptual framework.

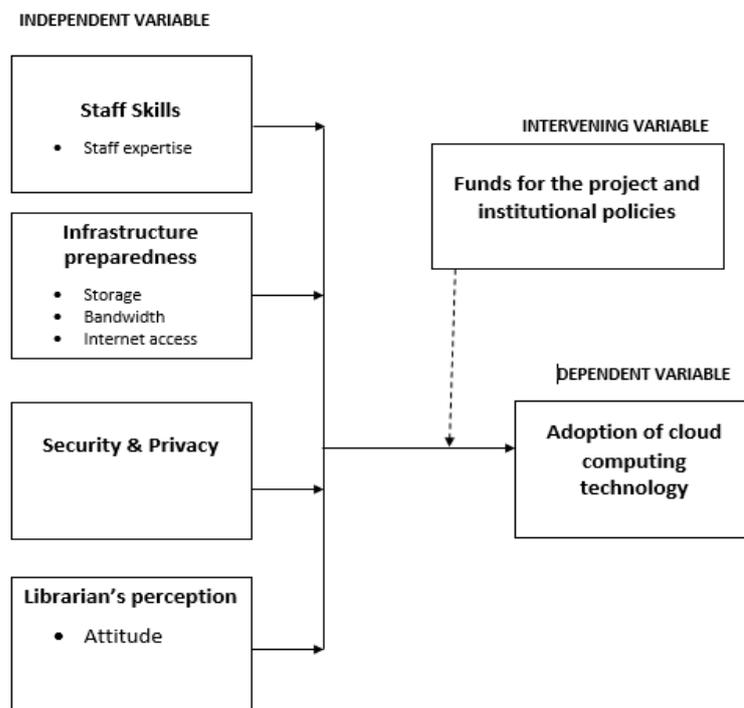


Figure 1: Conceptual framework.

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Aim of the Study

The aim of this study was to assess the preparedness of academic libraries towards of adoption of cloud computing technologies at Jomo Kenyatta University of Agriculture and Technology Library. This will enable academic libraries to have a clear path on how to prepare towards cloud computing adoption.

Objectives of the study

1. To establish how infrastructure as a component of preparedness influence adoption of cloud computing technologies.
2. To examine how librarians' ICT skills as a component of preparedness influence adoption of cloud computing technologies.

LITERATURE REVIEW

ICT infrastructure has enabled academic institutions to easily provide teaching, learning and research services to a growing number of students in every institution by overcoming barriers such as time, space and cost. Academic libraries in institutions remain to be a great facility that should not lag in the adoption of ICT technologies that will transform their services. ICT infrastructure entails computers, information systems, network, and the internet, display screen technologies and peripherals (Subba & Kumar, 2019).

A technology readiness index helps institutions to assess its readiness to adopt cloud-based services by determining the infrastructural capability of the institution to adopt new technologies. The index checks the availability of computers, the internet, information communication skills available by staff (Karim & Rampersad, 2017) (Lee et al., 2018). Internet in Africa generally has been characterized by poor performance and high latency to service access where academic libraries with successful service provision utilize local area network, the internet and intranet services to enable effective dissemination of information to users remotely (AMD, 2014).

There have been discussions whether librarians still have a place in the 21st century, Mathews & Pardue, (2017) believes that libraries have no place in the next century while Adams (2015), opined that the position of the librarian is still relevant but librarians ought to redefine their roles to fit technological advancement therefore making libraries to consider ways that could improve the skills of staff. Cloud services minimize the involvement of non-ICT staff, the need to have cloud computing experts is not an option due to roles such as regulatory compliance, service support, cloud service developers and meeting this gap in developing countries may take a bit longer to fully adopt cloud computing (Truong et al., 2016).

Karim & Rampersad (2017) identified a gap among librarian's skills and priority areas for training and skills critical information technology required by library and information professionals with regard to the requirements of the current technology in the development of libraries.

Computers in the library are mostly used for housekeeping operations, online searching of the database and computer labs where students can access e-resources (Kishor Tiwari et al., 2015). A study by Walmiki and Ramakrishnegowda (2016) at Kerala university in India established that libraries had inadequate ICT infrastructure such as hardware, software, and the internet that are meant to enhance library services in the current world. This scenario is boosted by Subba (2019), who conducted a research in Darjeeling district of West Bengal India found out that for an institution to guarantee quality learning and research, investment of ICT infrastructure was not an

option with the current growing teaching and learning programs such as Open and distance learning where librarians and academic libraries are still expected to provide services to off-campus students. Access to electronic resources by most African university libraries has been a great challenge due to inadequate infrastructure facilities (Kamau et al., 2018) (30).

A study by AMD in Europe and USA to evaluate skills of staff, it observed that 21% and 14% of staff in Europe and USA respectively did not have knowledge completely on cloud services where organizations with over 500 employees having less understanding compared to small organizations (AMD, 2014). In America, a study by Eells and Jaguszewski (2015), noted that since Minnesota libraries were opened, ICT skills were inadequate before the library invested heavily in training for both professional and non-professional staff which greatly minimized transition impulse

In India, Paulson (2015) study found that university libraries in Rajasthan were on different stages of ICT infrastructure development alluding lack of proper management, low funding and frequent technological changes were the main challenges limiting successful shift to ICT platforms. Scholtz & Gomez (2016) highlights that the current internet infrastructure in most parts of Africa does not guarantee sufficient access to the cloud services comfortably. Africa still has poor internet infrastructure shown by a sample of 66% of websites. A study by Sudhier and Seena (2018), on the adoption of cloud computing in Kerala university, found that library professionals had low-level skills on the usage of cloud technologies where most staff cited lack of orientation and involvement of top management as the main hindrance to gaining interests on cloud computing

Adoption of cloud services in Africa still faces infrastructural challenges, a study Alison Gillwald and Moyo (2016) on five African countries; South Africa, Ethiopia, Ghana, Nigeria and Tunisia found that most parts of Africa still faces challenges in power supply which hinders the adoption of such technologies. The study also observed a challenge rollout of broadband infrastructure although more efforts have put by public and private companies to enable access to the internet by investing in international submarine cables (Gillwald & Moyo, 2016).

Africa being hosted abroad by leading African countries on technology with remote hosting ranging from 4-82%. South Africa has a better web hosting infrastructure among the African countries providing a good internet infrastructure due to good support from global internet providers (Chavula et al., 2019). In Nigeria, Igun (2016), observed that training of librarians inadequate and needs radical changes to equip librarians with the required skills to deliver services.

In Kenya, A study by Kamau et al., (2018), on "Access to and Use of ICTs in the Provision of Information to Distance Learners in Kenyan Universities" found that distance students experienced challenges in accessing off-campus resources due to poor facilities and ICT infrastructure. Kenyatta University and the University of Nairobi which was studied posed ICT infrastructure such as desktop computers, laptops, cyber cafes, personal smartphones, and internet connection though the ratio of computers to students was too low in both institutions compared to the recommended 10 PCs per 100 students (KENET 2008). Additionally, ICT facilities and other infrastructure such as power supply were lacking at the regional centers of the two institutions (Kamau et al., 2018). A study by Odongo, (2014), on "an Assessment of ICT Adoption in Kenyan Academic: A case study of University of Nairobi libraries." found out that there was a need to train library staff on current technologies and impact more ICT skills and more investment in ICT infrastructure to facilitate easier adoption of ICT solutions in university of Nairobi.

RESEARCH METHODOLOGY

To find out relevant information for this, Jomo Kenyatta University of science and technology library located in Kiambu County, Kenya was studied. The study used descriptive study design to carry out research, the design is recommended when one seeks to find out the attitude, opinions, expectations, and opinions from people. Random sampling procedure was used to select the sample population that finally participated in the study. Random sampling was considered suitable for this study because the researcher wanted to give the respondents an equal opportunity to respond to the questionnaire. The study used Krejcie and Morgan (1970) sample size determination where 40 librarian were chosen to participate in the research. Kenyatta University Post Modern Library was chosen because it has similar characteristics and levels of cloud computing adoption with JKUAT library. The questionnaires were distributed by the researcher and picked after two weeks. For data analysis, inferential and descriptive techniques will be used to infer and make conclusions and recommendations.

On ethical consideration, the researcher obtained approval to conduct research from National Council for Science and Technology (NACOSTI) with permit number NACOSTI/P/19/2990.

RESULTS AND FINDINGS

The researcher first sought to establish the personal information of the respondents in terms of gender, age and Level of education , this was important since it enabled the researcher to establish the relationships of the respondents' characteristics and ICT skills.

From the findings 60% were males and 40% females. In the age brackets 42.5% were in the age bracket of 31-35 years, 22.5% respondents in the age bracket 26-30 years, 12.5% in the age bracket of 36-40 years 17.5% were above 35 years and finally the minority 5% who were below 25 years. In education levels, 24 (60%) had bachelors, 6 (15%) were diploma holders and 7 (17.5%) were master's degree holders while 3(7.5%) had PhDs.

The findings indicated that staff below 30 years had more skills and understanding on ICT and cloud computing.

Librarian's skills and expertise in JKUAT Library

Table 1: librarian's skills and expertise in JKUAT Library

Statement		Frequency	Percentage
LIMS Software Knowledge (KOHA and OPAC)	Expert	5	12.5
	Intermediate	12	30
	Basic	23	57.5
	Total	40	100.0
Institutional repository management	Expert	3	7.5
	Intermediate	9	22.5
	Basic	28	70
	Total	40	100.0
Electronic resources management	Expert	8	20
	Intermediate	16	40
	Basic	16	40
	Total	40	100

Library Networks management	Expert	3	7.5
	Intermediate	7	17.5
	Basic	30	75
	Total	40	100.0
Digital Library Knowledge	Expert	4	10
	Intermediate	10	25
	Basic	26	65
	Total	40	100.0
Installation and customization of KOHA and Linux	Expert	2	5
	Intermediate	12	30
	Basic	26	65
	Total	40	100.0
MS office packages	Expert	30	75
	Intermediate	7	17.5
	Basic	3	7.5
	Total	40	100.0
Library Automation knowledge	Expert	3	7.5
	Intermediate	9	22.5
	Basic	28	70
	Total	40	100

Table 1 shows that majority of the respondents almost three quarters posed basic skills in almost all categories except MS office Packages where most respondents (70%) were experts. Institutional repository management 7.5%, library Networks management 7.5% and Installation and customization of KOHA and Linux 5% were the least skills with experts in the library. Findings also showed that respondents who had a working experience of between 1-5 years had better skills relating to library services. (Kavulya, 2017) identified a gap among librarian's skills and priority areas for training and skills critical information technology required by library and information professionals with regard to the requirements of the current technology in the development of libraries. The findings endorse the studies of (Kavulya, 2017) 2020/7/10, Shivaputrappa & Naik (2015) who noted that most librarians had basic skills in computer usage and many organizations and institutions in all sectors were facing challenges in ensuring IT competencies among staff because of fast technological changes that need regular training for the staff.

ICT infrastructure in JKUAT library

Table 2: ICT infrastructure in JKUAT library

No.	Hardware	Available (Number)	Not Available
1	Computers	40	
	Server Systems	Remote server	
	Desktop Computers	8	
	Laptop Computer	40	
2	Printers	2	
3	Scanner for Digitization	2	

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4	Barcode Scanner	6	
5	Barcode Printer	1	
6	Back-up Device (Hard Drive)	2	
7	LCD Projector	1	
8	UPS	3	
9	Identity card reader		✓
10	Campus LAN	✓	
11	WIFI	✓	
12	Bandwidth	16 bps	
13	Library Computer labs	1	
14	Digital library	✓	
15	Online databases	✓	

Table 2 shows the ICT infrastructure investments at JKUAT library. The library has 88 computers, 2 Printers, 2 Scanner for Digitization, 6 Barcode Scanner, 1 Barcode Printer, 2 Hard Drive, 1 LCD Projector and 1 UPS. WIFI and campus LAN are also available in the library. Digital library and online databases were also being used in the library. The library didn't not have identity card reader which is always used as a security feature and connected to the system for library usage statistics. The Local Area Network (LAN) of a university system is essential to provide access to the information sources and services electronically to end-users at their points. Users are able to access e-resources such as full-text journals, books, reports, standards, newspapers, content pages of journals and books, abstracts and bibliographic databases of research articles, reference sources such as dictionaries, encyclopedias, directories, etc. The results from JKUAT library showing that the library had only 88 computers available to students' access compared to a large students population of 29500. One of the strategic ICT indicators for higher education is the number of personal computers per 100 students (KENET, 2017) One of the strategic ICT indicators for higher education is the number of personal computers per 100 students. KENET (2017) recommends student to computer ration of 10 PCs per 100 students, JKUAT library was experiencing a ratio of 1 PC per 336 students which is too low compared to the standard ratio. Internet speed of 16mbs in the library is too low to guarantee fast downloads and access to various websites by students. ICT infrastructure in JKUAT library is still at different stages of development. Insufficient computer hardware and suitable software and lack of internet facilities with required bandwidth indicate that university library is yet to establish extensive facilities required for efficient information access. Hence, there is an urgent need on the part of the university library to plan, implement and develop ICT infrastructure to be fit in facing the challenges ahead. The library servers were remotely stored. These results ratify a study Scholtz & Gomez (2016) who found out that the internet infrastructure and hardware infrastructure in most parts of Africa does not guarantee sufficient access to the cloud services comfortably.

CONCLUSION AND RECOMMENDATIONS

The purpose of the study was to assess ICT preparedness of academic libraries towards adoption of cloud computing looking two major aspects; infrastructure and skills. The study concludes that though the library is utilizing some of the cloud computing services, the library is not fully prepared towards full adoption of cloud services. The findings showed that ICT infrastructure was not sufficient in relation to expected student ratio and lack of internet facilities with required bandwidth. The staffs were not adequate with skills required for cloud computing making a great challenge offering all the services needed by the patrons.

With the foregoing findings, it is prudent to conclude that there is need for the library through the university to allocate more funds towards the purchase of ICT library infrastructure such as computers, internet facilities and storage facilities. Also, due to inadequate staff skills identified, the research recommends training, workshops and seminars for the staff to ensure that library staff gain knowledge and skills that will help the library in the implementation of cloud computing.

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